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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quas qui fugit pariter Naturam fugit.—*Linnæus.*

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The Society was established for the promotion of Microscopical and Biological Science by the communication, discussion, and publication of observations and discoveries relating to (1) improvements in the construction and mode of application of the Microscope, or (2) Biological or other subjects of Microscopical Research.

It consists of Ordinary, Honorary, and Ex-officio Fellows of either sex.

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The Journal, containing the Transactions and Proceedings of the Society, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c., is published bi-monthly, and is forwarded post-free to all Ordinary and Ex-officio Fellows residing in countries within the Postal Union.

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FIG. 1.

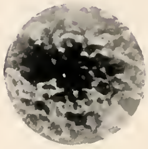


FIG. 2.

FIG. 3.

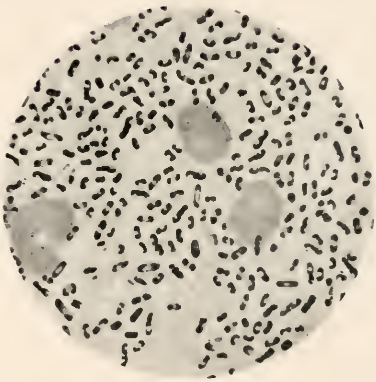


FIG. 4.

FIG. 5.

FIG. 6.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY, 1908.

TRANSACTIONS OF THE SOCIETY.

I.—*A Reply to Professor Porter's and Mr. Everitt's Criticism upon my Paper on the Resolving Power, etc.*

By Edward M. Nelson.

(*Read November* 20, 1907.)

During the recess Messrs. Porter's and Everitt's paper, criticising my limits for the resolving power of a telescope, has been published in the Journal. In the meantime, I have gone over the experiments a second time, and results substantially the same as those printed in my paper have been obtained. These experiments prove that the constant (called *c* in my paper) is 32 p.c. less than the radius of the first dark ring, as calculated by Airy, and as measured, formerly by Fraunhofer and Cooke, and now by Professor Porter and Mr. Everitt.

The measurements published by Professor Porter and Mr. Everitt are those relating to the rings, etc., seen in a telescope when pointed to a single artificial star; but the measurements published in my paper are those made with artificial double stars, when the separation in the telescope was a minimum visible. The following quotation from my paper * shows that this is so :—

"The first dark ring No. 2 was measured by removing an artificial double star from a telescope until the dark rings made contact; the distance of the telescope from the star was then measured, and the separation of the stars being known, the angle was found."

The "No. 2" refers to the number opposite the experimental result † which Professor Porter and Mr. Everitt have selected for criticism. In brief, Professor Porter and Mr. Everitt have

* See this Journal, 1906, at foot of p. 524. † Tom. cit., table on p. 525.

measured one thing, and I another, and the difference between our measurements amounts to 32 p.c.

Professor Porter and Mr. Everitt say :—" The question is therefore not merely one of disagreement between theory and experiment, but also one of disagreement between Fraunhofer's and Mr. Nelson's experimental values."

I have never published nor shown my measurements of the single artificial star to any one, so it is quite impossible for Professor Porter and Mr. Everitt to know whether they do, or do not, agree with those of the truly renowned Fraunhofer.

I am still of opinion that the radius of the first dark ring of a single star is too large a measure for the telescopic resolving limit of a double star; in other words, the resolving limit of a telescope is less than $\frac{5'' \cdot 555}{a}$.

This month (October 1907) Mr. W. F. A. Ellison has published an account of the separation of ω Leonis and ζ Boötis by $8\frac{1}{2}$ inches of aperture; these results correspond to a limit of $\frac{3'' \cdot 315}{a}$ and $\frac{3'' \cdot 06}{a}$ respectively.

These observations are far finer than any I have ever been able to accomplish. Mr. Ellison has thus lowered the value of c to $0 \cdot 6718$, and has increased my percentage of 32 to 45.

The values of the microscopical experiments (Nos. 4 and 13) given in my table may be far from correct. The difficulty of these microscopical antipoint measurements is very great indeed ; those with a telescope are mere child's play in comparison.

II.—*On the Diffraction Rings for a Circular Opening; and on the Limit of Resolving Power.*

(Being a rejoinder to Mr. Nelson.)

By Alfred W. Porter, B.Sc.

(*Read November* 20, 1907.)

There are two different though related questions connected with Mr. Nelson's reply to the paper by Mr. Everitt and myself. The first is, what is the size of the first dark diffraction ring for the case calculated by Airy and others? and the second is, what is the ultimate resolving power of a telescope for a close double star? I do not mean to say that these questions are explicitly stated, but Mr. Nelson confuses them both in his original paper and in his reply to our criticism.

What I wish to make perfectly clear, first of all, is that our short paper referred only to the former of these questions, viz. the radius of the first dark diffraction ring. Airy's calculation of this radius was for the case of a point source of light: and as a physicist I feel somewhat perturbed that a calculation which was free from any obvious flaw should be called into question. It was with the object of testing the calculation that our measurements were made, with the result that we obtained a practically complete experimental verification of the theoretical value. Hence, whatever may be the explanation of Mr. Nelson's data, this explanation is not to be found in incorrectness in the theoretical calculation.

Now this was the only point dealt with in our paper. Mr. Nelson in his reply forces upon us a consideration of the second question, viz. that of the ultimate resolving power.

It is very difficult to gather the exact mode in which his experiments were made. From his paper we (and others) concluded that he moved his stars till the first dark rings came into contact. From his reply, we gather that his two stars were moved to such a distance that they just failed to be seen as two. But this latter *does not give one a measure of the first dark ring*, as he seems to claim! Mr. Nelson does not appear to realise that his two star images may be so near as to overlap, and yet show a dark line separating them. I believe that this last fact is at the bottom of the confusion in his statements.

When the two stars are a distance apart corresponding to the conventional limit of resolution, the intensity curves are as shown in fig. 1, the dotted curve being the resultant intensity of the overlapping images, each of which has an intensity given by the continuous lines. It will be seen that the intensity in the middle is less than the adjacent maxima by about one-third. Such a proximity of images will give a well-marked band of separation of the images, yet in this case the distance between the maxima is only equal to the radius of the first dark ring. Now a rigorous calculation shows that Mr. Nelson's results correspond to a closeness for which the depression of intensity in the middle will have rather more than disappeared. Hence, putting

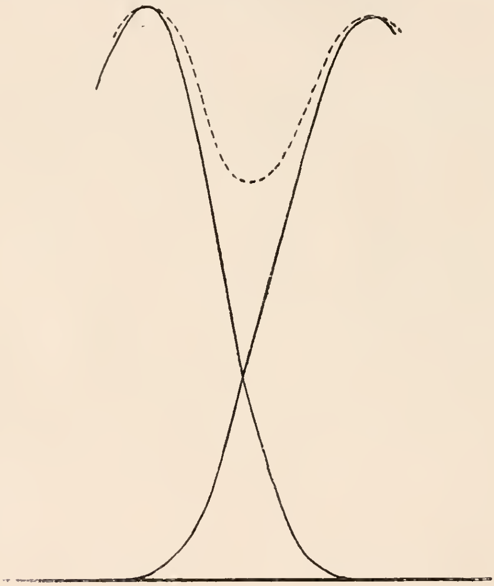


Fig. 1.

aside errors, which may amount to about 5 p.c., we may say that Mr. Nelson succeeds in seeing the depression of intensity in the middle until it completely disappears. Mr. Nelson is to be congratulated in this achievement: it denotes quite exceptionally keen vision; but he is totally mistaken in thinking that from the distance between his two stars in this case he can calculate the radius of the first diffraction ring.

Now in regard to this extremely successful resolution. The usually accepted limit was never intended to be the ultimate value; it was fixed in a purely conventional way, so as to provide a standard (in terms of which different openings and instruments might be compared) which would have a perfectly definite meaning, be totally independent of a particular observer's vision, and at the same time represent the resolving power which a good (though not phenomenally good) observer might be expected to read. I have myself taught in my classes for ten years past that this standard is purely conventional, and is easily surpassed.

However, accepting Mr. Nelson's data, we must admit the possibility of very considerably exceeding the conventional limit. In order to meet such exceptional cases, I desire to propose a new standard, which shall possess the merit of the old one of being independent of the observer. Let the stars be brought to such a closeness that the central depression *just* disappears; it is obvious that this closeness represents the "ne plus ultra" case of resolution for monochromatic light. No one, however keen his vision, will quite succeed in seeing the star double at this limiting distance. I propose, therefore, to take this degree of closeness as the ultimate limit of resolving power. It corresponds to the closeness for which the curves of intensity of the individual stars cross each other at their points of inflexion (that is, at the points at which they have no curvature).

It is true that even for this degree of closeness, the *oval* shape of the disk of light may enable one to infer that it is not a single star which one observes. Moreover, if the light is polychromatic, as usual, the tint at the centre of the resultant image may be expected to be redder than on each side; this, again, will tend to make the limit of resolution lower than we would otherwise expect. But the limit I here suggest is certainly so near the attainable value, even when auxiliary circumstances such as these intervene, that it is confidently put forward as the correct one to employ.

III.—*Mercury Globules as Test Objects for the Microscope.*

By J. W. Gordon.

(*Read Nov.* 20, 1907.)

Plate I. (figs. 1, 2).

The difficulty of explaining the appearance of certain objects under high magnification led me some two or three months ago to undertake a comprehensive study of the appearance in the Microscope of mercury globules. The hypothesis upon which I worked was that the mercury globule being a simple object of known shape and optical properties I could not be mistaken as to the appearances which it would present, and if in any respect these appearances should prove to be unexpected, they would probably be easily traced to their origin. This hypothesis has not been falsified, although it may be confessed that the appearance of mercury globules under the conditions of high magnification has considerably surprised me. The phenomena observed turn out to be due to causes which will, I think, interest the Fellows of the Society. I have therefore sought the opportunity of exhibiting some specimens, and placing a short description before this Meeting.

The first thing to strike the observer is a phenomenon which certainly ought not to have been unexpected, although I may confess that it surprised me, when I first observed it. A mercury globule occupying the centre of a bright field, and illuminated by a large cone of light from the condenser, presents a strong luminous band about its edge, which is in fact displayed upon its under face. Attention being drawn to the matter, it is quite easy to see that an objective of wide angle must see for a considerable distance round the under face of a spherical object. The diagram (fig. 2) serves to show how this comes about and incidentally to indicate the rule by which the inner edge of this luminous band may be calculated. Taking the ray from the point A to the point E to be an edge ray of the beam which enters the objective, it is easy to see that that ray must come from a point C in the beam received from the condenser, since the angle B A E must be equal to the angle B A C. Moreover, if we draw the perpendicular X X′ through the point A parallel to the optical axis, we shall have the angle E A X equal to the semi-angle of aperture of the objective. This, therefore, is a known angle. In like manner the angle C A X′

is the semi-angle of aperture of the beam received from the condenser. This is not necessarily a known angle, but if it can be ascertained, it is obvious from the diagram that the angle at O, the centre of the globule, subtended by the illuminated band A G, is equal to half the sum of the angles E A X and C A X′. For writing u and u_1 for these angles respectively, we have

$$\angle \mathrm{AOE} = \angle \frac{\mathrm{CAE}}{2} - \angle \mathrm{AEO} = \frac{u_1 + (\pi - u)}{2} - \left(\frac{\pi}{2} - u\right) = \frac{1}{2}(u + u_1) \quad [1]$$

This bright belt is clearly seen in the photograph (Plate I. fig. 1) of a mercury globule exhibited under these conditions. In addition there is seen in the centre of the globule a bright spot of light reflected from its upper face. The light which thus reaches the

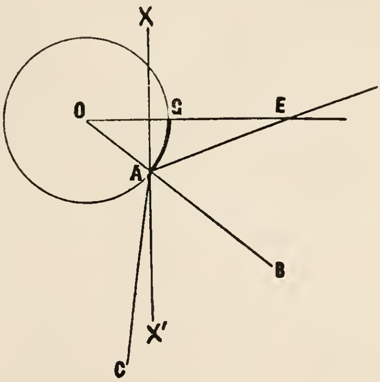


Fig. 2.

upper face of the globule can only come, and does in fact come, from the lenses of the Microscope, which reflect back and condense upon an object placed in the middle of a field a very strong light received by them from the field. In the photograph this spot of light is seen unfocused since it occupies a position about midway between the vertex of the globule and its equatorial plane, and the Microscope for the purpose of taking this photograph was, in fact, focused upon the illuminated belt which lies immediately below the equatorial plane upon the under face of the globule. But, by focusing up to the principal focal plane of the globule, it being considered for this purpose as a convex mirror, a detailed view may be obtained of the interior of the Microscope.

If a mercury globule upon the stage of the Microscope is illuminated by light from a very small source of illumination, and if, further, the condenser is so disposed that the image formed by it of the source of light lies a little above the equatorial plane of the globule, we then have the conditions, illustrated by fig. 3, under which Fresnel rings are formed, by the turning back upon itself of a small annular wave-front reflected from a narrow zone lying about the equator on the surface of the globule. Here Z is a section of the reflecting zone. A is a section of the ring upon which an incident annular wave front B C is focused, and A′ is a section of the ring to which it is reflected. B D is a section of a surface all parts of which lie at equal optical distances from the ring A′. Under these conditions the illumination at A′ will be a maximum, if the distance C D = 0, or $\frac{3\lambda}{2}$ $\frac{5\lambda}{2}$, etc., and will be a minimum, if it is equal to λ, 2 λ, 3 λ, etc. Thus, taking A′ in a series of different positions relatively to A, we get varying illumination, which passes from maximum to minimum and back to maximum successively, with the result of a system of Fresnel rings.

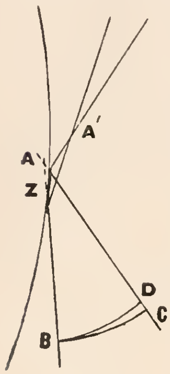


Fig. 3.

Under these conditions very magnificent displays of Fresnel rings can be produced, especially if the field is darkened by means of a top stop, and they have, in a way presently to be mentioned, an important application for the purpose of testing and perfecting the centring adjustments of the substage apparatus.

Returning now to the consideration of the bright spot in the middle of the globule, the first thing that strikes the observer is that a very large quantity of light is there reflected, and that the object on the stage is in fact receiving a very powerful top light from the objective. This impression, upon examination, proves to be well founded. In Plate I. fig. 2 we have a photograph of a small piece of etched tinfoil. This object was illuminated entirely by light thrown back from the refracting surfaces of the Microscope. If metallurgists wanted only to examine minute pieces of metal like this fragment, which, in fact, measures about $\frac{1}{100}$ inch in diameter, they would not have need to have recourse to any other system of illumination than that which is furnished by reflection from the lenses of the objective. This fact has an important bearing upon the appearance of all small objects seen in the Microscope. To this cause, for example, are due some of the most striking appearances presented by diatoms. And it is now apparent to me that to this cause must be attributed the high light shown upon the specimen of Staphylococcus, a photograph of which I showed to the Society in November last. The photograph is reproduced in Plate III. of the Journal of the Society for 1907 (facing p. 10). A very familiar illustration of this effect of top lighting is presented by the well-known appearance of *Pleurosigma angulatum* under a wide-angled lens. The silex of *angulatum* has a deep brownish yellow colour, which may be seen when the specimen is viewed by transmitted light, as, for example, by means of an objective of low angle. The coloration then is seen to be very strong, but if the same specimen be viewed while illuminated from the same source of light through a wide angled immersion lens, the yellow colour will entirely disappear. The silex then appears to be of a brilliant white, and detail which by the transmitted light was wholly invisible comes strongly into view. This is, I think, undoubtedly a case of top lighting, and the distinctive image which a wide-angled lens alone can show is to be attributed to the illumination of the upper surface by top light from the objective.

Another very familiar instance of the effect of this top lighting is afforded by the much discussed phenomenon known as an unoccupied aperture. The top light from an immersion objective is given back in very great abundance from its peripheral zones. This may seem to be a natural thing if one considers only that the peripheral zones comprise a large proportion of the whole surface. But there is probably some reason which I have not been able to divine, for assigning to the peripheral zones a reflecting power more than proportional to their area. For if the flooding of the stage with this top light be watched while the observer cautiously opens the iris diaphragm, it will be seen that nothing particular happens until a certain point is reached in the expansion of the condenser aperture. At that point the top light comes rushing in, and rapidly spreads over the field. If any reflecting surface lies between the object and the objective, the image is almost instantaneously ruined, and all detail is blotted out in a blazing mist of diffused illumination. It will now, I think, be evident why the explanation of the phenomena connected with the unoccupied aperture has given so much trouble to microscopists. They have omitted to consider the great abundance in which the peripheral zones supply this top light, and they have therefore omitted also to consider how all important it is to the use of an immersion objective that the space between the specimen and the first reflecting surface should be filled by an absolutely non-reflecting medium. When the front lens of the objective and the cover glass have different refractive indices, or when the oil interposed between them has a refracting index differing, it may be only slightly, from theirs, there is, of course, a reflecting plane or more than one, interposed between the specimen and the first refracting surface. The same thing occurs of necessity in the case of all specimens which are mounted dry. When from either of these causes such a reflecting surface exists it will, when illuminated by the top light from the objective, interpose an obstacle through which it is quite impossible to see anything except the most strongly marked features of an object. It is therefore not surprising that under these conditions the finer details, which high power lenses are specially employed to reveal, should be lost to view, and it is obvious that the remedy must be to cut off all superfluous light from those zones of the system which send it back in greatest abundance to the stage. When immersion objectives are designed with a view to the separating of the focus of reflection from that of refraction; or when the optical homogeneity of front lens, immersion fluid, cover-glass and mounting medium are duly considered in setting up the object, we shall be able to use cones of condenser light that will fill our objectives, but until these matters come to be considered in connection with the power of refracting surfaces to reflect light, the appearance of any given object under illumination by large condenser cones must be a mere matter of chance.

Another set of phenomena which are largely, though by no means wholly, explained by the top lighting comprises those connected with oblique illumination. It has been already pointed out that the reflected light from an immersion objective appears to play a very important part in the lighting of the object. When this top light is intended to fall sidelong on the object and to illuminate it by cross lights, it must of course be oblique top light. And this can be secured by shading half the objective. There appear to be a large number of oblique illumination effects explainable in this way.

The foregoing are general observations. It remains to describe in detail the various applications which I have so far succeeded in making of mercury globules for the purpose of testing the Microscope.

The first of these experiments relates to the Fresnel rings, the formation of which is illustrated by fig. 3, already described. It may be pointed out that the number of such rings which can be seen depends upon the aperture of the objective. In the formation of interference bands, as a rule, the outer members of the series fade out of view either because of the overlapping of different members or because the foreshortening of the aperture as seen from the outlying parts of the interference image cuts down its light-transmitting power to such an extent that the illumination becomes too weak to be seen. In the case of the mercury globule, however, a different set of conditions obtains. The reflecting zone is most foreshortened, as seen through the innermost rings. Its light-giving power therefore increases as the observer views it through the outer rings of the series, and it seems to be a fact that the limit of the number of rings seen in the Microscope is set by the aperture of the objective.

It follows from this consideration that the appearance of these rings can be used as a test for the centring of the globule in the optical axis of the objective. It may, I suppose, be taken for granted, at any rate for practical purposes, that the optical axis passes through the centre of the aperture of the objective. If there be any discrepancy it would, no doubt, be the aperture, and not the optical axis which would determine the formation of the rings. If, then, the mercury globule lies even at a very small distance out of the optical centre of the objective, the Fresnel rings will be visibly deformed. In one of the Microscopes exhibited this evening a mercury globule is displaced slightly from the optical centre of an objective. The rings, instead of forming a symmetrical concentric system, form a system in which one side is very much narrowed and the opposite side expanded to such an extent as to be quite unmistakable.

To start the centring operations, therefore, the first thing to be done is to place a mercury globule in the optical centre of the objective. For this purpose it is well to swing the condenser clear of the stage, and light the object directly from the lamp or mirror. It is, moreover, convenient in all these experiments to use a circular disc as the source of light, though, of course, the form of the light source is of very little importance when the condenser is out of use. When the observer is satisfied by the symmetrical formation of the rings that the globule lies truly in the optical axis of the objective, he will next proceed to rectify the position of his source of light. This may be done by inclining the mirror, or if the lamp is viewed without a mirror, by adjusting the position of the lamp. This adjustment can be roughly made by observing the illumination of the rings. If the source of light is considerably out of line with the optical axis of the instrument, one part of the rings will appear to be more brightly illuminated than another part. The displacement of the light source does not very sensibly affect the form of the rings or their disposition when the light source itself is at a considerable distance from the stage. But it does most materially affect their illumination. It is possible, therefore, in this way to obtain a collimated source of light. But a still more sensitive test will be presently mentioned.

The source of light having thus been adjusted in line with the mercury globule, the condenser may next be swung into position, and now the advantage of the circular source of light becomes apparent. The luminous disk should be of such dimensions that its image has a diameter slightly less than that of the globule. When, therefore, the source of light is truly focused in the middle of the field, it will be entirely occulted by the globule, and the Fresnel rings will be brilliantly seen upon a dark field. If there were no top lighting and no diffused illumination by reflection from the surfaces of the condenser, the Fresnel rings would, under these conditions, be seen on a field absolutely black; but this variously reflected light causes a considerable illumination of the stage, and the Fresnel rings, therefore, are only feebly seen unless the beam from the condenser is narrowed down to a small cone. It is, however, quite possible in spite of this diffused illumination, to see the Fresnel rings even in the bright field. By observing them under these conditions, with the aperture of the condenser opened wide, it is possible to centre the condenser in its turn. Its position will, of course, be central, when the rings are again evenly illuminated.

The final centring adjustment remains to be made—that, namely, which concerns the centring of the iris diaphragm. This is, of course, effected in the same way as the centring of the condenser. If when the iris is closed the rings are unevenly illuminated, it must be moved into a fresh position until they are seen to be of uniform brightness in all parts of the field. When this result is reached the centring is completed and well adjusted.

The mercury globule being now in position, it may be employed to examine the interior of the objective. For this purpose it is best to turn the sub-stage condenser aside, and to allow the light from the mirror, or, better still, direct light from the lamp to illuminate the stage. It is, probably, best even for this purpose to have a circular source of light, but that is not now so important as when observing the Fresnel rings. The light being accurately centred, if we now focus upon the principal focal plane of the globule, which lies about midway between its equator and its vertex, we shall see a series of images formed by the various reflecting surfaces of the objective. The general form of these images is that of a bright field with a circular dark object in its centre, but, with a very narrow cone of incident light, such as we get without a condenser, the bright field may be reduced to the dimensions of a thin bright outline to the dark image of the globule. What we actually see is a image of the stage with the globule itself at its centre. The diagram (fig. 4) shows generally what I take to be the optical system producing these images. Here one of the concave surfaces is represented by the curve F F, the conjugate point to the point B, the refracting surface F F being considered as a concave mirror, lies at point C. It is brought to a shorter focus very approximately in the principal plane of the globule by the upper surface of the globule, which serves as a convex mirror, and operates as a field lens to shorten the working distance of the concave mirror. The image so formed is seen through the Microscope in the ordinary way. If the point B is at the focus of the condenser, it and its conjugate point C will be brilliantly luminous. But even if it be out of focus, it is sure to shed light enough to be distinctly visible in the dark face of the mercury globule.

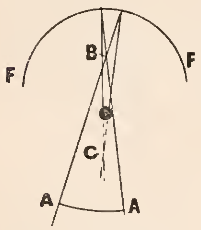


Fig. 4.

It will now be obvious that every reflecting surface in the instrument must send a certain amount of light back to the stage. It is not, however, every such surface which concentrates the light sufficiently upon the globule to produce a visible image there. It is a selection only of the reflecting surfaces which thus produce images such as can be examined in the Microscope. I imagine, however, that every separate lens must have at least one surface which thus yields a visible image. That, however, is too complicated a problem for me to be able to discuss it to advantage. What is quite clear from a mere inspection of the images so formed is that almost, if not entirely, all the lenses contribute to the collection of images. The multiplicity of such images and their disposition close behind one another—when a very small globule is used as the reflecting mirror—are, indeed, the principal defects of this system of examination. The images will, many of them, be found to come into view simultaneously, and then if, as often happens, they overlap but do not coincide with one another, a confused image results in which it is not easy to discern the outline of the object globule. In the case, however, of a well-constructed lens, the light being accurately centred, these images are all concentric, and the various pictures can be easily discriminated even when two or more of them come into focus together. This method of examining an objective will be found to be a very searching test of its mechanical perfection, for any lens not perfectly set will produce an excentric image. Moreover, this mechanical accuracy in the placing of the lenses is itself a condition of high optical quality. A single lens tilted to one side may produce but little effect in the ordinary working of an objective. But it will effectually prevent the instrument from yielding the finest results of which its combination is capable. This test, therefore, is of considerable value, and it has the merit not only of being a crucial test, but, in addition, of being one which indicates the nature of any defect detected. It will therefore, I imagine, be found to be a useful addition to the arsenal of the instrument maker, as well as an easily available test by which the microscopist can examine the mechanical perfection of his objectives.

The lenses of the objective having been in this way examined, we may now restore the substage, condenser and iris-diaphragm to their places. Then, of course, we shall have to work with focused light, and the appearance presented by the various images in the mercury globule will be altered accordingly. It will be found that there are two positions of the substage condenser in which definite images beside the image of the mercury globule are given. In one of them, the image is an image of the source of light; in the other, it is an image of an aperture of the condenser, defined as a rule, of course, by the iris diaphragm. The mercury globule and the source of light having been duly centred, it will be found that these two images afford an easier method of centring the substage mechanism than that already described of observations made upon the Fresnel rings. Thus, the iris-diaphragm being opened wide in order to expose the full aperture of the condenser, we ought, when the source of light is focused in the globule, to see it truly central. If that is the case, the optical axis of the substage condenser is coincident with the optical axis of the Microscope. Then a very minute image of the globule itself will be seen occupying the exact centre of the small image of the source of light. The slightest displacement of the condenser disturbs this arrangement and throws this opaque image of the globule visibly away from the centre of the source of light. This, therefore, is an extremely critical test of the centring of the condenser. The condenser having been centred, you may now alter its focal position so as to bring the aperture of the condenser and the image of the iris into view in the globule. If now the iris be closed, its image will be seen closing either truly upon the image of the globule or upon some excentric point according as the iris is in or out of centre. Here, again, the necessary adjustments are easily made, since their progress can be followed with the eye.

There is among the exhibits upon the table this evening one which very strikingly indicates the great abundance in which light comes back from the reflecting surfaces of the optical system. A comparatively large globule, actually of diameter of $\frac{1}{50}$ in., is mounted under a $\frac{1}{2}$-in. objective. The light is so arranged that a strong image is thrown back from the observer's cornea, when his eye is placed accurately at the eye-point of the instrument. The flashing of this image across the centre of the globule forms a very striking object, and it may be observed that in this experiment a very perfect image of the globule is in this way formed, and may be momentarily seen. But it is, of course, impossible to hold the eye stationary enough for anything more than a flash view of this image. Beside the corneal image a coloured and imperfectly focused image reflected from the interior of the eye may also be seen. I mention it not as an object upon which I have any observations to offer, but for the purpose of drawing the attention of others to it who will be able to study it to better purpose than I can.

The phenomenon just described may be made the starting point of an almost ideal test for resolving power. In place of the eye, which is a moving object, we may substitute a mercury globule properly mounted at the eye-point of the microscope. It will then reflect light precisely as did the observer's cornea in the last experiment, and if for this purpose we use a small mercury globule (one having a diameter of $\frac{1}{100}$ of an inch is very suitable), it will not impair the observer's view of the stage, when he looks down the instrument. In that case he will see, not the image reflected from his own cornea, but an image reflected from the under face of this new globule, which I will, when further referring to it, speak of as the speculum globule, to distinguish it from the object globule on the stage.

It may be convenient at this point to invite you to consider the nature of the optical arrangement thus set up. It is, of course, a very common observation that when two mirrors are placed on opposite walls facing one another we get a great number of successive reflections producing the appearance to the observer placed between them of a long vista of mirror frames and many repetitions of his own head. The same thing would, of course, happen if our mirrors were convex mirrors. But in that case the successive images would very rapidly diminish in size. In the case of plain mirrors the successive images diminish in apparent size as the result of perspective, but in the case of convex mirrors they would diminish not only as the result of perspective but also by reason of the magnifying power of the mirrors themselves. This is what happens in the case of two mercury globules facing one another. The observer looking, as indicated in fig. 5, past the

Fig. 5.

speculum globule into the face of the object globule, sees there an image of the inner face of the speculum globule and in that image, which I will speak of as an image of the first order, he sees an image of the second order of the object globule itself as reflected in the face of the speculum globule. This second order image is of necessity a very small image, for it has undergone reduction in size, first by the speculum globule and then by the object globule itself. If now we interpose a lens between these two globules we do not prevent in any way the interchange of reflections between them. The phenomena are, of course, somewhat complicated by the magnifying power of the lens, but are not otherwise affected by it. We are thus led to expect that if the optical system of the Microscope were interposed between the two globules of fig. 5, we should still have the second order image of the object globule seen in its own surface. This is what actually happens, and in one of the Microscopes upon the table this evening you will find an arrangement of this sort set up and a brilliant second order image of the object globule exhibited to view.

It will be interesting now to consider why the second order image happens to be so conspicuous. If it were simply a question of size, one would expect the first order image of the speculum globule to be more conspicuous still, but, in fact, that image cannot be seen. The reason can easily be assigned. The speculum globule lies in a perfectly dark field, and is illuminated only by light which it reflects from the stage of the Microscope. Only its reflecting surface, therefore, is a visible object at all, and thus the image of the speculum globule, theoretically present in the object globule, is an invisibly dark object. Under very special conditions of illumination it can just be seen. But to bring it into view is a difficult experiment, and one which I have not attempted this evening to demonstrate. The images of the speculum globule being thus excluded, we, nevertheless, have to consider a whole series of images of the second, fourth, sixth, etc., orders. These may all be dealt with in a word by considering only the case of the fourth order image. It will at once be appreciated that this, having undergone four reductions in scale by reflections between the globules, has become an object almost infinitesimally small. In fact it is much too small to be seen, and therefore, of all the images which are theoretically possible, only this second order image of the object globule is, in fact, a visible image. It, however, shines with such effulgence as to constitute it a most striking object, very easily identified and observed. Here, then, we have the primary conditions of a perfect test object: A circular disk which is densely black and of known, that is to say, of calculable dimensions, lying in a bright field and capable by a proper selection of mercury globules, of being made to any desired size, so that we can overpass the resolving power of any imaginable lens.

The optical system built up in this way of the two mercury globules mounted one at each end of the Microscope, has some interesting properties. It is to be observed that the two globules do not occupy positions which are conjugate to one another. On the contrary, each occupies what is an apertural plane in the optical system which focuses in the other globule. Consequently, the two principal focal planes of the globules are conjugate to one another, not their two centres. From this it follows that the dimensions of the image seen depend simply on the principal focal lengths involved, and are independent of the exact positions which the globules occupy. This fact is highly convenient, since it enables us to place the speculum globule at whatever distance from the eye lens is most convenient for the observation that we wish to make. The position of the object globule is, of course, definitely determined, since its principal focal plane must coincide with the focal plane upon the stage of the Microscope. But it may be desirable to vary the position of the speculum globule. A glance at fig. 6, which illustrates the optical system, shows that the conditions of illumination are identical over an appreciable range of distance along the optical axis in the region occupied by the speculum globule (g_1). It is also clear from this consideration that the light reflected from the surface of the speculum globule does not fill the whole aperture of the Microscope, but passes along certain zones, these zones being more central when the globule is near the eye-lens, and more peripheral when it is remote from the eye-lens. A very pretty experiment can be made by moving the speculum globule slowly from one of its extreme positions to the other. We can then watch the gradual change in the appearance of the image as it is transmitted through different zones of the system. The most noticeable change is that the colour varies, the image being, as a rule, strongly blue at one end and distinctly red at the other, a good achromatic image being obtained at some intermediate point.

The diagram, fig. 6, shows the path of an incident pencil from

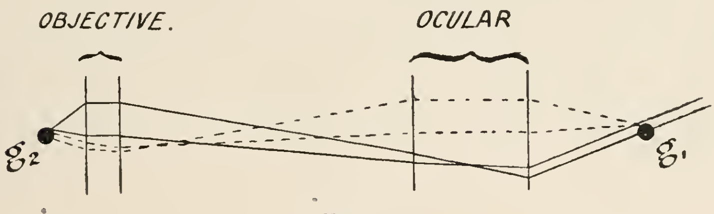


Fig. 6.

a point on the object globule in full lines—the path of a reflected pencil in broken lines. It is obvious that the diameter of the black disk seen in the object globule (g_2) can be very easily calculated. Looking down the instrument we have in the field the original of the picture pourtrayed in the object globule, and it is seen under the full magnifying power of the Microscope. It exhibits, of course, a bright field, an illuminated edge of the globule, which melts into the field, and a dark centre, the diameter of which last depends upon the aperture of the objective and the angle at which the light from the condenser strikes the under face of the globule. If this latter factor were known it would be an easy thing to calculate the diameter of the darkened part of the disk by the formula of equation (1), but as the exact angle of the condenser cone depends upon the focusing of the condenser, and as, moreover, the focusing of the condenser may most conveniently be adjusted with reference to the brightness of the resulting image, this cannot very well be made the subject of calculation. But since it is to be seen in the Microscope and of full size it can quite easily be made the subject of measurement. We may, therefore, take the following magnitudes to be known.

The optical length of the Microscope; which may be written L.

The equivalent focal length of the ocular;—written f_1.

The diameter of the speculum globule;—written g_1.

The equivalent focal length of the objective;—written f_2.

The diameter of the object globule;—written g_2.

The diameter of the dark patch upon the object globule;—written D.

It will be evident on reference to the diagram, fig. 6, that the apparent size of the second order image in the object globule of its own darkened surface, which may be written d, is,

$$d = \frac{g_1 g_2 L^2}{16 f_1^2 f_2^2} . D . \qquad . \qquad . \qquad . \qquad (2)$$

It is evident from this equation that the dimensions of the test object (d) can be varied in two ways; that is to say, we may alter the size of the object globule or we may alter the size of the speculum globule, and thus, by varying these two elements in the combination, we can produce a black dot of any required dimensions however small. Moreover, the mathematical law is one that works out to a very convenient system in practice. If we alter the size of the speculum globule the value of (d) alters according to a simple proportion, so that we may write the above expression (2)

$$d = C g_1.$$

C being a constant; if everything except the speculum globule is left unchanged. We have thus the means of very gradually altering the dimensions of the test object by substituting speculum globules of slightly varying dimensions.

If, on the other hand, we vary the object globule we, of course, alter the value of D at the same time. In fact, D is itself directly proportional to g_2, therefore we may write the product

$$g_2 D = C_1 g_2^2.$$

If we assume everything to remain unchanged except the object globule, we may write equation (2) as follows:—

$$d = C_2 g_2^2.$$

It thus appears that by changing the object globule we very rapidly alter the size of the test image, and if we alter the size of both the globules simultaneously, we get finally a value in the form

$$d = C_3 g_1 g_2^2.$$

Under these conditions the size of the test image varies very rapidly indeed. And thus with a comparatively small range of mercury globules it is possible to obtain test objects of all dimensions down to such as will be invisible in the finest instruments that can be made, while at the same time we have the power to vary the size of our test object at any point in the series by the finest degrees of change of magnitude.

It will do doubt be understood that in the case of the speculum globule it is necessary, and in the case of the object globule convenient, to have it mounted between glasses in Canada balsam. In the case of the speculum globule, which reflects the image from its lower face, it is necessary to make sure that the lower face is not resting in contact with the glass. If the balsam is at all viscous, the globule may subside into that position in use, and so present a flattened face to the object globule which, of course, entirely alters the dimensions of the resulting second order image.

EXPLANATION OF PLATE I.

Fig. 1.—Mercury Globule.
„ 2.—Etched Tinfoil.

IV.—*Light Filters for Photomicrography.*

By E. Moffat.

(*Read November* 20, 1907.)

Plate I. (figs. 3–6).

For a number of years my attention has been directed to light filters in connection with photomicrography, as a means of obtaining well contrasted photographs of objects whose natural or faintly stained appearance has occasioned one the greatest amount of trouble, and in many cases had to be abandoned in despair. Some fine pathological preparation, highly valued it may be, and from which the stain has all but disappeared—to unmount and re-stain which might be attended with considerable risk, owing to the fineness of the texture—or some very pale-yellow insect dissection, or other difficult object, has to be photographed: without a filter and orthochromatic plate the attempt would be well nigh hopeless, but given a correctly prepared filter to meet the special needs of the case, the result will be highly gratifying.

The spectroscope in such cases is invaluable in the determination of colour and depth of tint required. A simple pocket instrument is sufficiently good, but where greater accuracy is demanded, one can easily rig up a table instrument with two cheap telescopes — one being used as a collimator, using the object-glass only, and the other is easily converted into a small astronomical telescope; a dense glass prism and slit completing the arrangement. A scale can be made on paper of the principal Fraunhofer lines, and this can be used for recording by artificial light, where the absorption bands appear on the spectrum of the dyes or filters we are about to employ.

If we place in a cell of about 1 cm. deep a weak solution of the dye by which the preparation is stained, we shall find that the spectrum is modified, and some parts may be missing altogether, as where the absorption bands appear. Now, to obtain the greatest contrast, we must photograph in the absorption band region with a filter which will always be the complementary colour, and therefore produce the greatest darkness upon the resulting print, the shadows upon the negative having practically clear glass; e.g. fuchsin gives a band about midwaybetween D and E, and is well met by a screen or liquid filter composed of a saturated solution of copper acetate and a little potassium bichromate. These may be made up in two separate cells, or mixed together, when a muddy compound will be produced, but by adding acetic acid drop by drop this will clear up, and a fine permanent filter will be the result, this being excellent also for visual work.

My experience has been that with these liquid filters a far superior result is obtained than with gelatin-stained films, as the latter when rubbed stop a considerable amount of light. The liquid filters pass a maximum of light, and so reduce exposure to a minimum, and at the same time act as heat-absorbing troughs, enabling the Microscope to keep longer in focus. Monochromatic light is hardly practicable unless the arc lamp is used, and, after all, a bichromatic light is ample for nearly all purposes, and by working with the two chemicals named much good work can be done. A saturated solution of copper acetate in a fairly deep cell, say 25 mm., will cut out the red end of the spectrum and also the orange beyond the D line. A strong solution of potassium bichromate will absorb the spectrum from the violet end through the blue and beyond the F line. A special case may arise where a red sensitive plate and a red filter are required, such as in a faintly-stained methylen-blue preparation, where the absorption band is principally about the C line; but in practice a good negative can generally be got of this by a deep orange filter and a yellow sensitive plate—these plates being exceptionally good for photomicrographic work, and generally giving greater contrast than the plate sensitised to the whole spectrum.

As before stated, insect dissections, and similar objects of a pale-yellow or straw colour—the chitinous substances assuming such tints when mounted in balsam—might be well represented by Bismark brown (Vesuvian), which has an absorption band from the violet end of the spectrum to the F line. A successful result can in most cases be obtained by a filter of gentian-violet, which has an absorption band in D towards the yellow, using an ordinary slow plate and giving a minimum exposure.

Excessively rapid dry-plates I have found to be of no advantage, as there is a greater danger of chemical and light fog, owing to the time usually required in development of photomicrographic negatives in comparison with field or landscape work, much greater contrast being demanded. Personally, I have found that when the first appearance of the image is from $2\frac{1}{2}$–3 minutes, and is completed in about 15–18 minutes, the best negatives are obtained, pyro soda, with a large quantity of potassium bromide, being the developer used.

The accompanying photographs were taken on Barnet orthochromatic plates and printed on glossy bromide paper, the light used being a Nernst lamp, 1 ampere on 100-volt circuit, with the addition of an ordinary lantern condenser, the exposure being marked on each.

In conclusion, unless a good picture is portrayed upon the ground-glass screen to the naked eye without the use of a magnifier, just as in ordinary photography, the resulting negative will probably be a failure, but by the use of the above simple filters, supplemented by the spectroscope, much may be accomplished upon subjects hitherto considered impossible, and in all cases much useful information may be acquired.

EXPLANATION OF PLATE I.

Fig. 3.—*Trypanosoma gambiense.* $\times$ 1500. Leitz objective ; $\frac{1}{12}$ oil-immersion ; 6 $\times$ compensating ocular ; Barnet ortho plate ; Nernst lamp. Exposure, 3 minutes.

,, 4.—*Bacillus pestis.* $\times$ 1200. Potassium bichromate filter. Exposure, 3 minutes.

,, 5.—Poison fang of Spider. Gentian-violet filter. Exposure, 10 seconds.

,, 6.—Gizzard of Cricket, showing teeth. Gentian-violet filter. Exposure, 10 seconds.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Removal and Transplantation of Ovaries.‡—F. H. A. Marshall and W. A. Jolly have previously adduced evidence in support of the view that heat and menstruation are induced either directly or indirectly through the activity of an internal secretion or hormone arising in the ovaries, and that the corpus luteum provides a secretion which assists in the nourishment of the embryo during the first stages of pregnancy. In the present paper the investigators show that the existence of ovarian tissue is an essential factor in normal uterine nutrition; and further, that the nature of the ovarian influence upon the uterus is chemical rather than nervous, since the transplanted ovaries (in rats), while still maintaining their functions (at least, in many cases), had lost their normal nervous connections. It is extremely probable, therefore, that the uterus is dependent for its proper nutrition upon substances secreted by the ovaries, not merely at the heat periods and during pregnancy, when they show their greatest activity, but throughout the whole of the œstrous cycle.

Inheritance of Pigmentation in Mice.§—L. Cuénot continues his important investigations on the inheritance of pigmentation in mice, all of which go to show the general occurrence of Mendelian phenomena. In fact, all the determinants known in mice conform strictly to Mendelian rules. "On ne connait chez les souris que des caractères mendéliens."

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to escribe and illustrate Instruments, Apparatus, etc., which are either new or ave not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Trans. Roy. Soc. Edinburgh, xlv. (1907) pp. 589–99 (2 pls.).

§ Arch. Zool. Expér., vi. (1907) Notes et Revue, No. 1, pp. i–xiii.

Artificial Insemination in Mammals.*—J. J. Iwanoff discusses the experiments, sometimes successful, which he and others have made in the artificial insemination of sheep, cows, and mares. He notes, *inter alia*, that the seminal fluid of hybrids of horse and zebra contains no spermatozoa, that the sperm may be kept successfully in weak solutions of sodium chloride and carbonate, and that the spermatozoa show great resisting power against cold, alcohol, and other untoward conditions.

By artificial insemination Iwanoff made a hybrid between a female white mouse and a male white rat. The hybrid was very large.

Gastrulation in Petromyzon.†—S. Hatta describes this process in considerable detail. Amongst others he emphasizes the following peculiarities. Blastulation and gastrulation overlap each other to a great extent in the period of their occurrence. The prime cause of this belated mode of development is indisputably due to delay of segmentation on account of an enormous accumulation of yolk within the ovum. "Concrescence" has not been detected at any stage. The macrospheric hemisphere has an activity of its own. "This is an important factor in bringing about the gastrulation in *Petromyzon*. That such is the case in the *Petromyzon* ovum, which contains a much larger quantity of yolk than the frog's ovum, and that there is no yolk plug in the former, are very striking facts." To explain this the author assumes that the frog's ovum is secondarily holoblastic, as has already been maintained by Mitsukuri.

Determining Factors in Metamorphosis of Anura.‡—P. Wintrebert deals with the bearing of pulmonary respiration on this problem. He finds that in tadpoles of *Rana temporaria* artificially prevented from exercising this function, metamorphosis is not prevented, although it is delayed. The want of the exercise of the lungs does not prevent their development. At the end of transformation larvæ, which up till then have not breathed by their lungs, when transported into open water do not try by taking in surface-air to remedy the asphyxia caused by the atrophy of the branchiæ. In particular, when their fore-limbs have no support they do not try by hind-limb movements to keep their heads above water. The absorption of the tail is more complete if the water is abundantly renewed. The tadpoles of *R. temporaria* die in the same current in which *Alytes obstetricans* metamorphoses and survives. In this latter form cutaneous respiration in an aquatic medium suffices for blood aeration.

Experiments with Tadpoles.§—P. Wintrebert finds that larvæ of *Rana temporaria*, transported from water to air, undergo precocious metamorphosis. The gills and tail atrophy, being useless. The paralysed tail becomes a mere skeleton, but keeps its form. It seems that the abnormal degeneration of the gills and the tail, and the precocious

* Arch. Sci. Biol., xii. (1907) 135 pp., 6 figs. See also Zool. Zentralbl., xiv. (1907) pp. 603–4.

† Journ. Coll. Sci. Univ. Tokyo, xxi. (1907) Art. 2, pp. 1–44 (3 pls.).

‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 1154–6.

§ Op. cit., lxiii. (1907) pp. 403–5.

reduction of the alimentary canal, furnish a large amount of absorbed material, and this perhaps hastens the definitive development of the limbs and the formation of the spiracular opening.

Experiments with Axolotls.*—P. Wintrebert describes his method of transforming axolotls into amblystomas in an inclined aquarium with an aquatic portion and a relatively dry portion, and with some sponges forming an intermediate area. He tried Powers' method of leaving the axolotls in the water, and suddenly stopping the food supply after a period of super-abundant nutrition. But no transformation was effected in this way. A modification of Marie von Chauvin's method, as above suggested, is usually effective. The importance of the environmental factor has been exaggerated; the hereditary influence is paramount.

Segments of Head and Brain in Gull.†—A. Meek has studied embryos of the Lesser Blackbacked Gull (*Larus fuscus*). He distinguishes in the prosencephalon three regions or "prosomeres," in the mesencephalon two regions or "mesomeres," and in the rhombencephalon thirteen "rhombomeres." Seven head somites are clearly represented in the gull, but the author finds reasons for concluding that the total number of segments was $15\frac{1}{2}$. The probable relation of these to the ganglia is indicated. According to the author, the mixed dorsal nerves "were primarily, and are still, largely developed from a series of intersegmental ectodermal ganglia, and the connection with the brain and spinal cord is a secondary one. The ganglia became connected together by longitudinal commissures forming a chain of ganglia on each side, and extending to a common meeting place in front of the brain—at all events, in the Cyclostomes. Those in the body lost their connection with the spinal cord, but retained their relationship with the ectoderm, thus forming the nerve and organs of the lateral line." "In the head region the ganglia and the nerves arising from them attained a conspicuous development, establishing the organs of sense, the sensory, and, with few exceptions, the motor nervous system of the region, and extending in certain cases beyond it." The author sees reasons for concluding that "an early transitory attempt at a lateral line formation takes place in the gull, in other birds, reptiles, and mammals."

Development of the Alimentary Canal in the Trout.‡—Sophie Egounoff describes the development of the various regions of the trout's alimentary canal. The œsophagus arises from a solid endodermic tract, surrounded by a mesodermic sheath; its anterior and posterior regions develop differently. The stomach is also solid to start with. In both œsophagus and gullet, the connective tissue, the circular muscles, the longitudinal muscles develop in the order in which these are named. The intestine becomes hollow first, and remains long in the form of a cylindrical tube lined by simple cylindrical epithelium. After the intestine has assumed its definitive structure, the pyloric appendages arise by the evagination of the wall.

* C.R. Soc. Biol. Paris, lxiii. (1907) pp. 521-3.
† Anat. Anzeig., xxxi. (1907) pp. 408–15 (5 figs.).
‡ Rev. Suisse Zool., xv. (1907) pp. 19–74 (2 pls.).

b. Histology.

Intercellular Connections in Fowl's Egg.*— E. A. Andrews describes bridges of clear protoplasm passing from cell to cell across the cleavage furrows of a young blastoderm, and between cells in the superficial layer and deep-lying cells. Whether in the normal living blastoderm of the fowl's egg there are such cell-connections, and whether they serve to establish physiological communication, remains to be demonstrated, but the supposition that such phenomena are general seems increased by this case.

Microbioïds of the Purple Gland of Murex brandaris.†—R. Dubois obtained in an alcoholic extract of this gland peculiar doubly refractive droplets like Lehmann's "cells"; they can give rise spontaneously to "musculoid" fibres. They go through "une véritable évolution," becoming more regularly spheroidal, acquiring a nucleus and a nucleolus, and they develop reddish-brown pigment. They give off pseudopodia (or should one not say pseudo-pseudopodia ?) with apparent spontaneity.

Matrix Tissue.‡—F. K. Studnička describes various forms of "Grundsubstanzgewebe," or matrix tissue :—The young dental papilla in Selachians, the corium and mucus-cartilage of Ammocoetes, the corium and subcutaneous gelatinous layer in the lancelet and *Lophius*, the pericerebral tissue in *Lophius* and *Ophidium*, and the gelatinous and hyaline tissue in the skeleton of *Lophius* and *Orthagoriscus*.

The matrical substances may arise through the direct modification of the protoplasm of a reticulate embryonic tissue, and may be directly exoplasmic (tooth-papillæ of Selachians).

The matrical substances may arise not only between individual cells, but also between cell-layers of the embryo, as if they had an intercellular origin. It is highly probable that they arise from structures which resemble the intercellular parts or walls of epithelium, and it is certain that in these cases they are exoplasmic (gelatinous tissue of *Amphioxus* and *Lophius*, supporting lamellæ and some gelatinous tissue in Cœlentera).

The "Grundsubstanzgewebe" may remain without cells, growing and nourishing itself independently, and forming new tonofibrils in its interior (gelatinous tissue of *Amphioxus* and the vitreous humour). In other cases it may include cells (gelatinous tissue of *Lophius*, sheaths of the notochord). Finally, there are cases in which an originally cellular matrix-tissue may secondarily lose its cells, and yet remain capable of nutrition and formative processes (filling tissue in the bones of *Lophius* and *Orthagoriscus*).

Striped Muscle.§—K. Hürthle describes some interesting observations on striped muscle, made with a view of reaching some definite view as to the nature of the contractile substance. We can only refer to a few points. Kühne's observation of the movements of a living Nematode

* Johns Hopkins Univ. Circular, No. 3 (1907) pp. 9–15 (2 pls.).
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 435–8.
‡ Anat. Anzeig., xxxi. (1907) pp. 497–522 (15 figs.).
§ Biol. Centralbl., xxvii. (1907) pp. 112–27.

within a muscle-fibre suggests that the fibrils are firm elastic threads, which were thrust to the side by the worm's movements. If the contractile substance is fluid, it should be affected by gravity, unless the capillary forces are sufficient to antagonise this. An ingenious experiment with a centrifugal machine showed that rotations of 1200–1400 per minute did not affect the distribution of the contractile substance, though the force was some 400 times greater than that of gravity. When a fresh fibre is cut with a sharp knife, nothing exudes, and this is surely against the assumption of a fluid contractile substance. But the view that the fibrils are firm elastic threads also present difficulties, especially as to the formation of the transverse disks. Hürthle asks consideration for the idea of functional transverse connections, which appear in certain functional conditions of the muscle and disappear in others. In the process of contraction there may be a strengthening of the framework. If the muscle is regarded as an elastic band, its modulus of elasticity is much lower than occurs in any inanimate body. With Brücke, we must still say "Der Aggregatzustand des lebenden Muskels ist ein Geheimnis eigentümlicher Art."

Tetrads in Somatic Cells.*—Paolo della Valle has found distinct "tetrads" in various somatic cells of larval salamanders and in the root of the pea. In the metaphase of some mitoses, among the other chromosomes, there are typical tetrads with granular or elongated elements. The author regards the occurrence of tetrads as quite accidental. It is seen whenever a chromosome, with a transversal splitting, divides at the metaphase and the two halves are not separated towards the two poles. It has nothing to do with the re-union of homologous chromosomes.

Secretion of Mammary Glands.†—F. Bertkau maintains that the formation of milk is purely a secretory process, and that there is no necrobiosis of any kind on the part of the secretory epithelium. Those who have described necrobiotic processes have been deceived by imperfect technique. The cells, like the muscle-cells of sweat glands, between the membrana propria and the epithelium of the glandular alveoli, are true smooth muscle-cells.

Vindication of the Neuron Theory.‡—S. R. Cajal states the case for the neuron theory of His and Forel. He brings forward a series of facts, based on the study of nerve-regeneration, which support the histogenetic theory of His and Kupffer. He follows that with a statement of the arguments based on embryonic neurogenesis. The result is a convincing vindication of the neuron theory. The illustrations of the paper are remarkably fine.

Valves in the Veins of a Frog.§—E. Suchard finds that there are numerous sigmoid valves in the veins of *Rana esculenta*. They are comparable to those of Mammals, and are perfectly developed. They

* Atti R. Accad. Sci. Napoli, xiii. (1907) 39 pp. (1 pl.).
† Anat. Anzeig., xxx. (1907) pp. 161–80 (7 figs.).
‡ Tom. cit., pp. 113–44 (24 figs.).
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 452–3.

usually occur in pairs, sometimes in threes. The femoral valve which Gruby described in 1842 occurs in the femoral vein before its anastomosis with the external iliac. That which Gruby described at the confluence of the three tributaries of the superior vena cava is really a complicated system of sigmoid valves. Valves also occur in the toad.

Glandular Endothelium of Lymphatic Canals and Renal Capillaries in Tadpoles.*—L. Bruntz finds that these elements are true nephrocytes, comparable cytologically and physiologically to the nephrocytes of Invertebrates, such as the branchial nephrocytes of Crustaceans and the pericardial nephrocytes of Insects.

Minute Structure of the Internal Ear.†—W. Kolmer has investigated this subject in the pig, calf, goat, and horse, and describes the histology of the ductus cochlearis, Corti organ, stria vascularis, Reisner's membrane, and membrana tectoria. In general the structure of the auditory organ corresponds in these larger mammals, both anatomically and histologically, with the descriptions given by other authors for smaller mammals. In all the forms examined, Held's support apparatus of the Corti organ could be demonstrated with essentially the same structure. Stress in particular is laid upon the "Hörhaaren" and their relations in the cochlea, maculæ and cristæ, which according to Piper have to do with hearing rather than with static orientation.

Regeneration of Cross-striped Muscle in Vertebrata.‡ — A. Schmincke reviews the literature on this subject and gives an account of his own researches on Ichthyopsida. For example, in *Triton tæniatus* and *T. cristatus* regeneration goes on by means of sarcoplasts, which are transformed into long spindle-like elements; by amitotic nuclear increase syncytial bands arise rich in nuclei and give rise to young muscle fibres. The greater part of the muscle fibres is formed by superposition and confluence of the long spindle elements which have arisen from the sarcoplasts. The mode of nuclear divisions in muscle regeneration is mitotic and in the isolated sarcoplasts amitotic. In fishes regeneration sets in late, in the frog relatively early, in newt, tree-frog and turtle after a longer time. In extent it takes place very slightly in fishes, it goes further in the frog and tree-frog, but only in newts can it be regarded as anything like complete.

Observations on the Living Developing Nerve-fibre.§—Ross G. Harrison has been able to watch what takes place in the end of a growing nerve, and finds that the nerve-fibre develops by the outflowing of protoplasm from the central cells. The protoplasm retains its amœboid activity at its distal end, the result being that it is drawn out into a long thread, which becomes the axis cylinder. No other cells or living structures take part in the process.

The development of the nerve fibre is thus brought about by means of one of the very primitive properties of living protoplasm, amœboid

* Arch. Zool. Expér., vii. (1907) Notes et Revue, No. 4, pp. cxi.-xiv.
† Arch. Mikr. Anat., lxx. (1907) pp. 695–767 (4 pls.).
‡ Verh. Phys. Med. Gesell. Würzburg, xxxix. (1907) pp. 15–130 (1 pl.).
§ Amer. Journ. Anat., vii. (1907) pp. 116–18.

movement, which though probably common to some extent to all the cells of the embryo, is especially accentuated in the nerve-cells at this period of development.

One of his devices was to excise a piece of medullary cord about 4 or 5 segments long from an embryo frog, and to replace this by a cylindrical clot of blood or lymph of the proper length and calibre. No difficulty was experienced in healing the clot into the embryo in proper position. After 2 to 4 days the specimens were preserved and sectioned. It was found that the funicular fibres from the brain and anterior part of the cord, consisting of naked axones without sheath cells, had grown for a considerable distance into the clot.

Central Nervous System of Cyclostomes.* — G. Sterzi has published the first instalment of a treatise on the central nervous system of Vertebrates. He deals with *Petromyzon*, *Myxine*, and *Homea*, discussing exhaustively not only the nervous system, but the associated skeleton, membranes, and vessels.

c. General.

Sense of Touch in Mammals and Birds.†—W. Kidd has made a careful anatomical study of the palmar and plantar surfaces of a large number of mammals and of a few birds, with special reference to the presence and the pattern of the papillary ridges. He finds that the papillary ridges (which are found chiefly in Primates) are to be regarded as primarily tactile in function, and only secondarily as adaptations to prevent slipping. Thus they occur in places where they cannot possibly help in prehension, e.g. on the extensor surface of the terminal phalanges in *Lemur brunneus*. Further, the pattern is in many cases such that the ridges cannot possibly tend to prevent slipping, either in walking or prehension. The increasing complexity in pattern, which finds its climax in the terminal phalanges of the human hand, is to be regarded as an adaptation for increasing the delicacy of the touch. Whorls are a further development of loops and arches. The degree of development of the papillæ of the corium depends greatly upon the importance to the animal of the tactile sense ; thus lemurs have very highly developed papillæ, and so also have many birds, for whom maintenance of equilibrium is a daily necessity.

Hand and Foot in Hylobates agilis.‡—Duncan C. L. Fitzwilliams describes these with reference to form and function, indicating the differences between them and the hands and feet of man. In *Hylobates* the fingers are capable of flexion and adduction to the middle line, but have little tendency to oppose the thumb, and transverse and longitudinal creases are therefore met with. In man, opposition of the thumb to the fingers is one of the most prominent characteristics of the hand, and the creases, in consequence, are oblique. There is much

* Il sistema nervoso centrale dei Vertebrati. I. Ciclostomi (Padova, 1907) xiii. and 731 pp., 194 figs.
† The Sense of Touch in Mammals and Birds. London, 1907, 176 pp., 164 figs.
‡ Ann. Nat. Hist. cxvi. (1907) pp. 155–61.

less resemblance between a man's and a gibbon's foot than there is between their hands. In fact, the foot of the gibbon more closely resembles the human hand than the human foot.

Pattern of Cubs of Lions and Pumas.*—R. I. Pocock finds that the patterns of the cubs of lions and pumas are specific characters. These species usually described as uniformly coloured, were formerly marked as their cubs are marked, and in no other way. The pattern of lion cubs is intermediate between the spotted pattern of leopards or jaguars and the striped pattern of tigers. From this it may be inferred that leopards (including jaguars), lions, and tigers are nearly related one to another. On the assumption that spots preceded transverse stripes in evolution, it may also be inferred that the stripes of tigers originated from the fusion of rosettes into transverse chains, as Bonavia maintained. The pattern of puma cubs affords no support to the belief that pumas are nearly allied either to leopards or lions: it rather suggests that pumas may be regarded as large self-coloured representatives of one of the groups of smaller species of *Felis*, in the same way that lions may be regarded as large and otherwise modified representatives of a group exemplified by leopards.

African Mungooses.‡ — R. C. Wroughton supplies notes on the various known forms of the section of the Herpestinæ—usually known as the *Herpestes gracilis* group—which are small mungooses with a dark tail-tip, usually black, rarely brown. They vary in size and colour, and occur all over Africa. Four groups of species are recognised, and a diagnostic key is given to the sixteen forms which are distinguished.

Geographical Races of Lesser Horse-shoe Bat.‡—Knud Andersen adduces evidence to show that there are three distinct races of *Rhinolophus hipposiderus*. There is a small southern form (*Rh. h. minimus*) distributed, broadly speaking, over the Mediterranean sub-region, south-eastwards to Sennaar and Keren; a large northern form (*Rh. hipposiderus*) ranging from the extreme north-west Himalayas (Gilgit) through north-west Persia and Armenia, over the whole of central Europe, north of the Balkans and the Alps; and a form (*Rh. h. minutus*) apparently confined to England, Wales, and Ireland. Recently, M. Mottaz has suggested that the two Continental forms are not distinct races, but represent sexual differences only. This view is shown to be incorrect. An interesting point is that the author in an earlier contribution on this subject predicted the existence of intermediate forms in border districts, e.g. south-west Switzerland, and such forms he has now obtained from Geneva.

Enigmatical Tooth. —Maurice de Rothschild and Henry Neuville describe in great detail a peculiar tooth from East Africa. It bears some resemblance to the abnormal tusk of an elephant, but the authors cannot accept this interpretation. They conclude that it belonged to

* Ann. Nat. Hist., cxix. (1907) pp. 436–45 (2 pls.).
† Op. cit., cxvi. (1907) pp. 110–21.
‡ Op. cit., cxix. (1907) pp. 384–9.
§ Arch. Zool. Expér., vii. (1907) pp. 271–333 (3 pls. and 34 figs.).

some unknown large African mammal, recently extinct, or still represented by living specimens, and that this unknown animal was closely related to the Proboscidea. "*Semper aliquid novi ex Africa*," remains true.

Genital Organs of Bradypodidæ.*—Rémy Perrier describes these, with especial reference to the mode of fixation. In general, he concludes that the persistence of the testes in the abdominal cavity is primitive in Edentates and not a secondary return to an ancestral condition, and that the Edentates are not related to any other order of Placentals, but represent an independent stock dating from the early differentiation of the Placentals into orders.

Brain of Hatteria punctata.†—Julia Gisi has made a detailed study of the brain of this interesting reptile. In form and structure it closely resembles the Lacertilian brain. It is more primitive as regards the position and paired differentiation of the cerebellum, in the development of the cortical plates of the cerebrum, in the simple structure of the velum medullare anticum, and the slight thickening of the medulla.

The tracts of the nerve-fibres are in general like those in other reptiles, but there are some secondary and quantitative deviations from the Lacertilian type, e.g. as regards the commissura mollis and the stronger posterior commissure. Resemblances to Amphibians are seen in the origins of the 5th, 7th and 8th nerves, and in the independent course of the glosso-pharyngeal and the separated frontal vagus portion. But it must be noted that some of the peculiarities of form and proportion, which distinguish the brain of *Hatteria*, are expressions of growth-adjustments in correlation with the sense-organs and the like, and do not reveal much as to the systematic position of the animal.

A relatively primitive position is indicated by the rich development of the epithelial regions, such as the roof of the third ventricle. A median section shows that the thickening of the nervous regions of the brain is relatively slight, and the development of the glandular parts is highly specialised.

Notes on South African Chamæleons.‡—G. B. Longstaff and E. B. Poulton make some observations on colour change in several species of chamæleons. The suggestion is made that in *Chamæleon dilepis* there is a dry season hibernation during which the colours are steadfast. The most interesting point recorded is that when *C. pumilus* is subjected to unilateral illumination, the side in deep shadow assumes a brighter tint than that towards the light, which takes on a relatively dark colour. This has the effect of neutralising the shadow on the one side and toning down the high illumination of the other, so that all appearance of solidity is dissipated.

Anatomy of Heart in Frog and Turtle.§—J. Dogiel gives an account of the muscles and nerves of the heart in *Rana esculenta* and *Emys caspica*. In the frog auricles, ventricle and bulbus, the muscles

* Ann. Sci. Nat. (Zool.) v. (1907) pp. 1–37 (2 pls. and 6 figs.).
† Zool. Jahrb., xxv. (1907) pp. 71–236 (1 pl. and 21 figs.).
‡ Journ. Linn. Soc., xxx. (1907) pp. 45–8.
§ Arch. Mikr. Anat., lxx. (1907) pp. 780–97 (2 pls. and 11 figs.).

consist of reticulate bundles of different thicknesses united together, and all apparently consisting of cross-striped elements. The muscles of the sinus-forming veins are grouped in bundles running in various directions; these are smooth-muscle elements. Between the auricles and the ventricle is an intermediate zone in which neither cross-striped nor smooth-muscle fibres are to be found. Nerves and nerve-cells occur in the veins constituting the sinus, in the auricles, the ventricle, and near the bulbus, and further there is a well developed network on the upper surface of the bulbus. In the turtle the distribution is somewhat similar, but the majority of the nerve-cells occur in the region of the ligamentum atrio-ventriculare, where this ligament joins on the ventricular base and beside its origin in the auricles. The nerve-fibres run parallel to the muscle-fibres and sometimes penetrate deeply between bundles. The view is thereby suggested that a single nerve-fibre in its course innervates several muscle-fibres and excites them to contraction.

Production of Albinism and Melanism in Frogs.*—G. Tornier has experimented with larvæ of *Pelobates fuscus*, and finds that a minimum diet of flesh results in albino frogs, that a maximum produces melanism, and that reddish and greyish colours can be evoked at will by regulating the food-supply.

Fishes of Lake Baikal.†—L. S. Berg describes the skeleton of *Procottus jeittelsi* and other Cottidæ from Lake Baikal, and discusses the osteology of Cottocomephoridæ and Comephoridæ. He gives a synopsis of these three families of Baikal Cataphracti and discusses the systematic position of the various types. A list is given of all the fishes known to occur in the lake, 34 in all. Of these there are 17 which are general in Siberian fresh waters, and 17 which are endemic. The endemic species may be divided into two sets, (*a*) those which are nearly related to species widely distributed in Siberia (*Salmo alpinus erythrinus*, *Coregonus migratorius*, *Thymallus arcticus baicalensis*, *Cottus kneri* and *C. kessleri*); (*b*) those which are quite unique (the sub-family Abyssocottini, the family Cottocomephoridæ, and the family Comephoridæ). There are no forms in the Siberian waters, nor in the Arctic Ocean, nor in the Pacific, which come near to these; thus the absence of a post-clavicle in the Baikal Cataphracti is distinctive. These peculiar forms live at greater depths than any other fresh-water fishes, for they descend to depths of 1600 metres. They are not, the author maintains, relicts of previous geological periods, nor immigrants from the Arctic or the Pacific Ocean, they are *sui generis*, and have arisen as such in Lake Baikal during its long geological history. They are very ancient forms, very divergent from typical Cottidæ, and their resemblances to marine forms are due to convergence.

Buccal Incubation in Arius fissus.‡—C. and V. J. Pellegrin communicate some very interesting facts in connection with the care of the young in this species from the coast of French Guiana, which may be

* Zool. Anzeig., xxxii. (1907) pp. 284–8.

† Zoolog. Untersuch. am Baikal-See, Lief. iii. (St. Petersburg and Berlin, 1907) 75 pp. (5 pls. and 15 figs.).

‡ Comptes Rendus, cxlv. (1907) pp. 350–2.

briefly summarised. In the female the eggs are to be found in three different stages of development; the number ripening at one time is about twenty. The male takes these in his mouth, where they remain until after hatching, until, in fact, the yolk sac is absorbed. During the whole of this incubation period the male is condemned to fasting.

Food of Plaice and Dabs.* — James Johnstone, as the result of the examination of the stomachs of 114 plaice and 146 dabs caught in the same hauls, has made out an interesting contrast in the matter of their feeding. The dab is an omnivorous feeder, taking anything on the sea bottom from a sprat to a zoophyte, but nevertheless indicating a preference for particular food-animals such as Ophiuroids, crabs, and Lamellibranchs. In the case of the plaice, by far the commonest food-animals appear to be Lamellibranchmolluscs, e.g. *Solen*. Next in importance come the Polychæte worms, which very seldom afford an exclusive food for the plaice, but are nearly always associated with Lamellibranchs. Both errant and tubicolous forms are eaten. Ophiuroids afford a very exceptional food. In the consideration of the commoner food-animals eaten by each species there is a probable explanation of the ubiquity of the dab as compared with the plaice. Some interesting comments are made on the relation of the food supplies to the migrations of fishes.

Teleostean Abnormalities.†—James Johnstone describes an hermaphrodite hake from the West of Ireland. Both ovaries are present and apparently normal, but at the posterior end of each is a testis, which is well developed and larger than the ovary to which it is attached. At the place of union the lumina of the ovaries are continuous with those of the proximal part of the testes. The probability is that the fish was a functional male. The same paper contains an account of a *Trigla gurnardus* with an abnormal lower jaw. The mouth is reduced to a small crescentic slit, and both jaws are quite immovable. The chief modification of the skull consists in the dwarfing of the bones of the lower jaw. There is no apparent angulare, but this is perhaps ossified with the articulare. This element is greatly altered in form, having its long axis dorsiventral. The lower jaw proper consists of an apparently single bone, which is a flat hoop forming the lower margin of the gape. It is probably due to the fused and completely ossified Meckelian cartilages.

Œsophageal Pouches in Centrolophus niger Gmelin.‡ — John Rennie in a note on the function of these structures records the fact that in a specimen found off the north-east coast of Scotland they were "filled with a soft, creamy, pulpy substance, similar to the contents of the stomach and pyloric cæca," but in a less advanced stage of digestion. He suggests that those fishes possessing such pouches, Stromateidæ and Tetragonuridæ, may regurgitate their food; "and as these pouches are so very thoroughly supplied with spines, it seems possible that some sort of rumination is indulged in."

* Proc. and Trans. Liverpool Biol. Soc., xxi. (1907) pp. 316–27 (2 charts).
† Tom. cit., pp. 309–14 (3 figs.).
‡ Ann. Scot. Nat. Hist., No. 64 (1907) pp. 216–18.

Fish Vertebræ as Prehistoric Amulets.*—Angelo Mosso gives an account of prehistoric amulets (in the museum of the island Virginia in Lake Varese) which consist of the vertebræ of the pike and of a shark.

Nervous Lobe of the Hypophysis and the Vascular Sac.§ — L. Gentes points out that the vascular sac or infundibular gland is independent of the nervous lobe of the hypophysis. They are adjacent dependencies of the wall of the infundibulum, but they are not homologous. They co-exist in most Teleosteans, but in Selachians the infundibular gland is seen isolated, and in most Vertebrates above fishes the nervous lobe is seen isolated. In Cyclostomes both are absent.

Tunicata.

Gill-slit Formation in Ascidians.‡—Paul Fechner describes this in *Ecteinascidia*, *Styelopsis*, *Polycyclus*, and *Pyrosoma*. There appear to be two modes of development in Ascidians. In one the new spiracula (Kiemenspalten) arise throughout independently of those already present. In the other the definite spiracula descend from a few primary slits, from which they arise by division and splitting. After a stage with two pairs of stigmata, there occurs a quickly passing stage with three pairs (which in the later literature are characterised as primary protostigmata), and which become very long cross slits, taking up the whole breadth of the pharynx. From the division of each of the primary protostigmata there arise six transverse slits — the secondary protostigmata (primary stigmata of van Beneden). By repeated division perpendicular to their length the six first transverse rows of slits arise, each having 12 to 18 spiracula.

Ascidians of Californian Coast.§—W. E. Ritter gives an account of the off-shore Ascidians of the Californian region. Fourteen species are described ; the depths, geographical position, and other data as to habitat are given. Of 263 stations occupied by the 'Albatross' from March to June, 1904, only 16 yielded Ascidians. The data obtained are rather scanty to admit of generalisations, but indications in two directions are rather strong. The off-shore Ascidian fauna is considerably richer south than north of Point Conception, so far as concerns the areas worked over, and the deep water along and just beyond the continental shelf is more prolific of this form of animal life than is the shallower in-shore water. Twelve of the species described are new.

Homologies of the Muscles of Cyclosalpa.‖—W. K. Brooks communicates a note on the musculature of this sub-genus of *Salpa*. While there is much specialisation among the muscles of the various species, there is a very complete series joining the simplest and least specialised form, the solitary *S. pinnata*, to the most specialised one, the aggregated

* Atti R. Accad. Sci. Torino, xlii. (1907) pp. 1162–5 (1 pl.).
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 499–501.
‡ Zeitschr. Wiss. Zool., lxxxvi. (1907) pp. 523–56 (2 pls. and 2 figs.).
§ Univ. California Publications, iv. No. 1 (1907) pp. 1–52 (3 pls.).
‖ Johns Hopkins Univ. Circular, No. 3 (1907) pp. 173–4.

S. floridana. The first six muscles are much alike in all the solitary and in all the aggregated forms. The rest of the muscles, from muscle 7 to muscle 16 are no doubt homologous in a general way, but it is impossible to follow out the homology in detail. The solitary forms are more like each other in respect to these muscles than are the aggregated forms.

Structure of Salpa.*—Miguel Fernandez describes in young chains of *Salpa africana-maxima* a papilla-like organ with a ridged surface, which projects from the pharynx into the mantle, on the dorsal surface between the ganglion and the anterior attaching disk. It is larger in proportion to the youth of the chain, and it disappears in the adult. It consists of connective-tissue with inclosed cavities, and is traversed by nerves from the ganglion. Its import is quite obscure. A similar organ occurs under the anterior end of the endostyle, at a short distance from its end. and rather to one side.

INVERTEBRATA.

Nitrogen Metabolism in Marine Invertebrates.*—Luigi Sanzo has investigated this subject. He finds in the blood, tissues, and perivisceral fluid of marine Invertebrates a substance (yielding nitrogen with sodium hypobromite) which serves for the preparation of urea from the blood and tissues of Vertebrates. This substance gives all the characteristic reactions of urea, so that until the contrary is proved it may be regarded as identical. In the Mollusca and Crustacea investigated this substance is more abundant in the liver than in the muscles, and in these more so than in the perivisceral fluid; it is three times more abundant in the liver of *Sepia* than in the same organ of *Aplysia.* This may be correlated with the feeding, as *Sepia* feeds on marine animals and *Aplysia* on algæ. In Echinoderms the percentage content is very slight, and is three times as great in the Echinoidea as in the Holothuroidea.

Identification of Chitin by its Physical Constants.* — Igerna B. J. Sollas points out that the chemical identification of chitin by its characteristic decomposition product, the amido-derivative of sugar known as chitosamin, is often inapplicable because of the small amount available. She has therefore tried to find a method of identifying chitin by determining its physical constants. The specific gravity of chitin from various sources approximates to the value 1·398, a number which represents the specific gravity of chitin precipitated from its solution in strong acid. The refractive index lies between the limits 1·550 and 1·557.

The bristles of *Lumbricus*, the pupal skin of *Pieris* and other Lepidoptera, the radula of Mollusca, and the shell of *Sepia*, when freed from mineral matter and easily soluble organic substances, have specific gravities and refractive indices which lie between the same limits as those of chitin from various sources.

* Zool. Anzeig., xxxii. (1907) pp. 321–8 (6 figs.).
† Biol. Centralbl., xxvii. (1907) pp. 479–91.
‡ Proc. Roy. Soc. London, Series B, lxxix. (1907) pp. 474–81.

Mollusca.

Latent Segmentation in Molluscs.*—Werner Marchand finds hints of latent metamerism in the four gills of *Nautilus*, in the four gonads of some bivalves (such as *Poromya*), in the cœlom pouches, and so on, and infers that the ancestral molluscs had at least three segments—a head segment and two gonadial segments, with separate ducts. He favours Günther's suggestion that Chætognatha are related to the ancestral stock from which Molluscs arose, and concludes by maintaining (what his paper at least can hardly be said to warrant) that "we have every reason for speaking of a latent segmentation in molluscs."

α. Cephalopoda.

Hectocotylisation and Luminosity in Cuttlefishes.† — W. E. Hoyle, in his Presidential Address to the Zoological Section of the British Association, discusses some questions suggested by the study of Cephalopods. Attention is first directed to hectocotylisation, and a useful list of genera is given showing the position of the hectocotylised arm or arms, where this peculiar modification occurs. In this connection he discusses the systematic value of this character, for in every family (with one exception, Sepiolidæ) the position of the hectocotylised arm is constant within the limits of the family. The position of *Spirula* forms the next subject of inquiry. It is regarded as the representative of a distinct family, and it is not unlikely that it may one day become the type of a division co-equal with Myopsida and Œgopsida. The genera *Idiosepius*, *Sepiadarium*, and *Sepioloidea* are then discussed. It is concluded that the position of the hectocotylised arm is not by itself a sufficient guide to the systematic position of doubtful forms.

After discussing Jaeckel's view that the *Orthoceras* type was firmly attached, and that Belemnites were anchored in the mud, the author proceeds to the luminous organs. These have now been observed in 29 out of about 70 genera of Decapods, and have been found to present a most interesting variety in position and structure. A valuable list is given of the luminous Cephalopods, with bibliographical references, and with notes on the position of the organ, which may occur in nine different situations. It may be noted that the luminous organs are practically confined to the ventral surface of the animal. Another remarkable fact is the existence of organs concealed beneath the mantle and beneath the integument covering the eyeball, which can only be effective by reason of the transparency of the tissues in the living creature. The organs may be glandular or non-glandular, and the latter may be simple, without special optical apparatus, or complex, with more or fewer of the following structures: pigment layer, reflector, lens, and diaphragm. These organs occur in so many and such scattered families that their origin must be polyphyletic. Even in the same species they are not all on the same plan. It is plausible to suppose that they serve as recognition marks, and that they act as searchlights playing over the ground. The production of the light is a phenomenon

* Biol. Centralbl., xxvii. (1907) pp. 721–8.
† Rep. Brit. Assoc., 1907, 20 pp.

parallel to the production of heat in a contracting muscle, or of electric discharges in the *Torpedo*. Very noteworthy is the remarkable economy of the illuminant; a perfectly infinitesimal proportion of the energy expended is wasted on the production of heat.

Liver of Cuttlefishes.*—L. Cuénot finds that the liver includes, apart from indifferent replacement-cells, two types:—(1) Goblet safranophilous cells with fat globules (often inclosing a yellow magma with crystals); and (2) vacuolar cells. The vacuoles and the magmas are periodically ejected. The vacuolar cells are proved by experiment to be excretory, and they also arrest pigments added to the food. Thus the liver is an absorbing organ—the chief absorbing organ, as in other Invertebrates. In the spiral cæcum fats are absorbed, but nothing else.

Octopus with Branching Arms.†—Edgar A. Smith gives a description of a Cephalopod from Japan, in which five of the eight arms branch more than once, and that irregularly. Such forking appears to be of rare occurrence. The species is that described as *Polypus cephea* Gray, from a single specimen, now in the British Museum.

New Cephalopods from the Irish Coast.‡—A. L. Massy describes *Polypus profundicula* sp. n., which appears to be very nearly allied to *Octopus ergasticus* Fischer, particularly in the form of the hectocotylised arm; *P. normani* sp. n., a graceful form taken at 710 fathoms; and *Helicocranchia pfefferi* g. et sp. n., a minute form with large, oval, pedunculate fins attached to the end of the dorsal surface, and with an extremely large siphon. The occurrence of several other forms not hitherto recorded for British and Irish waters is noted.

γ. Gastropoda.

Reproduction in Snails.§—J. Meisenheimer has made an elaborate study of the bionomics of pairing in *Helix pomatia*. To procure material he kept snails in a terrarium, and was able to witness the process fifty times, and to secure many interesting photographs and preparations. Pairing takes place in May and June, reaching its maximum frequency in the first half of June. Snails in search of mates may be seen to creep slowly about, feeling from side to side, with the forepart of the body slightly raised, and to remain rigid for short periods in that attitude. When two such snails meet, they raise themselves up so that almost the whole base of the foot is apposed, only the hinder part of it and the shell supporting the animal on the ground. This is the characteristic attitude, which is maintained throughout the whole process. Breathing is rapid, undulatory movements pass through the foot continually, mouth-papilæ and horns are in a state of constant activity, and the whole organism betrays signs of excitement. This preparatory stage is short, and both snails sink downwards in apparent exhaustion. After a pause of about half-an-hour, excitement again becomes manifest, and the movements recommence. One snail usually shows more activity

* Arch. Zool. Expér., vii. (1907) pp. 227–45 (1 fig.).
† Ann. Nat. Hist., cxix., (1907) pp. 407–10.
‡ Tom. cit., pp. 377–84.
§ Zool. Jahrb., xxv. (1907) pp. 461–502 (3 pls., 4 figs.).

than the other, the genital region becomes visible as a whitish spot with the female opening clearly marked, and, after a series of convulsive movements, the *spiculum amoris* is ejected with a final exhausting effort. It was once observed that both snails discharged their darts simultaneously, and this is said to be normal in *H. nemoralis*. The dart usually penetrates the margin of the foot, and the immediate effect of it is to cause increased excitement in the other snail, ending usually in the expulsion of its dart also. This phase may last for a couple of hours, and is followed by a long resting period. In the final stage the position and movements are similar, the genital tract is again prominent, and both male and female apertures are clearly visible. Many unsuccessful attempts may be made before the proper relative position, and the simultaneous extrusion of the organs have been attained, and the spermatophore of each snail is safely deposited in the receptaculum of the other. Slowly the snails disengage themselves, the genital region is retracted, the head slightly drawn in, but the undulatory movements of the foot continue, and the snails remain together for two or three hours until the terminal threads of the spermatophores, which still connect the two, are entirely drawn in. During the whole process the snails are quite indifferent to external circumstances. Moving them about, or turning a strong light upon them did not distract them in the least. It occasionally happened that three snails met together and united in the most manifold combinations. Which two ultimately succeeded in pairing depended simply on the chances of position ; there was no hint of anything like selection.

Some time later the snail hollows out a passage leading down to a roomy chamber in the ground, and, hanging head downwards through this passage, drops the eggs one by one on the floor of the chamber, smooths over the top of their hiding-place, and leaves them to develop.

The second part of the paper deals with the morphology and physiology of the reproductive organs. The histology of the dart-sac and the mucous glands, and their relation to each other are described in detail. The extrusion of the dart is preceded by the outpouring of a considerable quantity of fluid from the glands. The author differs from v. Ihering and others in that he regards this fluid merely as a lubricant which facilitates the expulsion of the dart, and possibly also the entrance of the penis into the vagina. The spermatophore is an exact cast of the relevant male organs, due to the solidifying of the secretion of the flagellum, which is poured out just before and during the passage of the sperms from the vas deferens. The thick head part with its longitudinal ridges represents the anterior part of the penis, while the terminal thread corresponds exactly to the lumen of the flagellum itself. The spermatophore is formed just before and during copulation. The observer did not succeed in actually tracing the course of the spermatozoa to the upper end of the oviduct, where, within a diverticulum—the "fertilisation-sac"—the eggs are fertilised. He found numerous spermatozoa within the hermaphrodite duct, and these were in no way distinguishable from those—presumably from another animal—in the fertilisation-sac itself. The question as to their relative immaturity, as suggested by Perez, was not investigated.

In regard to the development of the ovum, an interesting point is the growth after fertilisation of little papillæ on the surface of the egg, to form a complete spiny covering, which degenerates again and is cast off within the oviduct. These spiny processes have been described as "pseudopod-like," and as being retracted later, but the author regards them as a protection against multiple fertilisation, and suggests that the fact that it takes this form instead of that of a mere skin-thickening may be due to "phylogenetic reminiscence."

In addition to a beautiful series of photographs showing the successive stages in the process of pairing, the paper is illustrated with drawings of all the internal parts, in all phases of rest and activity, extrusion and retraction. These were obtained by killing and immediately fixing snails in process of copulation.

Origin of the Nematocysts of Eolidiæ.*—L. Cuénot gives strong reasons for concluding that the nematocysts of the cnidophore-sacs of Eolids do not really belong to these animals. They are not made by the cells which contain them. They come from the Cœlentera on which the Nudibranchs feed.

He argues that the nematocysts pass intact through the digestive tract and enter the hepatic diverticula of the papillæ ; they reach the cnidophore-sacs and enter the "nematophagous" cells, where they are arranged so that the end by which discharge is effected is turned towards the free surface of the cell.

Cuénot removed the cnidophore-sacs from some Eolids, fed some with a species of sea-anemone, and left the others fasting. In both cases the sacs were rapidly regenerated, growing in the same way as in normal development. The well-nourished Eolids had their nematophagous cells equipped with the nematocysts of the sea-anemone, but the fasting Eolids showed no nematocysts.

Eolids do not seem to profit much by their borrowed nematocysts, which are rendered less effective by their position within an internal sac. It is true that some fishes seem to regard Eolids as unpalatable, but it does not appear that this is because of the nematocysts.

Development of Fulgur.†—E. G. Conklin gives an account of the development of *Fulgur*, devoting particular attention to the influence of the large mass of yolk. The cleavage of the egg of *Fulgur* is, cell for cell, like that of *Crepidula* up to the 56–60 cell stage, the only difference being in the relative sizes of the macromeres in these two genera. In later cleavages many more ectoderm-cells are formed in *Fulgur* than in *Crepidula*. The overgrowth of the yolk is very peculiar. By very great extension of the anterior half of the blastoderm, while the posterior half remains relatively fixed, all the organ bases are carried to the posterior margin of the blastoderm, where they form a kind of germ-ring. Subsequently the posterior margin also moves over the yolk, so that the blastopore is finally formed at the vegetal pole.

Before the extension of the anterior portion of the blastoderm an apical invagination of ectoderm cells is formed, which eventually dis-

* Arch. Zool. Expér., vi. (1907) pp. 73–102 (1 pl., 4 figs.).
† Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 320–59 (6 pls.).

appears. The cerebral ganglia arise on each side of the apical invagination. The velar cells arise around the outer margins of the ganglia. By the rapid growth of the anterior portion of the blastoderm these organ bases are forced far apart and posteriorly until they come to lie in the posterior margin of the blastoderm, and by a continuation of the movement they are carried around to the ventral side of the embryo, where the two halves of the organs approach each other and finally unite in front of the mouth. The buccal ganglia have a somewhat similar history.

All other organs arise from the median posterior portion of the blastoderm, and chiefly, if not entirely, from two "somatoblasts," strikingly like the origin of post-oral organs in Annelids.

All homologous organs arise from corresponding cleavage-cells in *Fulgur* and *Crepidula*, and probably all other Gastropods. Great increase of yolk does not modify the type of germinal localisation, though it profoundly affects gastrulation and later stages.

Structure of Californian Haliotidæ.*—Clayton F. Palmer describes the structure of *Haliotis rufescens* and *H. cracherodii*, devoting especial attention to the kidneys, the two reno-pericardial canals, the circulation, and the nervous system.

Development of Lung in Ampullaria depressa.†—B. McGlone finds that the lung is a secondarily derived structure, arising as an invagination of what would become a gill filament. The osphradium is similarly a modified gill, and may be the homologue of a gill situated on the left side.

Structure and Relationships of Oncidium.‡—W. Stantschinsky gives an account of three new species of *Oncidium* from Queensland, and discusses the systematic relationships of the members of this genus. He finds that the sub-genus *Oncis* includes more primitive types, but annectent forms unify the whole genus. The absence of dorsal eyes in the species of *Oncidium* is due to secondary degeneration. Most of the Oncidiidæ are amphibious, sometimes living in the sea, sometimes on the beach; but some species seem to have left the water altogether, and illustrate the influence of isolation in species-forming.

δ. Lamellibranchiata.

Supplementary Siphon in Lutraria elliptica.§—R. Anthony describes a curious abnormality in this common bivalve, namely, the occurrence of an extra siphon, arising apparently as a bud from the dorsal wall of the expiratory siphon. A section shows an external epithelium, a layer of circular muscle-fibres, a layer of longitudinal muscle-fibres, a second layer of circular muscle-fibres, a second layer of longitudinal muscle-fibres, a third layer of circular muscle-fibres, an internal epithelium, and a narrow central cavity. In other words, it has the normal structure of a siphon, but it ends blindly.

* Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 396–407 (1 pl. and 4 figs.).
† Johns Hopkins Univ. Circular, No. 3 (1907) pp. 176–9 (2 pls.).
‡ Zool. Jahrb., xxv. (1907) pp. 353–402 (2 pls. and 3 figs.).
§ Arch. Zool. Expér, vii. (1907) Notes et Revue, No. 3, pp. lxxxviii.–xcii. (5 figs.)

Arthropoda.

Arthropoda of British Coal Measures.*—Henry Woodward describes two king-crabs, *Bellinurus baldwini* sp. n. and *B. longicaudatus* sp. n.; a scorpion, *Eoscorpius* (*Mazonia*) *wardingleyi* sp. n.: *Geralinura sutcliffei* sp. n.; and discusses a representative of *Anthracomartus* Karsch.

a. Insecta.

Injurious Insects in Ireland.†—George H. Carpenter reports on injurious insects observed in 1906: such as the sheep-louse (*Trichodectes sphærocephalus*), in regard to which he recommends a second dipping ten days after the first; the long-horned barley-fly (*Elachyptera cornuta*); the root-gall weevil (*Ceuthorhynchus pleurostigma*); the cabbage-stem-borer (*Psylliodes chrysocephala*); the mussel scale-insect (*Mytilaspis pomorum*); the pine bark-beetle (*Hylurgus piniperda*); the willow-beetle (*Phyllodecta vulgatissima*).

Larch Shoot Moth.‡—R. Stewart MacDougall notes the occurrence in Oxfordshire of *Argyresthia* (*Tinea*) *lævigatella*, which has not yet found a place on British lists. It attacks young larches, and a single caterpillar can destroy a whole shoot. An account is given of the larvæ, pupæ, and adults, and of the life-history in general. The treatment suggested is to break off the affected shoots and destroy them before the escape of the moths.

Grain Weevils.§—R. Stewart MacDougall discusses the external appearance, life-history, and practical importance of *Calandra granaria* and *C. oryzæ*. The females lay one egg in each grain. The grub on hatching feeds on the contents of the grain, and when full fed pupates in the eaten-out husk. In favourable conditions the whole life-cycle can be completed in a month. The *Calandra* weevils feign death on being touched or shaken. They lie often for a considerable time refusing to show any signs of life, though handled. Movement may be induced by breathing on them. As remedial measures, fumigation with bisulphide of carbon, sieving or screening the grain, and ventilating are suggested.

Life-history of Apanteles glomeratus.||—R. Matheson gives an account of the life-history of *Apanteles glomeratus*, a parasite on the caterpillars of the cabbage butterfly. Mating takes place ten or twelve hours after emergence from the cocoon, and the females immediately go in search of their hosts. The eggs are deposited just beneath the epidermis of the latero-ventral region of the earlier stages of the *Pieris* larvæ, so that they are not affected by the moult. The eggs hatch in three or four days, and the larvæ feed on the lymph and fatty tissue of their hosts, avoiding the vital parts. They become mature during the larval life of their hosts and cut their way out through the skin. In

* Geol. Mag., iv. (1907) pp. 539–49 (5 figs.).
† Economic Proc. Roy. Dublin Soc., i. (1907) pp. 421–52 (6 pls., 11 figs.).
‡ Journ. Board Agric., xiv. (1907) pp. 395–9 (3 figs.).
§ Tom. cit., pp. 412–15 (1 fig.).
|| Canadian Entomologist, 1907, pp. 205–7.

summer 50 p.c. and in autumn 60–75 p.c. of the *Pieris* larvæ examined were infested with this parasite, which has therefore considerable economic importance.

Alleged Fixation of Carbon by Chrysalids.*—R. Dubois and E. Couvreur refer to Marie von Linden's conclusion that some chrysalids can utilise carbon dioxide, fixing the carbon. The authors have repeated the experiment with *Pieris brassicæ*, but without any success.

Marie von Linden† responds that there is no doubt that the chrysalids of *Papilio podalirius* and of *Hylophila prasinana* become heavier in an atmosphere rich in carbon dioxide, while they become lighter in atmospheric air. What is true of these need not be true of *Pieris brassicæ*, but it may be that Dubois and Couvreur worked with too dry an atmosphere. The assimilation of CO_2 requires humidity.

Chromosomes in Spermatogenesis of Anasa Tristes.‡—Katharine Foot and E. C. Strobell find that there are 22 spermatogonial chromosomes: that none of these retain their morphological individuality throughout the growth period; that in the early prophase the so-called odd (heterotropic) chromosome of Wilson and Montgomery (i.e. the eccentric chromosome of the later prophases, or metaphase) resembles in no way a nucleolus, and is morphologically wholly unlike the same chromosome figured by Wilson at this stage: that the 11 chromosomes of the first spindle are all bivalents, and that the 11 chromosomes of the second spindle are all univalents; that in both the first and second spindles one chromosome—which is believed to be the eccentric chromosome of the late first prophase—often lags in division, but that normally its final division occurs in both spindles

How Ants Find their Nest.§—H. Piéron points out that there is considerable variety in different species. In *Formica fusca*, *F. cinerea*, *F. rufibarbis*, *Camponotus pubescens*, etc., the orientation is predominantly visual: in *Aphænogaster barbara*, *A. testaceo-pilosa*, etc., which are very blind, the orientation is mainly muscular; in *Lasius flavus* and *L. fuliginosus* it is mainly olfactory. The first method admits of orientation from the greatest distance, the muscular method is only for short distances. There is most frequently a combination of methods. The olfactory method is relatively rare and never exclusively followed.

Psychobiology of Humble Bees.‖—Wladimir Wagner gives an account of the pyschobiology of humble bees, in which he deals with the social instincts predominating at different periods of the life-history. He concludes that the common life of the so-called "social insects" represents neither a family, nor a herd, nor a society, and still less a state unity. The study of various forms of biological organisation in the animal kingdom shows absolutely no connection between the life of social insects and true sociality. It represents a special form of sym-

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 219–20.
† Tom. cit., pp. 428–9.
‡ Amer. Journ. Anat., vii. (1907) pp. 279–316 (3 pls. and 4 figs.).
§ C.R. Soc. Biol. Paris, lxii. (1907) pp. 216–17.
‖ Zoologica, xix. (1907) heft 46, p. 1–239 (86 figs.).

biosis of a clearly indicated parasitic character: it lies quite apart from the evolution of sociality in the animal kingdom, with the various stages of which (assemblies, aggregations, herds, etc.) it has nothing in common.

Tunisian Ants.*—F. Santschi confirms the reality of the aberrant genus *Leptanilla*, of which he has obtained three new species, represented by males. They are probably the smallest male ants, yet they are allied to the Dorylinæ, in which some of the males (*Dorylus*) are peculiarly large. Santschi also reports some new and interesting cases of ergatomorphism.

Solitary Wasps.†—G. Adlerz gives an account of a large number of solitary wasps belonging to such genera as *Eumenes*, *Hoplomerus*, *Lionotus*, *Ancistroceros*, and *Odynerus*.

Forms of the Female of Papilio dardanus.‡—Chr. Aurivillius describes some new forms of the very interesting polymorphic female of *Papilio dardanus* Brown, and takes a survey of previously recorded forms.

Termitophilous Tineid Larva.§—Ivar Trägårdh describes a Tineid larva from nests of *Rhinotermes* in Zululand. The relations between the larvæ and the termites are evidently of a friendly nature. When disturbed, the larvæ were seen to make their way to other parts of the nest, coming along one after the other, at regular intervals, as in a procession, each larva being escorted by a few soldiers and workers. The larvæ depend upon the material of the nest for food. It seems that the lateral abdominal appendages of the larva function as exudation organs, emitting a strong odour which is attractive to the termites.

As appendages, which appear to be homologous, occur in other Lepidopterous larvæ, where their function, when known, is stated to be defensive, it is not probable that the Tineid larva has acquired them independently as an adaptation to its termitophilous life. It is more likely that their function has changed from being repulsive to being alluring organs.

Hibernation of Marasmarcha.‖—T. A. Chapman finds that in this Plume Moth the newly-hatched larvæ hibernate without feeding. Furthermore, without eating they are able to afford to secrete silk and spin a cocoon. The author does not know of any similar case among Lepidoptera. After prolonged search he found the cocoons in the sand surrounded by minute aggregations of sand particles. The larvæ of *Marasmarcha* (*phæodactyla*, *fauna*, *tuttidactyla*), always occur on plants that form a considerable mass, and it seems likely that the young larvæ form their hibernating cocoons amongst the dead leaves and other material of the plant close to the ground, and not on the plant itself, but have, owing to the density of the plant, little difficulty in finding a growing point when they come out in the spring.

* Rev. Suisse Zool., xv. (1907) p. 305–34 (7 figs.).
† Arkiv Zool., iii. (1907) No. 17, pp. 1–64.
‡ Tom. cit., No. 23, pp. 1–7 (2 pls.).
§ Tom. cit., No. 22, pp. 1–7 (1 pl.)
‖ Trans. Entomol. Soc. London, 1907, pp. 411–14 (1 pl.)

Life-history of Cydemon (Urania) leilus.* — L. Guppy, jun., has studied the life-history of this moth in Trinidad. The spherical eggs with longitudinal ribs are laid on the undersides of leaves, usually singly or in pairs; the larvæ, with sixteen legs, are particularly active and spring madly about when touched; after the first moult eight long black hairs appear on the body, and these increase in number with successive moults; the yellowish-brown glossy pupa lies inside a roomy cocoon of yellowish-red silk; the transformations occupy nearly six weeks, of which two are in the pupa stage. The larvæ usually feed from the underside of a leaf; when alarmed they drop immediately by a silken thread and remain suspended until the alarm is over; in locomotion they often lower themselves in a similar way. The haunts of the moth are probably in the forests of Venezuela, whence it migrates annually to Trinidad.

Human Myiasis due to Œstrus Ovis.† —Edmond and Etienne Sergent give an account of a human myiasis very common in some mountainous parts of Algeria, where there are fewer sheep than men. The disease is called "Thim'ni," and it is due to the larvæ of the sheep bot-fly which live in the facial cavities, producing painful and serious inflammation.

Migrations of Hypoderma Bovis Larva in Ox.‡—H. Jost gives a remarkable account of the wanderings of the larva of this fly in the tissues of the ox in the course of its development. The eggs, laid upon the skin, are licked off and enter the alimentary canal. About the junction of the gullet and stomach the young larvæ are hatched. They penetrate into the submucosa of the gullet, wandering here in abundance during several months (July to November). They then migrate by way of the diaphragm, kidneys, intermuscular connective tissue of the lumbar muscles, vessels, and nerve strands to the vertebræ, passing into the vertebral canal, where they stay usually between December and May. Subsequently the larvæ wander through between the vertebræ and pass by way of the intermuscular connective-tissue of the back muscles to the subcutis, which is to be regarded as the last chief place of their assembling. They occur here from January up till July. The "bots" are pathological new formations of connective tissue, and the lining of the exit channel arises by a proliferation of the epidermis cells.

Viviparity in Ephemeridæ.§—Carl Bernhard has investigated this subject, with particular reference to *Chloëon dipterum*. Amongst other results he has arrived at are the following general conclusions. An Ephemerid is *oviparous* (1) when in each oviduct several eggs are formed in succession (polyoistic), which then after each other enter the calyx partly during the nymphal and subimaginal life; (2) when the eggs are enveloped in a strong chitinous chorion. An Ephemerid is *viviparous*

* Trans. Entomol. Soc., pp. 405–10 (2 pls.).
† Ann. Inst. Pasteur, xxi. (1907) pp. 392–9.
‡ Zeitschr. Wiss. Zool., lxxxvi. (1907) pp. 644–715 (1 pl. and 3 figs.).
§ Biol. Centralbl., xxvii. (1907) pp. 467–79.

(1) when in each oviduct only one egg is formed (monoistic), which is first observed in the calyx in the imago; (2) when the eggs are surrounded by a thin, soft, and non-chitinous chorion. The author shows that these characters are related to the different modes of reproduction. It appears that the larvæ of no other Ephemerid are so widely distributed nor so numerous as those of *Chloëon dipterum*, in spite of the smaller number of eggs in this species. This would seem to indicate that here a smaller number succumb during development than in oviparous species.

Autotomy in Orthoptera.*—H. Piéron describes protective reflex autotomy in *Mantis religiosa*, *Empusa egena*, *Gryllus campestris*, *Nemobius silvestris*, various Locustidæ and Acrididæ, and *Forficula auricularia*.

Excretion in Apterygota.†—Jur. Philiptschenko deals with the excretory and phagocytary organ of *Ctenolepisma lineata* F. as a contribution to the study of this subject. This species possesses three kinds of excretory structures, viz., the urinary cells of the fat body, the Malpighian vessels and pericardial cells, and a peculiar phagocytary organ, the pericardial septum. In this respect this insect approaches those Orthoptera which possess a permanent phagocytary organ, but between the two types there is nevertheless a whole series of far-reaching differences.

β. Onychophora.

Monograph on Onychophora.‡—E. L. Bouvier continues his monographic account of the Onychophora, the present instalment beginning the description of the family Peripatopsidæ, which includes the three sub-families Peripatoidinæ, Peripatopsinæ, and Paraperipatinæ.

δ. Arachnida.

Eyes of Scorpions.§—G. Police has made an elaborate study of these, and denies the alleged dimorphism of the lateral and median eyes. The former have been compared to simple eyes and the latter to compound eyes. But they develop in the same way and have the same essential structure. They represent a distinct type of eye. As regards their development and their single lens they may be compared to ocelli, but as regards the structure of the retinal elements (different from that of the simple eyes of spiders, crustaceans, and insects) and the arrangement of these, they approach the compound type.

In the simple eyes found in most Arachnids, and in many crustaceans and insects, the retinal unit is represented by a single cell, of which the distal part is unpigmented.

In the compound eyes of most crustaceans and insects, the retinal unit is a group of six cells (retinule) arranged around an axis. In these eyes the image, before reaching the retinule, traverses the cuticular

* C.R. Soc. Biol. Paris, lxiii. (1907) pp. 463–5.
† Zeitschr. Wiss. Zool., lxxxviii. (1907) pp. 99–116 (1 pl.).
‡ Ann. Sci. Nat. (Zool.) v. (1907) pp. 61–80 (8 figs.).
§ Zool. Jahrb., xxv. (1907) pp. 1–70 (2 pls. and 3 figs.).

refractive medium (the crystalline cone), and each unit is impressed by an image.

In the eyes of scorpions, the retinal unit is represented by a group of five cells, there is no crystalline cone, the image is refracted only by the cuticular crystalline structure, and there is one image for the whole of the retinules, each being impressed by a portion of the image re-refracted by the crystalline structure.

Sarcoptids in Wing-bones of Birds.*—E. L. Trouessart has found a new species of *Tyroglyphus* (*T. antricola*), apparently living as a commensal within the cavities of the wing-bones of parrots and other birds. It is likely that they entered while the birds were sleeping, by way of the nostrils, bronchi, lungs, and air-sacs. They probably feed on inhaled spores. Among the Tyroglyphids there were carnivorous mites (*Cheletes rapax* and *C. alacer*), probably feeding on the former.

New Type of Sarcoptid.†—E. Sergent and E. L. Trouessart describe *Mialges anchora* g. et sp. n., which lays its eggs on one of the Hippoboscidæ (*Lynchia maura*), a parasite of the domestic pigeon in Algeria. It is probable that the mite passes most of its life on the bird, and only attacks the insect when depositing its eggs. Only the mature females and the larvæ have been found. The mite uses the insect's blood as food. This is the first instance of a really parasitic Sarcoptid being found on an insect—indeed, on a cold-blooded animal. The first pair of limbs have no ambulacral sucker, but end in a double grappling-organ like an anchor.

Myriopodophilous Mites.‡—Ivar Trägårdh describes two new forms of Antennophorinæ, namely, *Neomegistus julidicola* and *Paramegistus confrater*, found in Natal and Zululand on Julidæ belonging to the genus *Spirostreptus*. He discusses the question of the various stages in the life-history of the mites, and the relationships of his new genera. The mites do not occur on the Julidæ in the winter months. It seems probable that they feed on the offensive fluid which their hosts secrete during the summer. Experiments confirmed this remarkable fact.

Acarid from Omentum of Negro.§—A. Castellani records the discovery of two specimens of an Acarid-like parasite, in the fat of the omentum of a negro who had died of sleeping sickness. The colour is dark yellowish, shape oval, palpi very short, six legs well developed, apparently without hairs, each leg composed of five segments. The total body length is 0·55 mm. The parasite resembles *Cytoleichus sarcoptoides* Heguin, occurring in various internal organs in fowls.

Scottish Hydrachnids.‖—Wm. Williamson continues his investigation of Scottish hydrachnids, and gives a list of 26 species collected during 1906. Seven of these are new Scottish records.

* Comptes Rendus, cxlv. (1907) pp. 598–601.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 443–5 (3 figs.).
‡ Arkiv Zool., iii. (1907) No. 28, pp. 1–33 (1 pl., 18 figs.).
§ Centralbl. Bakt. Parasitenk., xliii. (1907) p. 372.
‖ Trans. Edinburgh Field Nat. and Micr. Soc., 1906–7, pp. 393–4.

ε. Crustacea.

Ferments in Crustaceans.*—J. Giaja found in *Astacus leptodactylis* (as in the snail) a ferment called raffinase. This seems to be absent in marine Crustaceans (as also in marine molluscs). Lactase, also present in *Astacus*, was found, among marine forms, only in the lobster. In the lobster, however, there was no trace of invertine, which was found in all other Crustaceans experimented with. The gastric juice of *Palinurus vulgaris*, which acts on amygdalin, has no action on salicin.

"Granny" Crabs.†—W. A. Herdman has a note on what the Port Erin fishermen call "granny" crabs, though they are not necessarily old nor female. They are caught in considerable abundance during July and August, and are promptly killed, the impression being that they are diseased. A "granny" crab, which may be of any size above 4 inches, is generally female, and has a worn and dilapidated appearance, the shell being pitted and stained with black, and the great claws corroded and frequently broken. The surface is frequently overgrown with barnacles and other foreign bodies. The men say that the flesh has a strong bitter taste and a powerful purgative effect. There is, however, in all probability nothing abnormal about these crabs. They are merely individuals which are approaching the time when in every second year a crab of this size will cast its shell. The practice of destroying them is unwarranted.

Autotomy in Grapsus.‡—Anna Drzewina points out, in answer to Piéron, that autotomy of the claw occurs without violent excitation in specimens of *Grapsus varius*, in which the œsophageal commissures have been cut. She does not seek to deny the intervention of the cerebral ganglia in autotomy; they may have an excitatory or an inhibitory action; but the point is that their intervention is not indispensable.

Autotomy in Decapods.§—H. Piéron distinguishes between "evasive" autotomy, which seems to him "voluntary" in the same sense as an endeavour to escape is voluntary, and reflex autotomy, which is much more general. The muscular contractions which effect autotomy in *Grapsus* are of the same order as the normal locomotor contractions. Voluntary or evasive autotomy is particularly well developed in *Grapsus*, but it occurs elsewhere, for instance in hermit crabs. Reflex autotomy is not universally distributed even among the Brachyura.

Real Nature of Microniscidæ.‖—M. Caullery has given experimental proof of the view held by G. O. Sars, that Microniscidæ are really stages in the life-history of Epicaridæ, intermediate between the Epicaridian and Cryptoniscian larvæ. Although Bonnier persists in regarding Microniscidæ as a distinct family, Caullery thinks that the position held by Sars is incontestable. In the case of *Portunion*

* C.R. Soc. Biol. Paris, lxxiii. (1907) pp. 508–9.
† Liverpool Biol. Committee, 21st Report, 1907, pp. 25–6.
‡ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 493–5.
§ Tom. cit., pp. 517–19.
‖ Comptes Rendus, cxlv. (1907) pp. 596–8.

kossmanni Giard and Bonnier, parasitic on *Platyoniscus latipes*, Caullery has seen the production of "microniscid" stages.

New Cave Isopod.*—E. G. Racovitza describes *Spelæoniscus debrugei* g. et sp. n., from an Algerian cave. The very convex elliptical body can be rolled into a ball; the head is without frontal lobes, antennary tubercles, or scutellum, but has a deep antennary grove on each side of the median line; the antennæ are of the *Cylisticus*-type; the antennules have two joints; some of the other appendages resemble those of *Cylisticus*, others those of *Armadillidium*. Like *Eleoniscus*, this new genus expresses the tendency of *Porcellio*-like forms to roll themselves up, but it represents a failure in the solution of this problem. The perfect ball of the widely distributed *Armadillidium vulgare* is a complete solution, but in *Spelæoniscus* the antennæ are kept extended and exposed to attack. Thus *Spelæoniscus* has had to take refuge in a subterranean habitat, "cet asile que dame nature installa à peu de frais pour ses viellards, ses impotents et ses ratés." The new type is colourless, blind, and covered with tactile setæ; it has no longer any near relatives in daylight; it is an archaic representative of a fauna which has disappeared.

Terrestrial Isopods of the Family Eubelidæ.†—Harriet Richardson gives an account of a collection of new species of Eubelidæ made in Liberia by O. F. Cook. A new genus, *Ethelumoris*, is established near *Ethelum*: the flagellum of the second antennæ consists of two joints, the coxopodites of the first thoracic segment extend along the lateral margin, but arise from the underside of the segment.

Cave Isopods.‡—E. G. Racovitza reports on 16 cavernicolous species of Isopods, e.g. *Trichoniscus dispersus* sp. n., *Trichoniscoïdes pyrenæus* sp. n., *T. tuberculatus* sp. n., *Anaphiloscia simoni* g. et sp. n., in the neighbourhood of some of the forms included in the unnatural genus *Philoscia*, *Porcellio manacori* sp. n., *Cylisticus cavernicola* sp. n., *Eleoniscus helenæ* g. et sp. n. (the new genus presenting a mixture of characters seen in *Cylisticus* and *Armadillidium*, but most nearly related to *Eluma*), and *Armadillidium pruvoti* sp. n.

Annulata.

Urns of Sipunculids.§—W. Selensky has studied the structure and development of the much-discussed fixed and free-swimming "urns" of *Sipunculus nudus*, comparing them with the free-swimming urns of *Phymosoma* and the fixed urns of *Phymosoma* and *Aspidosiphon*. An urn consists of a vesicular cup, a neck, and a ciliated disk. It begins as a bud-like outgrowth from the walls of a blood-vessel; it consists of the connective-tissue of the wall of the vessel, and is surrounded by endothelial cells, among which there is one at least of the large ciliated

* Arch. Zool. Expér., vii. (1907) Notes et Revue, No. 3, pp. lxix.–lxxvii. (9 figs.).
† Smithsonian Misc. Collections, iv. (1907) pp. 219–47 (67 figs.).
‡ Arch. Zool. Expér., vii. (1907) pp. 145–225 (11 pls.).
§ Zool. Anzeig., xxxii. (1807) pp. 329–36 (4 figs.).

cells that occur in the endothelium of the vessels. The urns arise both on the inside and on the outside of the tentacular vessels, and there is no real difference between those which remain sedentary and those which become free-swimming. There is no doubt that they arise from the Sipunculid-tissue. They are not parasites. They are not phagocytic, but they help, as Cuénot pointed out, to purify the cœlomic fluid by collecting and agglutinating particles. They are, perhaps, comparable to the ciliated organs connected with the nephridia of Hirudinea, which are also derivatives of peritoneal tissue.

Reproductive Apparatus of Kynotus.*—L. Cognetti de Martiis describes the gonads and associated structures in this peculiar Madagascar genus of earthworms, and fills up the gaps in the previous descriptions by Rosa, Benham, and Michaelsen.

Calciferous Glands of Earthworms.†—A. Combault suggests that these glands have some respiratory significance. They may fix the CO_2 and thus avoid asphyxiation. The concretions may be the result of the fixing of the CO_2 in the glands. Some specimens of *Helodrilus caliginosus* sub-sp. *trapezoides*, were placed in very dilute lime-water; after 24 hours the glands were loaded with carbonate of lime. Further experiments confirmed this.

Nematohelminthes.

Free-living Nematodes.‡—J. G. De Man describes 18 species of free Nematodes, all of which (except *Eurystoma terricola* sp. n., from the soil) have been collected on the coasts of Zealand. Thirteen are new, e.g., *Ægialoalaimus elegans* g. et sp. n., *Cobbia trefusiæformis* g. et sp. n., *Parasabatieria vulgaris* g. et sp. n., and *Metalinhomæus typicus* g. et sp. n. A useful list is given of all the free marine Nematodes the author has found on the coasts of Zealand.

Toxic Effect of Sclerostomum equinum.§—M. Weinberg has experimented with extracts of this parasite, and has obtained rather important results. He finds that these extracts dissolve the red blood-cells of the horse. The toxic substance is secreted especially by the cephalic part of the parasite, and also by the digestive tube; it is resistent to a temperature of from 115–120° for 15–20 minutes, and is not specific for the horse, since it acts similarly upon the blood-cells of guinea-pig, rabbit, ox, and sheep. Sclerostomes also secrete a substance with the properties of a precipitin with horse and with rabbit serum. Extracts of larvæ have a similar but less marked effect. Other helminths found in the horse (*Oxyuris equi*, *Ascaris megalocephala*, *Tænia perfoliata*, *Tænia plicata*) do not secrete a hæmatoxin; it is noteworthy that the only parasite capable of doing so is the only one which lives on the blood of the horse.

* Atti R. Accad. Sci. Torino, xlii. (1907) pp. 1138–50 (1 pl.).
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 440–2.
‡ Tijdschr. Nederland. Dierk. Ver., x. (1907) pp. 227–44.
§ Ann. Inst. Pasteur, xxi. (1907) pp. 798–807.

Platyhelminthes.

New Cestode from Eagle.*—Pasquale Mola describes a new Cestode, *Davainea hertwigi*, found in the intestine of *Nisaëtus fasciatus*. When the eagle was caught it had in its beak a wall-lizard, in the peritoneal cavity of which cysts were found containing a cysticercus. This, the author considers, is the same Cestode found in the eagle, and that the life-cycle is completed between the two hosts, *L. muralis* and *N. fasciatus*.

Para-uterine Organ of Tænia nigropunctata.†—Pasquale Mola describes this organ, first noted by Crety in 1890. It is a winding tube, running in the middle line over each proglottis. It starts from the uterus and runs forward with an undulating course. An account of its histological features is given, and it is noted that cells pass from this tube to the uterus, forming an abundant parenchyma extending to every small uterine pouch and enveloping the eggs.

Classification of Cyclophyllidea.‡—O. Fuhrmann revises the classification of this order, altering the system proposed by Braun. He recognises ten families—Tetrabothridæ, Mesocestoididæ, Anoplocephalidæ, Davaineidæ, Dilepinidæ, Hymenolepidæ, Tæniidæ, Acoleinidæ, Amabilinidæ, and Fimbriariidæ—and nine sub-families, with a total of 66 genera.

Action of Heat on Immature Mussel-fluke.§—Raphael Dubois finds that *Gymnophallus margaritarum* Dubois can survive, for at least 48 hours, temperatures between 35° and 40° C., which are fatal to the mussel. The new form, which results from the influence of the increased temperature on the immature fluke, is probably a stage towards the final form. Therefore it seems likely that the final metamorphosis occurs in a warm-blooded animal, which is probably a bird.

New Rhabdocœla.‖—Nils von Hofsten describes three new Rhabdocœla from moor-lochs in the island of Gotland, namely, *Castrada instructa*, *Dallyelia pallida*, and *D. succincta*.

Polyclads from the Somali Coast and a Revision of the Stylochinæ.¶—Adolf Meixner gives an anatomical account of a number of polyclads, 13 species, collected by Ch. Gravier off the Somali coast, and takes this opportunity of making a revision of the previously described members of the family Stylochinæ.

New Marine Triclad.**—G. Du Plessis gives a description of a beautiful little Triclad, *Cercyra verrucosa* sp. n.—so-called because of

* Biol. Centralbl., xxvii. (1907) pp. 575–8 (5 figs.).
† Comptes Rendus, cxlv. (1907) pp. 87–90 (2 figs.).
‡ Zool. Anzeig., xxxii. (1907) pp. 289–97.
§ C.R. Soc. Biol. Paris, xliii. (1907) pp. 502–4.
‖ Arkiv Zool., iii. (1907) pp. 1–15 (1 pl.).
¶ Zeitschr. Wiss. Zool., lxxxviii. (1907) pp. 385–498 (5 pls. and 2 figs.).
** Rev. Suisse Zool., xv. (1907) pp. 129–41 (1 pl.).

the great development of papillæ in a double or triple series on the dorsal surface, which seem to serve as fixing organs. It is only the seventh Triclad found on the Mediterranean shores.

New Nemerteans.*—M. Oxner describes two new species which he has found at Roscoff—*Amphiporus martyi* sp. n., a very transparent form which lives along with *Lineus ruber*; *Prosorochmus delagei* sp. n., which is viviparous and hermaphrodite.

Incertæ Sedis.

Development of Ribs in Brachiopods.†—S. S. Buckman discusses the development of the ribbed stage in *Cincta* and *Eudesia*, and shows that there are various methods by which "similar looking ribbed forms" have been evolved from "similar looking smooth forms."

It may be of use to quote the general introduction to his study: "The test ornament of Brachiopods is found in three main phases—smooth, ribbed, and spinous. (A striate stage is sometimes interposed between the smooth and the ribbed, but not always.) These three phases are in this anagenetic sequence to one another: in relation to its nearest allies, a costate species of a given series is more advanced than a smooth one of that series, and a spinose one still further than a costate. There are catagenetic developments also in reverse order: in certain Productids the costate stage follows on a spinose; in *Acanthothyris* there are certain cases of the spinose ontogenetic stage being followed by a smooth. If, however, the catagenetic phases be put aside for the present, it may be said that the state of external ornament—smooth, costate, spinose—indicates the position of a Brachiopod as more or less advanced than its fellows." The author gives an interesting table showing sequences of developmental phases of test ornament, in the one case subsequent to *Cincta*, in the other case prior to *Eudesia*.

Rotiform Bryozoa of the Isle of Wight.‡—J. W. Gregory describes *Bicavea rotaformis* sp. n., which occurs at the base of the cretaceous *Holaster planus* zone in the Isle of Wight. It consists of a wheel-shaped body borne on a narrow cylindrical stem. Its nearest allies are some specimens from the Danian Chalk of Faxoe, described as *Radiopora urnula* var. *stipitata* by Pergens and Meunier in 1887.

Growth of Tendra zostericola.§—M. Bogolepow describes the growth of colonies of this Bryozoon on the glass sides of an aquarium. The original "cell" or oozoid formed a chain of blastozoids; blastozoid buds appeared which formed the beginning of an axis or of axes of the second order; and so on. Gradually a thick crust resulted. The author watched the processes of degeneration, the formation of "brown bodies," and the process of restoration, and he gives an account of the various appearances presented by the living colony.

* Arch. Zool. Expér., vii. (1907) Notes et Revue, No. 3, pp. lix.–lxix. (6 figs.).
† Quart. Journ. Geol. Soc., lxiii. (1907) pp. 338–43 (1 pl.).
‡ Geol. Mag., iv. (1907) pp. 442–3.
§ Zool. Anzeig., xxxii. (1907) pp. 305–16 (7 figs.).

Total Regeneration of Bryozoa.*—G. M. R. Levinsen reports that in some species of *Bowerbankia* and *Membranipora*, in *Valkeria uva* and *Cribrillina labiata* sp. n., and in some other cases, the whole individual is regenerated from the endosarc of the stolon. The zoecia reproduce their polypide a certain number of times, then the zoecium falls off, and the whole individual is replaced from the scar.

Genus Tubucellaria.†—A. W. Waters gives a brief account of the species of this genus, in which a description of a new form, *T. zanzibariensis*, is included. Some notes are given upon the ovicells, which appear to differ considerably in structure in different Bryozoa. It is suggested that in the present genus the shape of the opening of the ovicell "seems to be a specific character." The so-called "diminutive polypide" in the ovicellular zoœcia is shown to be derived from the substance of the ordinary form.

Rotifera.

New Marine Rotifera.‡—Carl Zelinka, in a work of considerable magnitude, describes two new species, *Synchæta atlantica* and *Rattulus henseni*, as occurring in great abundance in a certain limited area of the Atlantic Ocean, and which were collected by the German Plankton Expedition of 1889. The area inhabited by these two Rotifers, and these two species only, lies in latitude 60° 17′ N., and between longitude 14° and 30° W., or about midway between the northernmost coast of Scotland and the southernmost point of Greenland. A few more specimens of the same two species were obtained near Bermuda, and then, with the exception of a single dead lorica of a *Colurus* (or *Monura*) obtained in a haul near Ascension, no more Rotifers at all were encountered in any other parts of the Atlantic Ocean, which was crossed three times.

The fine-plankton net was lowered to a depth of 400 m., and the richest catch of *Synchæta* and *Rattulus* in the above-named area was obtained in lat. 29° W., and contained, by Henson's method of counting, as many as 364,352 *Synchæta* and 44,500 *Rattulus* to every column of water having a surface area of ·1 sq. m. (about 1 sq. ft.) and a depth of 400 m. A vast number of floating eggs of these Rotifers were obtained at the same time. The fact that Rotifers occur at such great depth was not known before, and the barrenness, as regards Rotifera, of the rest of the Atlantic Ocean is certainly very remarkable.

The author finally gives an elaborate review and list of all known marine and brackish-water Rotifera, 156 in number, and discusses the question of the origin of this marine fauna.

Echinoderma.

Luminosity of Amphiura squamata.§—Irene Sterzinger finds that the luminous organs of this Ophiuroid are at the tips of the tube-feet.

* Oversigt k. Danske Vidensk. Selsk. Fordhandl., 1907, pp. 151–9 (1 pl.).
† Journ. Linn. Soc., xxx. (1907) pp. 126–32 (2 pls.).
‡ Plankton Expedition der Humboldt-Stiftung, 1889, ii. (Kiel, 1907) pp. 1–79 (3 pls.). § Zeitschr. wiss. Zool., lxxxviii. (1907) pp. 358–84 (2 pls.).

The luminosity is due to mucus, which is secreted by cells of the external epithelium at the tip of the tube-foot. It accumulates in the intercellular spaces, and passes out by apertures in small papillæ at the tip. The luminosity is extra-cellular.

The animal produces non-luminous as well as luminous mucus; both are soluble in hydrochloric acid. Mucus glands occur also in the tube-feet of other Echinoderms, e.g., *Astropecten aurantiacus*, in the sensory buds of *Ophiothrix fragilis*, and in the tentacles of *Antedon rosacea*. The mucus seems to help adhesion in *Amphiura squamata* and *Ophiothrix fragilis*, both of which are able to climb up vertical walls.

Abnormality in Test of Echinolampas.*—R. Fabiani describes in the fossil test of this sea-urchin a peculiar abnormality in the ambulacral plates, especially in two of the areas of the trivium. The poriferal zones of one series converge rapidly towards those of the other series in the same ambulacrum, they almost unite, and then they suddenly diverge again and follow their usual course.

Development of Ophiothrix fragilis.†—E. W. MacBride summarises the leading points in the development of *Ophiothrix fragilis*. An important discovery made in the course of his investigations is that there are two types of development, depending on whether fertilisation is effected naturally or artificially. For example, if the former, segmentation results in the formation of a thick-walled blastula; if the latter, a solid mass of cells or morula results. The abnormal development has a considerable resemblance to the normal development of *Ophiura brevis*, and is of interest as showing how far-reaching in its influence on the subsequent development is the condition of the egg at the moment of fertilisation, and the idea is suggested that here, perhaps, is to be found the origin of variations. The author remarks that "we must assume that eggs are capable of fertilisation before they are quite ripe, and that the fact that eggs can be fertilised is no proof that they are fully ripe, or that the resulting development is normal. This conclusion has, I think, a somewhat important bearing on the experimental studies for which the eggs of Echinodermata have furnished the material. Notably the statements which some authors have made about obtaining ripe eggs from sea-urchins like *Strongylocentrotus* all the year round must be received with great caution." On the disputed question of the homology of the right hydrocœle, it is noted that in *Ophiothrix fragilis* it is from the beginning on the right side of the larva.

New Zealand Holothurians.‡—Arthur Dendy and E. Hindle give an account of some Holothurians from New Zealand, amongst which they find six new species. Of these *Rhabdomolgus novæ-zealandiæ* is the most remarkable; by its discovery the view is confirmed that spicules are really absent in this genus, which has hitherto been discredited by systematists, and which must now be revived.

* Atti Accad. Sci. Veneto-Trentino-Istriana, iv. (1907) pp. 75–8 (2 figs.).
† Proc. Roy. Soc., Series B, lxxix. (1907) pp. 440–5 (4 figs.).
‡ Journ. Linn. Soc., xxx. (1907) pp. 95–125 (4 pls.).

New Species of Cucumaria.*—R. P. Cowles describes *Cucumaria curata* sp. n., from the Californian coast. Many individuals are usually seen together, in the breeding season at least, forming black patches just below low-tide mark. The species is of especial interest on account of the care of the eggs and young. As soon as the eggs are laid they are transferred, probably by means of the tentacles, to the ventral surface of the body, and are kept there until they develop into young forms several millimetres in length. The eggs are large, almost 1 mm. in diameter. Associated with the Holothurian during the breeding season there is a small Nematode which feeds upon the eggs, often destroying the whole brood.

Cœlentera.

Madreporaria from Amboina.†—M. Bedot has done good service to students of Madreporarian corals by publishing not only full descriptions, but abundant beautiful illustrations, of a large collection (79 species) of Madreporaria from Amboina.

Rare British Coral.‡—W. A. Herdman dredged from the Train bank, 8 miles off Port Erin, a distinctly rare British coral, *Paracyathus pteropus*. It was described by Gosse from a specimen found attached to a shell of *Cyprina* from the deepest part of the Moray Firth, but as the soft parts were unknown to Gosse, a brief description of the Isle of Man specimen was drawn up from the living specimen by Chadwick. The column is cylindrical, not much higher than the corallum; the disk is flat, or very slightly raised in the centre, without distinct margin; the tentacles are 28 in number, arranged in two alternating circlets, the stem is tapering, membranous, studded with numerous warts (cnidophores ?), the head is sub-globular and opaque; the mouth is a lengthened and very mobile slit, with crenulate lips; the colour of the column, disk, and tentacles is transparent white, and a broad vandyked band of vivid emerald green surrounds the mouth; the diameter of the corallum is 3 mm.

Statoblasts in a Scyphistoma.§—E. Herouard has found in a Scyphistoma at Roscoff (like Dalzell's "*Hydra-tuba*"), encysted buds "with a latent life and representing veritable statoblasts." They are formed on the pedal disk and are inclosed in a chitinous envelope. If the envelope be burst, the bud begins to proliferate and forms a polyp. The "statoblasts" are formed during a resting period, and the time necessary is about 15 days. After a statoblast is formed, the polyp moves a short distance on its "pedal sole," leaving the statoblast behind. After coming to rest again, the polyp forms a new statoblast.

Revision of Medusæ Belonging to the Family Laodiceidæ.‖ E. T. Browne includes in this re-defined family the following genera:

* Johns Hopkins Univ. Circular, No. 3 (1907) pp. 8–9 (2 pls.).
† Rev. Suisse Zool., xv. (1907) pp. 143–292 (46 pls.).
‡ Liverpool Biol. Committee, 21st Rep., 1907, pp. 24–5.
§ Comptes Rendus, cxlv. (1907) pp. 601–3.
‖ Ann. Nat. Hist., xx. (1907) pp. 457–80.

Laodice, *Staurophora*, *Ptychogena*, *Staurodiscus*, *Toxorchis*, *Melicertissa*. The character, now selected as distinctive of the family, is the presence of cordyli, commonly called sensory clubs, on the margin of the umbrella. A cordylus is quite distinct from marginal bulbs and tubercles or sprouting tentacles and cirri. Its shape varies slightly in different genera, but it always has a clear translucent appearance, without any coloration, and is free from nematocysts. It is also without otoliths and such concretions as are generally found in sense-organs.

Gonophores of Plumularia obliqua and Sertularia operculata. *—S. Motz-Kossowska refers to the general opinion that, among the Calyptoblastea, Medusoids occur only in the Campanulariidæ and related families, such as the Campanulinidæ and some of the Lafœidæ. In 1902 Torrey found free gonozoïds in Haleciidæ; the author has found medusiform gonozoïds in *Plumularia obliqua* Saunders (in which a male Medusoid was seen to detach itself) and in *Sertularia operculata L.* (in which the liberation of a Medusoid, almost mistakable for that of the former species, is probable).

Tubularia indivisa var. obliqua.†—F. H. Gravely found this variety at Port St. Mary, Isle of Man. It is characterised by a single large tentacle covering the umbrella-mouth of each female gonophore and capable of moving to a slight extent. A similar form has been described by Bonnevie and Swenander. The female gonophore shows a single radial canal instead of four—a feature correlated with the presence of the single large tentacle to the base of which the canal runs. The male gonophore shows no radial canals or tentacles, but shows—what the normal *T. indivisa* apparently does not—conspicuous sterile cells in the outer layers of sperm, these cells often bearing delicate processes that pass inwards towards the spadix.

Cordylophora lacustris.‡—Sven Ekman discusses the distribution of *Cordylophora lacustris* Allman in Swedish waters.

Porifera.

African Fresh-water Sponges.§—R. Kirkpatrick reports on specimens of a new variety of *Ephydatia fluviatilis* L., collected by J. Stuart Thomson, from a pond near Cape Town. This almost cosmopolitan species has been found in Europe, Asia, and America, but is now recorded for the first time from Africa. A second species, *Spongilla cerebellata* Bowerbank, was obtained from a pond near Cairo by Innes Bey. Thus the two commonest European species have to be added to the list of African fresh-water sponges, of which 21 species are known. The Cape specimen, which is named *E. fluviatilis* var. *capensis* var. n., is a strongly marked variety, as regards its oxeas, amphidisks, and gemmules.

* Arch. Zool. Expér., vii. (1907) Notes et Revue, No. 4, pp. cxiv.–xviii. (3 figs.).
† Liverpool Marine Biol. Station, 21st Ann. Rep., 1907, pp. 15–17.
‡ Arkiv. Zool., iii. (1907) pp. 1–4.
§ Ann. Nat. Hist., xx. (1907) pp. 523–5 (11 figs.).

Protozoa.

Foraminifera of Galway.* — F. W. Millett has published some notes on Foraminifera collected on the seashore at Galway, by F. P. Balkwill, in 1879–80. Along with Balkwill, he reported on this collection in the Journal of Microscopy and Natural Science, iii. 1884, but as the plates came out roughly, he has had the original drawings reproduced by photogravure. The classification and nomenclature have been brought into accordance with modern researches. Among the more interesting forms the following may be noted :—*Spiriloculina acutimargo*, *Miliolina auberiana*, *Ammodiscus shoneanus*, *Trochammina plicata*, *Lagena clathrata*, *L. fimbriata*, *Pulvinulina patagonica*, *Lingulina carinata* (in Silvestri's genus *Ellipsolingulina*).

Tertiary Foraminifera of Victoria.†—F. Chapman gives an account of the Foraminifera in the Balcombian deposits of Port Philip. He comments on the abundance of Foraminifera in many of the clays and limestones of the Victorian Tertiary strata, and on the gigantic size and redundant growth of many of the species—an index to the congenial life-conditions.

Physiology of Pulsating Vacuole in Infusoria.‡—A. Kanitz discusses the relation of temperature to the activity of the pulsating vacuole in Infusoria. The reactions to temperature are such as to render physical explanations, e.g. osmosis, insufficient. They appear to conform to the R.G.T. rule (Reaktionsgeschwindigkeit Temperaturregel), according to which a raising of the temperature 10° increases the reaction speed from two to three times. The results obtained with the pulsating vacuoles of different Infusoria in accordance with this rule are most readily explained in relation to chemical processes.

New Hypotrichous Infusorian.§—E. Fauré-Fremiet describes a new form, which he makes the type for a new genus, *Ancystropodium maupasi* g. et sp. n. This form possesses a contractile pedicle, consisting of a protoplasmic strand, which carries on its left border seven marginal cilia. The species is a highly differentiated one, adapted for fixation by means of its tranverse cilia. The author considers the question of a possible relationship with the Vorticellidæ, but regards such a view as untenable.

Ichthyophthirius multifiliis on British Roach.‖—James Johnstone records the occurrence of this Ciliate upon the skin and gills of roach in Hesketh Lake, Southport. Only the roach were affected, and pike, perch, and eels living in the same water showed no signs of disease. The epidemic produced considerable mortality among the roach for about a month, after which it died out. This appears to be the first record of this Ciliate in British waters. An account of its structure and mode of multiplication is given.

* The Recent Foraminifera of Galway. Plymouth, 1908, 8 pp. (4 pls.).
† Journ. Linn. Soc. (Zool.) xxx. (1907) pp. 10–35 (4 pls.).
‡ Biol. Centralbl., xxvii. (1907) pp. 11–25.
§ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 377–8.
‖ Proc. and Trans. Liverpool Biol. Soc., xxi. (1907) pp. 292–5 (1 pl.).

Notes on Acinetaria.* — B. Collins describes *Ephelota gemmipara* Hertwig and *Hypocoma acinetarum* sp. n. The former has buds at once tentaculate and ciliated, as Ishikawa observed in the case of *E. bütschliana*. Multiplication occurs by transverse (never longitudinal) fission, by multiple ovoid, tentaculate, non-ciliated buds, and by multiple ciliated buds, which, as noted, sometimes show tentacles before their separation from the parent. A full account of the structure of the animal is given, but the results are mainly in agreement with those of R. Hertwig. It is noted, however, that there is a horse-shoe of large cilia on the dorsal surface of the embryo. The new species of *Hypocoma* lives on the stalk of *Ephelota* and on *Acineta compressa*; it has a secondarily acquired asymmetry; there is a single ventral tentacle and an interesting posterior invagination; the ciliation is in concentric ellipses. It seems that *Hypocoma* is not a primitive type—a possible starting-point for the Acinetaria and derived from *Chilodon*. It is rather a highly specialised terminal type, morphologically deformed. The affinities between Acinetaria and Ciliata should probably be looked for in the direction of the Peritricha.

Trypanosomes of the Upper Niger.†—A. Laveran has sought experimentally to clear up the difficult question of the specific nature of the agents in the Trypanosome diseases of this region. Two oxen inoculated with the virus of "Mal de la Zousfana" and "El Debab," and quite cured, showed themselves completely refractory to *Trypanosoma soudanense*, whence it may be concluded that the Trypanosome of these diseases is really *T. soudanense*. It is of interest to note that the Trypanosome observed in horses and dromedaries in Algeria exists also in the Upper Niger. It is possible that the centre of infection is this latter region, and that transportation to Algeria is effected by the caravans coming from Timbuctoo.

Role of the Spleen in Trypanosomiasis.‡ — A. Laveran and Thiroux have looked into this important subject. They find that the Trypanosomes found in the spleen during life, or even after death, have the same structure as those taken from the general circulation. Extract of spleen has not, in vitro, trypanolytic properties, nor in animals whose spleen is removed is trypanosomiasis sensibly modified. In trypanosomiasis, as in malaria, the spleen, without doubt, contributes to the freeing of the circulation from the debris of the hæmatozoa following trypanolytic crises, but this seems to be all that it can do.

Trypanosome of Pontobdella muricata.§—Muriel Robertson records her observations on a Trypanosome from the alimentary canal of *Pontobdella muricata*. She agrees with Brumpt that this is probably the *Trypanosoma raiæ* of the skate. It is evidently of frequent occurrence in *Pontobdella*, since of 60 specimens examined only one failed to yield examples. A series of forms is described, and points in their minute structure, e.g. the kinetonucleus, are discussed. The flagellum appears to

* Arch. Zool. Expér., vii. (1907) Notes et Revue, No. 4, pp. xciii.–ciii. (3 figs.).
† Comptes Rendus, cxlv. (1907) pp. 293–5. ‡ Tom. cit., pp. 14–18.
§ Proc. Roy. Phys. Soc., xvii. (1907) pp. 83–108 (4 pls.).

be developed from a pair of arrested mitotic figures developed out of the distal of the two segments into which the original kinetonucleus divides. The process of division is described.

Trypanosomes of Frog and Leech.*—Carlos França finds that the Invertebrate host of *Trypanosoma costatum* and *T. rotatorium* of the frog is a leech. From the leech he has been able to infect the frog. There is a Trypanosome phase in the frog, and a Herpetomonad phase in the leech. The author has also some notes on the culture of the frog's trypanosomes † and on their intra-vitam staining.‡

Development of Piroplasma canis in Dog.§—G. H. F. Nuttall and G. S. Graham Smith describe the appearance of this parasite in unstained preparations, its mode of multiplication, including an account of the nuclear changes, the fate of the various forms as observed in the living blood, and the complete cycle of development within the blood. The mode of multiplication stated briefly is as follows. A free pyriform parasite enters a normal red-blood corpuscle and rapidly assumes a rounded form. It then enlarges and passes through an actively amœboid stage, at the end of which it again becomes rounded. After a short period of quiescence in this condition, it protrudes two symmetrical processes, which rapidly grow and become pear-shaped. The protoplasm of the parasite flows into these processes, and its body consequently gradually diminishes, until it is represented by a minute rounded mass, to which the pyriform processes are attached. Eventually this also disappears, and, finally, two mature pyriform parasites are left, which are joined together for a time by a thin strand of protoplasm. After a variable time these parasites are liberated by the rupture of the corpuscle, and swim away, to enter fresh corpuscles and repeat the process. Occasionally a single rounded intra-corpuscular parasite gives rise to four or more pyriform parasites by the protrusion of a corresponding number of processes. The authors never observed any forms which could be regarded as gametes.

* Bull. Soc. Portugaise Sci. Nat., i. (1907) pp. 27–8 (2 figs.).
† Tom. cit., pp. 5–8 (3 figs.). ‡ Tom. cit., pp. 9–11.
§ Journ. Hygiene, vii. (1907) pp. 232–72 (3 pls. and 14 figs.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Structure of Nucleus in Relation to Organisation of Individual.* J. B. Farmer has continued his investigations as to the structural constituents of the nucleus and their relation to the organisation of the individual. While recognising the great importance of the nucleus, the author believes that the properties of the individual may be, at least in part, attributed to the interaction of the nucleus with the cytoplasm external to it. Such interaction of cytoplasm and nucleus is seen in the fact that enucleated eggs of one species of echinoderm, when fertilised, give rise to larvæ resembling the male parent. It is also seen in the effects of polyspermy, and it is probable that the reason that polyspermy so seldom occurs in healthy cultures, is that a sudden chemical change results from the entrance of the first sperm into the cytoplasm of the egg. The author has proved that in several Fucaceæ and in some ferns the entrance of the first sperm into the egg-cytoplasm is followed by the paralysis or disorganisation of other sperms in the neighbourhood. Evidence that cytoplasm is the cause of similar disintegration is also afforded by the Gymnosperms, and most markedly by the Cycads with motile spermatozoids.

As to the act of fertilisation, the author considers that not only must there be union of two, and not more than two nuclei, but these nuclei must retain a certain structural basis, and he agrees with Darwin, Weismann, and De Vries in regarding the constituents of the nucleus, and not the nucleus as a whole, as charged with the control of the chemical transformations in the cell, which reveal themselves in the characters of the cell. The chromomeres which constitute the chromosomes may be compared to ferments which set up in the extra-nuclear cytoplasm, chemical changes which constitute development. The present work favours the Mendelian theory, and it appears that fertilisation is to be regarded as a mechanical mixture of the nuclear constituents rather than the formation of a chemical compound. The units in each of the sexual nuclei retain their individuality, and at fertilisation these units are sorted out into different combinations. Experiments and observations show that the actual number of chromosomes is immaterial, but the usual constancy of number is evidence of the organising function of the cell as a whole rather than of independence of the chromosomes. Chromosome-reduction is

* Proc. Roy. Soc., lxxix. B (1907) pp. 446–64.

both a consequence and a condition of sexuality, and affords convincing proof of the existence of persistent structural units, which are directly responsible for the characters manifested by the developing organism. The significance of reduction is in the sorting out of structural entities and in the distribution of entire sets of them in the sexual cells. The relatively small number of chromosomes renders it impossible to regard them as structural entities, and their real importance lies in their structure as similarly organised groups of chromomeres, but not necessarily of the same chromomeres. It is possible that the chromomeres themselves may prove to be the structural entities of the cell. The constancy in form of the chromosomes is an expression of organisation within the cell, not of unchanging aggregation of the same constituents. Evidence is afforded that given a complete set of chromosomes, whether in single or in duplicate, the complete life-history may be covered, and that the duplicate set arising from sexuality is merely a means of producing variation.

The primordia (structural entities), which constitute the hereditary mechanism, impose the limits within which development can take place, but within those limits other conditions, e.g., specific exciting substances, may determine the path actually followed.

Cytology of Pollen-mother-cells of Nymphæaceæ.*—W. Lubimenko and A. Maige have made a morphological and cytological study of pollen-development in the Nymphæaceæ.

The authors draw the following conclusions from their investigations. During the prosynapsis stage, the nuclei of the pollen-mother-cells increase in size, until they are 4–5 times larger than the vegetative nuclei. The increase in size of the nucleus is accompanied by a corresponding, but less marked, increase in the size of the cells themselves. The increase in size of the nuclei may perhaps be considered as the result of delay in nuclear division. During the passage from prosynapsis to synapsis there is a still greater increase in the size of the nucleus in proportion to the size of the cell; this increase in size is the result of enlargement of the nuclear-sac and of the nucleolar and lino-chromatic masses, and is always followed by a slow enlargement of the mother-cell itself. In the spireme stage the volumes of the reproductive nuclei undergo a diminution in size, and are then only six times larger than the vegetative nuclei. This diminution of volume corresponds to a re-establishment of the normal proportions in the nuclear-sac, the nucleolar and the lino-chromatic masses, and is accompanied by the appearance of a well-differentiated nuclear membrane.

The chromosomes are formed by concentration of the chromatin at certain points of the spireme; they are of various forms, and seem to be composed of a varying number of small bodies.

During the period which elapses between chromosome-formation and the disappearance of the nuclear membrane, the volume of the nucleus diminishes by one-half. It is probable that the entire spindle is formed exclusively from nuclear substance (linin and nucleolus), and that the cytoplasm has no part in its constitution.

* Rev. Gén. Bot., xix. (1907) pp. 401–25 (5 pls.).

Cystolith-formation in the Cistaceæ.* — M. Gard has examined the silicified thickenings which occur in the leaves of many Cistaceæ. They are found in epidermal cells, stomata, palisade, and spongy parenchyma, and although they have no pedicel, the larger formations greatly resemble true cystoliths. They are not usually confined to a single cell, but extend through several adjacent cells. They often surround a stoma or the base of a hair. They are analogous to similar formations which have been noticed in the Oleaceæ, Santalaceæ, Loranthaceæ, and Euphorbiaceæ. Although they cannot be utilised in the distinction of species, they appear to be constant in individuals of very different origin, e.g. in *C. monspeliensis* they always abound in the lower epidermis, while the *C. populifolius* they surround the stomata; it may thus prove useful to mention them in anatomical descriptions.

Structure and Development.

Vegetative.

Centripetal Wood in the Coniferæ.†—Ch. Bernard has investigated various members of the Coniferæ in order to discover how far centripetal wood is developed in the bracts and scale-leaves. The present research is a continuation of that published by the author in 1904, and is especially intended as a reply to the criticisms of Bertrand. The latter was of the opinion that the so-called centripetal wood was nothing but a diffused mass of cork, developed for physiological reasons. The author re-affirms his former statements, and contends that centripetal wood still exists, although sometimes in a much modified form, in the leaves of conifers, and more particularly in the leaf-tips; the existence of such wood in the bracts and scale-leaves is also clearly demonstrated. The plants examined include *Agathis borneensis*, *Katakidozamia* sp., *Araucaria imbricata*, *A. Bidwillii*, *Thuya occidentalis*, *Larix decidua*, *Cedrus Libani*, *Picea orientalis*, *P. excelsa*, *Abies cephalonica*, *Pinus montana*, *P. Cembra*; the author believes that the confirmatory results given by these genera tend to show that all the Coniferæ have preserved, at least in those organs which have retained their ancestral characters, the typical centripetal xylem.

Stem of Ibervillea Sonoræ.‡—A. A. Knox has investigated the stem-structure of *Ibervillea Sonoræ*. The author describes the exterior of the stem as having a tendency to the seven-angled type, but later on it is terete. There are five bundles forming an outer ring, while the number in the inner ring varies from five to nine. There are endocyclic and ectocyclic sieve-tubes, as well as commissural sieve-tubes connecting the phloem of adjacent bundles. There is an active inner cambium. The sieve-tubes gradually become obliterated and serve as a secretory system, and their contents provide wound-gum. There is a periderm with phellogen and phellem. There is no true bark nor any deep phellogens. There is a large deposition of calcium carbonate which gives the surface of the stem a greyish appearance. The meristematic

* Comptes Rendus, cxlv. (1907) pp. 136–7.
† Bot. Centralbl., xxii. (1907) pp. 211–44 (50 figs.).
‡ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 329–44 (1 pl. and 2 figs.).

parenchyma of the medullary rays gives rise to supernumerary masses of phloem in the secondary stem. No interfascicular cambium is present, but there is much dilatation of all the parenchyma.

Origin of Leaves and Stem.*—L. Flot has contributed the last of his series of papers dealing with the origin of the leaves and stem. The following are the conclusions formed by the author. The first differentiation of the meristematic apex of Phanerogams consists in the formation of foliar outgrowths arising from a layer of cells which ultimately gives rise to a vascular meristem. The latter forms cortex and epidermis both above and below, and in the centre is differentiated into ordinary fibro-vascular tissue. The direction of growth is determined by the different pressures on the terminal bud, being greatest where the pressure is least. The outgrowth thus formed constitutes a foliar segment and ultimately develops into a typical leaf. The stem-structure is first determined by the structure and anastomoses of the young leaf-bases, and when these are complete, the whole mass of cortical and vascular tissue and epidermis constitutes the stem. When once the stem has thus been formed, the lower cells of each leaf-base rapidly multiply and so form internodes, thus causing the stem to increase in length. Increase in thickness may be brought about by increase in the number of bundles, and this is in accordance with the number of leaves ; or it may be due to the appearance of new meristematic layers, but even then it is possible to discover the traces of the primitive leaf-structure.

Water-stomata of the Lobeliaceæ.†—M. Tswett has made a careful study of the hydathodes of *Lobelia Dortmanna*, *Lobelia splendens*, and *Lobelia fulgens*. While confirming the descriptions of these structures given by Buchenau and Minden, the author claims that the stomata found in connection with them represent quite a new type. The opening of each stoma is divided into halves by a thickened, cutinised partition which stretches from one extremity of the guard-cells to the other. In several cases this cutinous membrane is continued right over the opening so as to completely close it. Twenty other species of Lobeliaceæ have also been examined, nineteen of which have similar stomata, while the remaining one is doubtful. It is of interest to note that the Campanulaceæ, which were also examined, have water-stomata of the ordinary type, and are destitute of a cutinised membrane. The author is uncertain as to the exact physiological meaning of these new stomata, but believes that their early and complex formation points to some important function in connection with the early life of the leaf.

Lenticels of Palms.‡—C. L. Gatin has studied the development of the lenticels found upon the roots and at the base of the rootlets of certain palms. The author finds that these structures are also found on the petiole of the cotyledon of several distantly related species. They are not confined to plants reared artificially, but may also be found on those growing under natural conditions. They develop where the hypo-

* Rev. Gén. Bot., xix. (1907) pp. 169–92 (5 figs.).
† Tom. cit., pp. 305–16 (1 pl.).
‡ Tom. cit., pp. 193–207 (13 figs.).

dermal sclerenchyma is interrupted, owing to the activity of a diffuse layer of active cambial cells. Their structure strongly recalls that of the "Staubgrübchen" of the Marattiaceæ, and in their mode of formation they resemble ordinary lenticels. The author objects to the term "pneumathodes," proposed by Jost, and proposes to class the lenticular structures found on palm-roots with those found in the Marattiaceæ under the name of "primitive lenticels." It is interesting to note the analogy in structure of the respiratory organs of the palms, the Cyathaceæ and the Marattiaceæ.

Extra-floral Nectaries.*—E. Schwendt has studied a large number of genera with special reference to extra-floral nectaries. In the Polygonaceæ the nectaries are simple epidermal formations, and have no typical secreting tissue. In *Gossypium* and *Tecoma radicans* there is an ill-defined secreting tissue. In the Polypodiaceæ and in *Acacia cornigera*, glandular tissue is present but no special secretion, while in the Oleaceæ there is a typical secreting tissue, and also a specially modified secreting upper surface. Vascular bundles are specially modified in connection with the more complex nectaries. The nectar-secreting upper surface of the Polygonaceæ, etc., and the disk-like nectaries in *Tecoma radicans* are also trichomes. The secreting hairs of the Polygonaceæ begin development by radial division of a single epidermal cell, while in the Oleaceæ and *Gossypium*, the first divisions are tangential. The radial walls of the stalk of the trichomes are suberised just before secretion begins. The nectaries of the Polypodiaceæ are of a type hitherto unknown, in that the gland can simultaneously secrete nectar both on the upper and under surface of the lamina. Tannin is so abundant in the nectaries that there is reason for supposing that it has some connection with the formation of sugar; it first makes its appearance while the nectary is still in a meristematic condition. There appears to be good reason for the view that nectaries originated as regulators of the passage of water through the epidermis, i.e. that in the first place they behaved somewhat like hydathodes.

Reproductive.

Polycarpellary Origin of the Pistil of the Lauraceæ.†— M. Mirande has studied the pistil in the Lauraceæ, and concludes that the present opinion as to its monocarpellary character is erroneous. The investigations in the Cassythaceæ clearly show traces of three carpels, the posterior of which is prolonged into a style and stigma, while the two latero-anterior abort. The ovarian canal which opens at the base of the single persistent style, and brings the ovarian cavity into communication with the exterior, is nothing but an incomplete stylar canal which ends at the level where the two anterior carpels are about to expand. Further investigations made upon other groups of the Lauraceæ confirm these results, and hence the author concludes that the pistil of the Lauraceæ is composed of several—usually three—open carpels, one posterior, and two latero-anterior.

* Bot. Centralbl., xxii. (1907) pp. 245–86 (2 pls.).
† Comptes Rendus, cxlv. (1907) pp. 570–2.

Physiology.

Nutrition and Growth.

Parasitic Flowering Plants.*—A. Fraysse contributes a summary of his recent papers dealing with the biology of parasitic Phanerogams. The genera examined include *Osyris alba*, *Cytinus Hypocistis*, *Odontites rubra*, *Euphrasia officinalis*, *Lathræa squamaria*, *L. clandestina*, and *Monotropa Hypopitys.*

The author finds that the plants most readily attacked by such parasites as *Lathræa*, *Euphrasia*, etc., which attach themselves by suckers, are those with bacteria-nodules, tubercles, mycorhizas, etc. The suckers are sometimes pericyclic, sometimes endodermic in origin, and probably represent modified roots. The invasion of the parasite usually causes the formation in the host of a cambium zone, a layer of cork or other similar structures for the purpose of isolating the infected region. There may also be much mucilage or gum formed around the point of attack. Some of the green parasites absorb both mineral food and carbon compounds from their hosts, e.g. *Odontites*, while others only absorb carbon compounds, e.g. *Euphrasia*. Those without chlorophyll absorb the whole of their food from the host. In all cases, the parasite has a selective power, and by means of diastases converts the absorbed food-materials into compounds suitable for assimilation. Glucose appears to be the principal source of carbon, and there is a special diastase present for converting the starch of the hóst-plant into this sugar. The latter may be immediately assimilated, or may be absorbed and then reconverted into a form of starch until needed. Tannin may be used, as in *Cytinus*, as an agent of nutrition and protection. The suckers contain substances which protect the parasite from the toxins secreted by the host. Infection is effected by the agency of cellulose-diastases, and other ferments of a similar character, which are most active when the host offers the greatest resistance.

Parasitic Phanerogams and Nitrates.†—M. Mirande has conducted experiments with the view of discovering whether parasitic phanerogams absorb nitrates. The method employed was that of qualitative analysis of the plant-sap by microchemical methods, using the sensitive sulphuric-diphenylamine reaction, and special attention was given to the organs of attachment, roots, suckers, etc. Parasites with little or no chlorophyll do not absorb nitrates from the host-plants, semi-parasites may or may not absorb nitrates. It appears that the reduction of nitrates depends upon the chlorophyll-function, and hence those plants which are destitute of chlorophyll, and thus unable to reduce nitrates, absorb nitrogen from the host-plants in a state of organic combination, thus profiting by the chlorophyll-function of the host-plants. Variation in the power of nitrate-absorption fluctuates with the amount of chlorophyll present.

* Rev. Gén. Bot., xix. (1907) pp. 49–69 (13 figs.).
† Comptes Rendus, cxlv. (1907) pp. 507–9.

Course of Molecular Physiology.*—H. Schouteden has edited the manuscript of a course of lectures by the late Professor Léo Errera on the application of physical laws to the phenomena of plant physiology.

Irritability.

Geotropism in the Roots of Lupinus albus.†—P. M. Georgevitch has made a cytological study of the roots of *Lupinus albus* with special reference to geotropism. The root-cap surrounds a columella, which, together with the adjacent cells, is rich in starch-granules. Normally these granules rest upon the physically lower cell-walls. In the normal cells of the root-tip the nucleus behaves as if lighter than the rest of the cell-contents, while the starch-corpuscles appear to be heavier, and follow the direction of the force of gravity, when the position of the root is changed. There is in each cell an accumulation of protoplasm, which stains very deeply, and which bears an important relationship to the position of the starch-granules, for when the root-tip is bent, so that gravity acts at right angles, or parallel to the organic axis, the starch-granules cover the physically lower cell-wall, while the protoplasmic layer rests upon the morphological lower cell-wall. The movement in any direction of the starch-granules is always accompanied by movement of the protoplasmic layer. Also, the cell-nucleus is influenced by the force of gravity, and can be either positively or negatively geotropic. The cell-nucleus of geotropically directed roots shows the same structure as that of the ordinary cell-nucleus, and exhibits normal, mitotic cell-division. The cells of the growing root under the influence of gravity behave as if subjected to a one-sided pull or pressure, those on the concave side being short and broad, while those on the convex side are much elongated.

Epidermis of Foliage-leaves in Relation to Light-perception.‡—M. Nordhausen has experimented with *Fittonia*, *Impatiens*, etc., with special reference to the connection of the epidermal cells with light-perception. Haberlandt's theory that the papillose outer walls of the epidermis act like lenses, throwing light upon the opposite sides of the cells, the plasmic linings of which are sensitive to light, has not been confirmed by the present experiments. Moreover, the reason put forward by Haberlandt for the failure of certain experiments, viz. that the light-sensitiveness is not inherited but acquired, and may, therefore, vary with changed conditions, is criticised by the author, who contends that this sensitiveness would then be constantly changing under normal conditions. The conclusion appears to be that the papillæ of the epidermis stand in no direct causal relationship to the perception of light by the leaf-blade.

* Cours de Physiologie Moléculaire fait au doctorat en sciences botaniques en 1903 par Léo Errera. Extrait du Recueil de l'Institut botanique de Bruxelles, VII. Brussels: Lamertin, 1907, xii. and 153 pp., 20 figs. in text.
† Bot. Centralbl., xxii. (1907) pp. 1–20 (1 pl.).
‡ Bot. Gesell., xxv. (1907) pp. 398–410.

General.

Pleistocene Flora of Canada.*—D. P. Penhallow has examined various leaves from the interglacial deposits of the Don Valley, Toronto. The specimens included *Acer pleistocenicum*, *A. torontoniensis*, *Carya alba*, *Cercis canadensis*, *Cyperus* sp., *Gleditschia donensis*, *Maclura aurantiaca*, *Picea nigra*, *Ostrya virginica*, *Platanus occidentalis*, *Populus grandidentata*, *Prunus* sp., *Quercus alba*, *Robinia pseudacacia*, *Tilia americana*, and *Ulmus americana*. The present examination confirms previous conclusions as to the Don flora, and the existence of a climate warmer than the present one. It is now definitely proved that successive northerly and southerly movements of the continental ice-sheet involved corresponding movements in the vegetation, and brought about the elimination of unstable species. The evidence of the Pleistocene clays of Toronto agrees with that of similar deposits at Elmira, New York, etc.

Affinities of the Chicoraceæ.†—L. Dufour has studied the cotyledons of this group with special reference to its evolution and affinity. There are two distinct types of cotyledons; those of the first group are broad, but they rarely exceed 20 mm. in length, while the petiole is often ill-defined. This type of cotyledon is characteristic of *Cichorium*, *Lactuca*, *Sonchus*, *Crepis*, *Taraxacum*, *Hieracium*, etc. The second type is less common, but is found in the genera *Scorzonera*, *Tragopogon*, *Geropogon*, and *Podospermum*; here the cotyledons often reach a length of 50–60 mm., while the breadth does not exceed 3 mm. The author regards the present classification of the Chicoraceæ as very artificial, and suggests that they should be divided into two groups according to the characters of their cotyledons. One group should comprise such types as *Tragopogon*, etc., the simplest being *Scorzonera* and *Tragopogon*, with undivided leaves, while *Podospermum*, with its much-divided leaves, is the most highly evolved type. The other group should comprise *Cichorium*, *Lactuca*, etc., and here, again, there is a gradual transition from the simple to the much-divided leaf.

Both groups appear to have had a common origin in plants with simple leaves, and this character is frequently revealed in the cotyledons and first foliage leaves.

Monograph of the Genus Ribes.‡—Ed. de Jancewski has published an exhaustive account of this genus, in which he includes as a section, as is now usually done, *Grossularia*, to which belongs the gooseberry. The genus contains 133 species, for most of which a figure of the flower is given in addition to a very full description of the plant.

Harmful Secretion of Sugar in Myrmecophilous Plants.§—M. Nieuwenhuis von Uexküll-Güldenband has studied myrmecophilous plants, in order to test the opinion of Delpino, Kerner, and others, that the secretion of sugar in extra-floral nectaries, is useful in attracting

* Amer. Nat., xli. (1907) pp. 443–52 (2 figs.).
† Comptes Rendus. cxlv. (1907) pp. 567–70.
‡ Mem. Soc. Phys. Hist. Nat. Genève, xxxv. (1907) pp. 199–517 (202 figs. in text).
§ Proc. Acad. Amsterdam, ix. pt. 1 (1907) pp. 150–6.

ants which protect the plants against injurious insects. The results of the investigations appear to show that in many plants, the secretion of sugar does much harm, by attracting not only ants, but beetles, bugs, etc., which eat the sugar and also the nectaries, leaves and flowers. This is the case with the orchid *Spathoglottis plicata*, a shrub-like malvaceous plant, and others. In *Hibiscus rosa-sinensis* and in *Hibiscus tiliaceus*, where extra-floral nectaries occur, no sugar is secreted owing to the growth of a fungus in the nectaries, and here the plants are healthy and uninjured by insects. There is no confirmation of Burck's theory that extra-floral nectaries occur near inflorescences, in order to attract ants which serve as a protection against bees and wasps which would bore the flowers. The number of bored flowers stands in no direct relation to such nectaries, but rather in relation to the position of the plants, weather, etc. Moreover, the shapes and positions of the nectaries do not appear to be adapted for ants, and young plants, where most protection is necessary, have no sugar secretion. The ants which are attracted appear to be of a peaceful nature, and unable to afford any protection to plants; the dangerous ants, which might be of use in this way, are carnivorous and can only be attracted by animal food. The author believes that the real meaning of these nectaries has yet to be discovered, and that new investigations must include plant-physiology as well as biology.

Influence of Nectaries on the Opening of Anthers.* — W. Burck has conducted investigations with the object of discovering whether the nectaries and other glucose-secreting tissues influence the opening of the anthers by withdrawing water from them. Experiments conducted upon *Diervillea rosea*, *Digitalis purpurea*, *Oenothera Lamarckiana*, etc., show that water is withdrawn from the anthers by osmosis set up by the glucose-containing tissue found in the stamens and corolla. Other flowers, whose anthers behave differently, have similar tissue, but to a very much smaller extent. In a second series of experiments conducted upon *Stellaria media*, *Cerastium semidecandrum*, *C. erectum*, *Holosteum umbellatum*, and many other flowers having a nectary at the base of each stamen, the bursting of the anthers appears to be due to the osmotic influence of the nectaries, not as in the first group, to simple glucose-containing tissue. While in a third series of experiments upon such flowers as *Ranunculus acris*, *Brassica oleracea*, *Geranium molle*, etc., negative results were obtained, the general conclusions seem to show that nectaries and glucose-secreting tissues play an important part in enabling the anthers to open at the right time, independently of the hygroscopic condition of the air.

Bargagli-Petrucci, G.—**Descrizione di alcuni tricomi de Palme.** (Description of some trichomes of palms.) *Nuovo Giorn. Bot. Ital.*, n.s. xiv. (1907) pp. 293–5 (1 pl.).

Colozza, A.—**Studio anatomico sulle Goodeniaceæ.** (An anatomical study of the Goodeniaceæ.) *Tom. cit.*, pp. 304–26 (2 pls.).

* Proc. Acad. Amsterdam, ix. pt. 1 (1907) pp. 390–6.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Apogamy and Apospory.*—H. Woronin discusses the question of apogamy and apospory in certain ferns. She has discovered apogamy in *Notochlæna Eckloniana*, *N. sinuata*, *Pellæa tenera*, *P. flavens*, and has followed out the development of the germinating plants in these as well as in *Trichomanes Kraussii*. And in the latter plant she has also followed out the development of the antheridia and the formation of the prothallium, which usually is a flat expansion arising from a filament. In this plant also she produced apospory artificially. Various physiological experiments made by the author are described, and a full summary of her results is given.

K. Goebel † has succeeded in producing apospory artificially in various ferns, obtaining prothallia, sporophytes, and intermediate structures. He finds that regeneration is more active in young than in older leaves; that the product of regeneration is not necessarily a sporophytic structure; that there seems to be no great difference between the nuclei of prothallia and those of sporophytes, and so no sharp distinction between the x and $2x$ generations.

Genus Antrophyum.‡—R. C. Benedict treats of the genus *Antrophyum*, giving a synopsis of its sub-genera and of the American species. Four sub-genera are distinguished, one of them being new, *Antrophyopsis*, which comprises five African species, *A. Boryanum* being the type. Nine American species are recognised and re-described. Two of them are new, *A. Dussianum* from the West Indian Islands, and *A. Jenmani* from British and French Guiana.

Bryophyta.

(By A. Gepp.)

Apospory and Sexuality in Mosses.§—Él. and Ém. Marchal give an account of the methods and results of their experiments undertaken to determine the sexuality of the protonemas obtained by cultivation of portions of pedicel and theca of the maturing sporogonium, Stahl and others having already shown the possibility of obtaining such a protonema by regeneration. Results were obtained with fourteen species, but only those derived from three dioicous species, *Bryum caespiticium*, *Mnium hornum*, and *B. argenteum*, are now published. 1. The aposporic protonema resulting from the regeneration of the sporophyte is morphologically identical with the haploidic protonema; placed in favourable conditions it is apt to produce gonophytes. 2. These gonophytes are bisexual, like the sporogonium, from which they emanate. 3. This double sexual polarity expresses itself in the

* Flora, xcviii. (1907) pp. 101–62 (figs.).

† SB. k. Akad. Wiss., xxxvii. (1907) pp. 119–38 (figs.). See also Bot. Gazette, xliv. (1907) p. 317.

‡ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 445–58.

§ Bull. Cl. Sci. Acad. Roy. Belg., 1907, pp. 765–89. See also pp. 728–30.

production of synoicous flowers. These latter, however, are always accompanied in a predominant proportion by flowers which, by a latent influence, manifest only male polarity, or very rarely by flowers of female character. 4. The gonophytes which produce these male or female flowers are, nevertheless, also virtually bisexual, this bisexuality revealing itself immediately in the products of regeneration when synœcism reappears. 5. The protonema arising by regeneration of the sporogonium consequently gives birth among species, however strictly dioicous, to a new form, hermaphrodite, or more exactly, androgyno-synoicous, capable of reproducing itself indefinitely in an asexual manner.

Classification of Families and Genera of Mosses.*—V. F. Brotherus publishes a further contribution to the section Musci in Engler and Prantl's "Die natürlichen Pflanzenfamilien." He finishes the family Hookeriaceæ and treats of the Hypopterygiaceæ (with three genera), Helicophyllaceæ (two genera), Rhacopilaceæ (one genus), Leskeaceæ (twenty-three genera arranged in five groups). A large portion of the group Thuidieæ stands over for completion in the next part of the work.

European Hepaticæ.†—K. Mueller, of Freiburg, publishes the fifth part of his monograph of the European Hepaticæ in Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz, and gives full descriptions of the following genera of Marchantiaceæ with their species: *Reboulia*, *Grimaldia*, *Neesiella*, *Fimbriaria*, *Fegatella*, *Lunularia*, *Exormotheca*. *Dumortiera*, *Bucegia*, *Preissia*, *Marchantia*. Passing on to the second great division of hepatics—Jungermanniales, he begins the consideration of the section Jungermanniaceæ Anakrogynæ by describing *Sphærocarpus* and *Riella*.

Mossflora of Northumberland.‡—H. N. Dixon publishes a list of the mosses he collected in Northumberland in the summer of 1905, and of the species recorded by other bryologists, indicating the probable inaccuracy of some of these records.

French Mosses.§—R. Sebille gives a list of some rare or interesting species of the bryological flora of Saône-et-Loire. It consists of 139 species, chiefly authenticated by the late M. Philibert. In subsidiary lists are grouped the species of Mediterranean type, those of Alpine type, and those of the Atlantic coast type. G. Dismier ‖ gives a list of rare species found in the Vallée de la Voulzie near Provins (Seine-et-Marne).

North American Mosses.—E. G. Britton¶ publishes some notes on the nomenclature of North American mosses, with special reference to a recent part of Brotherus' monograph of mosses in Engler and

* Leipzig: W. Engelmann, i. abt. 3 (1907) pp. 961–1008 (figs.).
† Leipzig: E. Kummer, vi., lief. 5 (1907) pp. 257–320.
‡ Proc. Berwick Nat. Club, xix. (1907) pp. 305–26.
§ Rev. Bryolog., xxxiv. (1907) pp. 114–22.
‖ C.R. Congrès Soc. Sav., 1906, 3 pp.
¶ Bryologist, x. (1907) pp. 100-1.

Prantl's Die natürlichen Pflanzenfamilien. A description is given of *Pterygophyllum acuminatum* Par., an East Indian species now stated to have *Hookeria Sullivantii* C. Muell. as a synonym, having a distribution from Ohio to Guadeloupe and in South America.

A. Lorenz* publishes some further notes upon the bryophytes of Waterville in the White Mountain territory of New Hampshire, an incompletely explored region.

C. H. Demetrio† gives a list of 100 mosses collected in various parts of Missouri.

E. J. Winslow‡ describes the dehiscence of capsules and dispersal of spores which he had the good fortune to observe in process of execution in *Sphagnum* growing in a swamp in Vermont on a sunny morning in August.

Mosses of Madeira.§—A. Luisier publishes a note on some bryological additions to the flora of Madeira collected by C. A. de Menezes. The two genera *Cinclidotus* and *Brachymenium* have never previously been recorded for the Atlantic islands. Menezes has discovered *Cinclidotus fontinaloides* var. *madeirensis* Card. and *Brachymenium philonotula* Hpe., which latter, like *Philonotis obtusata* C.M., is a Madagascan species. Similarly in the Azores are found species whose affinity is with those of the African islands. Menezes has also discovered a new variety, *Astrodontium Treleasei* var. *latifolium* Card.

Muscineæ of the Canary Islands.‖—Pitard, Corbière and Negri publish an account of the principal Canary Islands, a bibliographical index and a catalogue of the Muscineæ with their stations, including 101 mosses, 20 of which are new to the flora, and 62 hepatics, 18 of which are new records for the Canaries and 3 new to science.

Arctic Muscineæ.¶—N. Bryhn publishes an enumeration and description of the bryophytes collected during the second Norwegian Polar expedition. These include 57 hepatics and 233 mosses, several of which are new and four are figured.

A. Hesselbo ** publishes a list of the Andreæales and Bryales found in East Greenland, between 74° 15′ and 65° 35′ lat. N., in the years 1898–1902. They were collected during several expeditions by Kruuse and Hartz, and amount to 132 species, several of them being new to the local flora.

Sphagna of Alaska.††—W. A. Setchell gives a summary of the cryptogamic work of the University of California Botanical Expedition to Alaska in 1899, and adds a list of some previously unreported Alaskan Sphagna, determined by C. Warnstorf, including 21 species and forms.

* Bryologist, x. (1907) pp. 102–3.
† Tom. cit., pp. 103–6. ‡ Tom. cit., p. 111.
§ Bull. Soc. Portugaise Sci. Nat. Lisbonne, i. (1907) p. 71.
‖ Mém. Soc. Bot. France, 1907, 44 pp.
¶ Vidensk.-selsk. Kristiania, 1906, 260 pp. (1 pl.).
** Meddelelser om Grönland, xxx. (1907) pp. 315–32.
†† Univ. of California Publications, Botany, ii. (1907) pp. 309–15.

Mosses of Antarctic America.*—P. Dusén publishes the fifth part of his contributions to the bryology of the Magellan region, West Patagonia, and South Chili. It contains records of 34 species, 13 of which are described for the first time, some by Dusén and some by Brotherus. One change of name is announced, from *Grimmia pachyphylla* Dus. to *G. Dicksonii* Dus. Six plates and two text-figures show the points of the new species.

Portuguese Species of Fissidens.†—A. Luisier publishes a note upon some Portuguese species of *Fissidens*. He describes a new variety of *F. serrulatus* called *Henriquesii*. *F. Welwitschii* he considers to be only a variety of *F. polyphyllus*. According to Bottini the latter species is a variety of *F. serrulatus*, and *F. Welwitschii* a mere form of the same. *F. polyphyllus* var. *Newtoni*, another Portuguese moss, is described in Husnot's Muscologia Gallica.

Genus Ephemerum.‡—C. Douin has made a study of *Ephemerum stellatum*, and is able to correct and complete the published descriptions of the plant. He gives numerous figures showing the development of the spores, the sterile and fertile plants under different aspects, the leaves, capsule, calyptra, etc. He also provides a key to the European species of the genus.

Two Species of Sphærocarpus found in France.§—C. Douin discusses in detail the species of *Sphærocarpus* found in France. A close study of much material has shown him that two species, distinguishable only by their spores, occur in France—*S. terrestris* and *S. californicus*. He describes carefully the development of the spores and shows how the mature tetrads differ in the two species. The *S. terrestris* described by Boulay in his Hépatiques, p. 178, is most probably *S. californicus*, which appears to be more common in France than the true *S. terrestris*. The spores in both species remain permanently united in tetrads. They are larger, yellowish, more loosely reticulated, cristate, not spinose, in *S. californicus*; whereas in *S. terrestris* they are smaller, obscure, black, of much smaller more numerous meshes, with crests very black and bearing numerous sharp black spines.

Variable Peristome of Philonotis.‖—G. Dismier discusses the specific value of the interlamellar thickenings of the peristome-teeth in the species of the genus *Philonotis*. He shows how several recent authors have employed these structures as diagnostic characters, and gives the results of his own observations, that the presence or absence of these structures is unstable and is of no value in the discrimination of species, and that their degree of development varies much from one specimen to another. *P. media* Bryhn is but *P. Macouni* (= *P. Ryani*) with the interlamellar protuberances absent. *P. rivularis* Warnst. is the same as *P. marchica*, but has the protuberances inconspicuously developed.

* Arkiv Botanik., vi. (1907) 32 pp. 6 plates, figs. in text.
† Bull. Soc. Portugaise Sci. Nat. Lisbonne, i. (1907) pp. 15–21 (9 figs.).
‡ Bull. Soc. Bot. France, 1907, pp. 242–51, 306–26 (80 figs.).
§ Rev. Bryolog., xxxiv. (1907) pp. 105–12 (figs.).
‖ Tom. cit., pp. 112–14.

Peculiar Unattached Mode of Growth of Leucobryum.*—W. H. Burrell describes the common but insufficiently known occurrence of *Leucobryum glaucum* in the form of unattached flattened balls, measuring 1–2 inches in diameter. They are found with normal attached tufts under beech-trees, where they tend to be kicked about by game-birds and other animals that feed upon beech-nuts. The thick spongy water-retaining nature of the leaves, and the free formation of adventitious buds, are other factors that contribute to the production of the cushions, as the plants contain a sufficiency of water for prolonged independent growth, and the numerous buds swelling out tend to produce a ball of branches radiating from near a common centre. The author cites a description by H. N. Dixon of unattached balls of *Porotrichum alopecurum* in moist hollows in Weldon Quarries in Northamptonshire. These balls measure 2–5 inches in diameter, and consist of profusely branched stems.

Thallophyta.

Algæ.

By Mrs. E. S. Gepp.

Regeneration of Algæ.†—S. Prowazek has been studying the subject of regeneration of algæ at intervals for the last six years, and he now publishes the most important of his results. His investigations were made on the following species: *Spirogyra Weberi* Kütz., *Mougeotia genuflexa* Ag., *Ulva lactuca*, *Cladophora*, *Bryopsis plumosa*, *Vaucheria sessilis*, *Valonia*, and *Ectocarpus*. His results are described under the following headings: 1. Phenomena which arise during or immediately after infliction of the wound (irritation and wounding phenomena). 2. Regeneration and reparation phenomena in the narrow sense. 3. Regeneration phenomena which exceed the original limit of form-structure. The paper is illustrated by text figures.

Influence of External Conditions on the Asexual Reproduction of Algæ.‡—H. Freund describes the experiments which he has made on this subject, with the results at which he has arrived. Among some of the conditions with which he experimented are temperature, intensity of light, increase and removal of nutritive salts, etc. The first plant dealt with is *Œdogonium pluviale*, and after detailing many series of experiments, he gives an interesting comparison between *Œ. pluviale*, *Œ. diplandrum*, and *Œ. capillare*. *Hæmatococcus pluvialis* was also treated. A section devoted to general considerations is followed by a summary of the results of this work.

In *Œ. pluviale* and *H. pluvialis*, the external conditions necessary to the formation of zoospores differ according to the previous conditions of growth. The significance of inorganic salts for the formation of zoospores in both algæ depends in the first place upon their chemical properties. After treatment with Knop's nutritive solution, *Œ. pluviale* forms zoospores, if nitrate and phosphate have been withheld. Diminu-

* Bryologist, x. (1907) pp. 108–11 (figs.).
† Biol. Centralbl., xxvii. (1907) pp. 737–47 (11 figs. in text).
‡ Flora, xcviii. (1907) pp. 41–100.

tion of light does not provoke formation of zoospores in plants grown in nutritive solution: while on the other hand they are produced both by diminution of light and by transference into diluted nutritive solution. *Œ. pluviale* also produces zoospores when it has been cultivated in cane-sugar solution and this is replaced by diluted Knop's solution.

Resting cysts of *H. pluvialis* which have lived in old foul water in bright light, develop swarm-spores when transferred to distilled water, or when provided with suitable nitrates (nitrate, nitrite, ammonium salts). Light is not necessary to produce this result, though it enhances the effect considerably. Cysts of *H. pluvialis*, which have been for a long time in darkness, form swarm-spores when they are again lighted or when they receive cane- or grape-sugar.

Algal Vegetation of Ponds.*—N. Walker has examined certain ponds situated above the Bramhope railway tunnel, near Leeds, occupying excavations in clay which were made sixty-seven years ago. He mentions three available sites for algæ, and gives the species found on each. Site 1: Winter shoots of *Œnanthe fistulosa* which form a pale green zone, from 2–3 yards wide, extending from the edge of the pond to a depth of about 9 in. Several factors which probably control the succession of algal associations are mentioned, and the species occurring in the various months are enumerated. Site 2: Shoots of *Potamogeton natans* and *Sparganium ramosum* occurring in the deeper water (1–3 ft.). The vertical distribution of the algæ on these shoots is in some cases striking, and seems to be affected by surface commotion caused by wind and by differences in the illumination. Species of *Œdogonium* and *Bulbochæte* are followed by *Spirogyra Weberi* and other filamentous algæ, to be displaced in their turn by species of *Mougeotia* and Desmids. Site 3: Short decaying shoots of the smaller flowering plants, which cover the floor of the pond in shallower parts not occupied by *Œnanthe*. The dominant alga is *Glœocystis vesiculosa*. In one shallow pond with deep mud, *Spirogyra longata* dominates throughout the year. The movement of *Phormidium inundatum* along the filaments of *Spirogyra* from the bottom to the surface is described.

New Green Algæ.†—F. S. Collins describes five new species, some of which have already been distributed in the Phycotheca Boreali-Americana. They are only in part from New England localities, but so general is the distribution of plants of this class that the author states they may be found in any temperate locality. The species in question are: *Pleurococcus marinus*, *Chætomorpha chelonum*, *Cladophora amphibia*, *Vaucheria longipes*, and *V. Gardneri*. The two species of *Vaucheria* are figured.

Copulation and Germination of Spirogyra.‡—A. Tröndle is the most recent investigator of *Spirogyra*. Other writers have left doubtful certain details in the behaviour of the nuclei with regard to sexual processes, and the present author is able to add fresh facts on these points. He describes phenomena which vary from those generally known,

* Rep. Brit. Assoc. York, 1906, pp. 758–9.
† Rhodora, ix. (1907) pp. 197–202 (1 pl.).
‡ Bot. Zeit., lxv. (1907) pp. 187–217 (1 pl., 13 figs. in text).

both in the preparations for copulation and in the topography of the copulating cells. The subject is treated under the headings: 1. Notes on the morphology of the process of copulation; (*a*) *Spirogyra neglecta*: (*b*) *S. spréeiana*. 2. Ripening of the zygotes; (*a*) starch and oil; (*b*) the chromatophores; (*c*) the nuclei. 3. Structure of the ripe zygotes; (*a*) contents; (*b*) membrane. 4. Germination of the zygotes. 5. Law of numbers and reduction of the chromatophores and chromosomes. The results are set forth in a detailed summary, and a list of literature is given. The paper is illustrated by a plate and text-figures.

Sargassum bacciferum.*—C. Sauvageau combats the statements of certain authors that *S. bacciferum* has been found growing attached anywhere, and declares definitely that this is not the case. It is to be regretted that the error should have been so widely accepted. The original home of *S. bacciferum* has never been found, though the species is known in such quantity in the Sargasso Sea, as well as floating in the waters round Cape de Verde, the Azores, Bermuda, New Orleans, Guadeloupe, Brazil, Chili, Australia, New Zealand, and Ceylon. It is rarely thrown up on the shores of Europe. There are two alternative theories as to this species: either it grows in a fixed state on the shores of some country, whence it is wafted by currents far and wide and almost entirely in a sterile condition; or it has lived and vegetated from time immemorial in a floating condition and propagated itself by budding. Piccone regards it as indicating a former tract of land now submerged, the ancient Atlantis. The present author suggests that collectors might do something towards unravelling this mystery by collecting and examining the plants which are growing among the drifting *Sargassum*, since some of these might be sufficiently characteristic to reveal their place of origin.

Sexuality of Halopteris scoparia.†—C. Sauvageau, the first discoverer of heterogamic sexuality among the Sphacelariaceæ, has found organs resembling antheridia in dried specimens of *Halopteris brachycarpa*, *H. congesta*, and *H. hordacea*. So far as he could tell, the oogonia are unilocular and inclose a single large oogonium. A still more interesting discovery has been made by this author, namely that of sexual organs on the well-known species *Halopteris* (*Stypocaulon*) *scoparia*, so widely distributed in Europe, the Atlantic, and the Mediterranean. The asexual organs are very common in winter, although the germination of the zoospores has never been followed. In December 1903, the author collected 26 examples of *H. scoparia* thrown up on the coast between Biarritz and S. Sebastian, and preserved them without any special care. On examination he found that while 25 of these had only asexual organs, the other one had instead oogonia and antheridia. These organs occupy the same position as the sporangia. The oogonia apparently contain only one oosphere, which measures about 100μ. In the hope of obtaining further material bearing sexual organs, the author collected plants from the warmer seas of Teneriffe, and he also examined plants from

* C.R. Soc. Biol. Paris, lxii. (1907) pp. 1082–4.
† Tom. cit., pp. 506–7.

Banyuls in the Mediterranean, but without success. The sexuality therefore of *H. scoparia* rests on the testimony of a single specimen, and it may be fairly deduced that the occurrence of antheridia and oogonia is extremely rare.

Aglaozonia melanoidea.*—In two interesting notes, C. Sauvageau adds largely to our knowledge of *A. melanoidea* and its life-history. He succeeded in finding it in the Gulf of Gascony, and now he finds it at Banyuls in the Mediterranean; besides which the late Anna Vickers dredged it up in the Bay of Naples. After Sauvageau had found it in the Gulf of Gascony, he put forth the theory that *A. melanoidea* might be the sporophyte of *Cutleria adspersa*. One objection to this theory was that *A. chilosa* would then be left without a gametophytic generation; and another was that *A. melanoidea* was then unknown in the Mediterranean. This latter objection has been now done away with. The plant found by Anna Vickers is an intermediate state between the sterile plants from Guéthary and the fertile ones from Banyuls. These fertile specimens were collected in December 1905 and January 1906, and were found to have sporangia grouped in sori, each of the rows of cells of a sorus being surmounted by an elongated sporangium. At the end of February and at the end of June, the plants were once more sterile, and corresponded with the specimens gathered at Guéthary. The sporangia contained eight zoospores, similar to those of *A. parvula*. The latter species is less common at Banyuls than is *A. melanoidea*. Cultures of the zoospores of *A. melanoidea* were made, and the results were extremely interesting. Hundreds of plantlets were produced, all showing the same character. They consisted of monosiphonous, very slender filaments, 2–4 mm. long, having long cells below. The shorter, less branched, plantlets were either sterile or nearly so, while the longer plantlets, much branched halfway up, were very fertile, bearing antheridia and oogonia in all stages of development. None of these plants resembled a young *Cutleria*: indeed, had their life-history not been known they would have been regarded as a new genus intermediate between *Ectocarpus* and *Cutleria*. The author designates this form "form Kuckuck," since that author had previously obtained certain confervoid filaments from a culture of *Aglaozonia parvula*. The actual position and signification of "form Kuckuck" in the life-cycle of *Cutleria* cannot at present be stated, but various suggestions are made by the author.

Algæ of the 'Valdivia' Expedition.†—T. Reinbold publishes his report on the marine algæ of the German 'Valdivia' Deep-sea Expedition (1898–9). The areas from which the specimens came are the Canary Islands, Cape of Good Hope, Bouvet Island, Kerguelen Island, the islands of St. Paul and New Amsterdam, Sumatra, Nicobar Islands, Diego Garcia (Chagos Archipelago), Mahé (Seychelles), Dar-es-Salaam, Red Sea; 162 species are enumerated, and 4 of these are new to science. The largest collections were made in Kerguelen, Sumatra, Diego Garcia, Mahé, and Dar-es-Salaam. In his general remarks on

* Tom. cit., pp. 139–41 and 271–2.

† Wiss. Ergebn. Deutsch. Tiefsee-Exped. 'Valdivia,' ii. 2 (1907) 38 pp. (4 pls.).

the algæ of the Indian Ocean, the author gives a list of areas the algæ of which are well known, insufficiently known, and slightly or not at all known, appending the titles of the more important papers, geographically arranged. The unknown areas are the Mozambique Coast, Delagoa Bay, much of the Indian Coast, Persian Gulf, and many small islands. The present paper fills in some of the gaps in treating of the islands of Diego Garcia and Mahé. In studying the algal distribution in the Indian or any other ocean, it is essential to have an accurate knowledge of the various ocean-currents—the most important factor in their distribution, carrying not only those species which float by means of air-vesicles, but also species parasitic upon them and the spores of many other species. The main currents in the Indian Ocean are as follows: South of the equator flows the great equatorial current from east to west, which upon striking the north point of Madagascar splits into two branches—the Agulhas and the Mascarene currents. The latter flows south, while the former, passing round west of Madagascar and sending out a small branch northwards, flows down the east coast of Africa. This warm Agulhas current is met south-east of the Cape of Good Hope (in about 40° S. lat.) by cold antarctic currents which deflect it to the east where it joins up again with the Mascarene current, and these united flow across to Cape Leeuwin, in West Australia, accompanied by cold currents on the southward side. At Cape Leeuwin a portion of this warm current, turning northward, unites again with the equatorial current, thus completing its circuit. Another and less important current runs south of the equator, but north of the aforesaid equatorial current and in the contrary direction—namely, from west to east. By the help of the above currents there is a possible means of communication between the marine floras of the Malay Archipelago and West Australia and those of the Mascarenes and Madagascar, as well as of the east coast of Africa.

The rest of the paper is devoted to a consideration of the character of the algal flora of the Indian Ocean. Taken as a whole it does not appear to have any very distinctive flora of its own. In the southern parts the character is that of the subantarctic zone. As regards the tropical parts the west and north have a fairly uniform character, but the east exhibits signs of the influence of West and North Australia and of the Pacific Ocean.

Bocat, L.—**Sur la Marennine de la Diatomée bleue; comparaison avec la Phycocyanine.** (On the Marennin of the blue diatom: comparison with Phycocyanin.)
[A chemical analysis of the blue coloration of *Navicula ostrearia*, designated by E. Ray Lankester as Marennin.]
C.R. Soc. Biol. Paris, lxii. (1907) pp. 1073–5.

Duggar, B. M.—**The Relation of certain Marine Algæ to various Solutions.**
[Plasmolytic experiments with various isosmotic solutions of sodium chloride, potassium nitrate, and sugar; also the poisonous action of certain salts of the alkalies and alkaline earths upon marine algæ.]
Trans. Acad. Sci. St. Louis, xvi. (1906) pp. 473–89.

Edwards, A. M.—**The so-called "Infusorial Earths," and their Chemical Analyses.**
Chemical News, xcv. (1907) pp. 241–5.

Mazza, A.—**Saggio di Algologia oceanica.** (Contributions to marine algology.)
[A continuation.] *Nuov. Notar.*, xviii. (1907) pp. 177–95.

SAUVAGEAU, C.—**Le verdissement des huîtres par la diatomée bleue.** (The green coloration of oysters by the blue diatom.)
[A long treatise, dealing exhaustively with all past work on the subject, and giving a bibliography of 91 works.]
Soc. Sci. d'Arcachon, x. (1907) 128 pp.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Cytology of Synchytrium.*—S. Kusano selected for this research a still undescribed species, *Synchytrium Purerariæ*. He devoted his attention to the relation between parasite and host, and comparisons are drawn between the results obtained and those of other workers in the same field. In the species examined no resting spores are formed, but sporangia can pass the winter within the tissue of the hosts and produce swarm-spores in spring. These spores probably enter by the stomata and find their way to non-chlorophyll, sub-epidermal cells. The parasite grows within the cells of the host, absorbing the walls and those of the neighbouring cells, or compressing them to make room for its large size, and thus, from being intracellular, comes to occupy an intercellular lysigenetic space. When growth finishes, a hyaline membrane is formed round it, and the whole contents break up into spores, which are ejected by the swelling up of the surrounding host-cells. Kusano found that the cytoplasm and nuclei of the host remained healthy, and though they eventually disappear, that is due probably to self-disorganisation.

Specialisation in Erysiphaceæ.†—G. M. Reed selected *Erysiphe Cichoracearum* for a series of experiments in this field. He recalls the work done on these lines, and gives his own results. The spores of the fungus were sown on 23 varieties of Cucurbitaceæ belonging to three different genera. There was no difficulty in obtaining inoculation in any instance ; the fungus spores taken from any species when transferred, grew at once on any other species. He contrasts his results with those of Salmon, who found some five physiological species in *Erysiphe graminis*. He considers that the species he was dealing with probably represents a less primitive form than the one on grass, and that it has become adapted to a larger number of hosts.

Parasitism of Valsa.‡—Spieckerman examined a number of pear-trees that had died, and found the branches beset with *Valsa cincta*. In cultures he produced pycnidia, but attempts at infection in the open gave only negative results. He concludes that the *Valsa* is a wound parasite, that it gains entrance, and then penetrates deeply into the sound tissue. The affected trees were all in a moist locality. An epidemic among cherry-trees was traced to the action of a *Cytospora*, also a "weak parasite," and the author includes these, and probably

* Centralbl. Bakt., xix. (1907) pp. 538–43 (1 pl.).
† Trans. Wis. Acad. Sci. Arts and Letters, xv. (1907) p. 527. See also Bot. Centralbl., cv. (1907) p. 536.
‡ SB. Nat. Ver. Preusz. Rheinl. Westf., 1907, pp. 19–27. See also Ann. Mycol., v. (1907) pp. 379–80.

many of the *Valseæ*, among the forms that may become parasitic in favourable surroundings.

Study of Fungi imperfecti.*—H. Klebahn is continuing his researches in this branch of mycology. He has succeeded in demonstrating the connection between *Marssonia juglandis* and the ascomycetous form *Gnomonia leptostyla*, both found on walnut leaves. Klebahn sowed the spores of *Gnomonia* on young leaves of the host-plant, and produced the *Marssonia* form. Intermixed with the rather large two-celled *Marssonia* spores he found small one-celled spores that have been wrongly described as a separate fungus under the name *Leptothyrium juglandis*. He also made gelatin cultures of the *Marssonia* spores, which he describes. The perithecia of the *Gnomonia* fruit carry the fungus over the winter, and to stamp out the disease it is only necessary to destroy the leaves in autumn or before the spring vegetation is formed.

Sexuality and Development of Ascomycetes.—Two papers on this subject have appeared recently. The first, by E. J. Welsford,† contains an account of the development of *Ascobolus furfurascens*. In this fungus the earliest stages show a scolecite of 6–10 usually similar uninucleate cells, which by division rapidly become multinucleate. The fourth cell from the end becomes larger than the others, and forms the ascogenous cell. The protoplasm and nuclei from the other cells of the scolecite pass into the ascogenous cell, where they fuse in pairs and enter the ascogenous hyphæ, which rise from that cell. These hyphæ grow out, bend over in the usual characteristic fashion, and form the asci. The author considers that the nuclear fusions in the ascogenous cell represent a reduced sexual process.

The second paper, by H. C. Fraser,‡ describes the sexual process in *Lachnea stercorea*, which the author sums up thus: (1) The archicarp of *Lachnea stercorea* consists of several cells, and terminates in a large, multicellular archegonium. (2) From the ascogonium a trichogyne, which is at first unicellular, but eventually consists of four, five, or six cœnocytic cells, grows out. Its terminal cell is much larger than the others, and may become continuous with the antheridium. (3) The antheridium, which is not always fully developed, is a unicellular cœnocytic sac; its origin could not be traced with certainty. (4) The male nuclei do not reach the ascogonium, but fertilisation of a reduced type occurs, the female nuclei fusing in pairs. (5) Ascogenous hyphæ, into which the fused nuclei pass, grow out from the ascogonium, and asci are formed, by the usual method, at their tips. (6) *Lachnea stercorea* is intermediate, with regard to its sexuality, between *Pyronema confluens*, on the one hand, and *Humaria granulata* on the other, and with regard to the organisation of its trichogyne, between *Pyronema* and certain of the Pyrenomycetes. Experiments were also made on spore germination in this species. They were treated with digestive fluids or with dung extract, and germination took place in about fifty hours

* Zeitschr. Pflanzenkr., xvii. (1907) pp. 223–37 (1 pl. and 2 figs.).
† New Phytologist, vi. (1907) pp. 156–61 (1 pl.).
‡ Ann. of Bot., xxi. (1907) pp. 349–60 (2 pls.).

after the beginning of the experiment. It was evidently induced by continued warmth and an alkaline medium, the action of which, in part at least is to cause softening of the wall of the spore.

Uredineæ.*—P. Dietel has described a series of new species of Uredineæ from Chili and Brazil, in South America. In most cases he is dealing with only one form of the rust.

J. Ivar Liro † gives an account of experiments with the rusts of Finland. For a number of forms he establishes the limits of growth, in others he confirms previous findings, and he gives also an account of his negative results. He experimented with *Melampsora Larici-tremulæ*, *Puccinia Æcidii-melampyri*, *P. Æcidii-rumicis*, *Uromyces Trifolii*, *Gymnosporangium*, and *Cronartium*.

J. C. Arthur ‡ treats of the Coleosporiaceæ, Uredinaceæ, and Æcidiaceæ in the recent issue of the North American Flora. He describes many new species. A number of names have been changed. The new genera are *Necium*, *Cionothrix* in the Uredinaceæ; *Cystingophora*, *Dicheirinia*, and *Discospora* in the Æcidiaceæ.

P. Magnus § publishes a note on the nomenclature of some recent species of *Uromyces* on Papilionaceæ. They have been wrongly named, and Magnus corrects the errors.

J. C. Arthur ‖ gives an account of his cultures of Uredineæ in 1906, the seventh series of such reports. Many of the cultures yielded negative results, and these are also recorded. One of the most interesting discoveries was the autœcious nature of flax rust, *Melampsora Lini*. This gives a good prospect of stamping out the rust by destroying the old flax straw on which the fungus lives during the winter.

A new species of *Diorchidium* is described by Th. Wurth.¶ The fungus causes deformations of the host-plant, especially of the leaf-stalk. The teleutospores of this fungus are vertically septate, giving two cells on one stalk; occasionally a third cell was formed at the side of the others. The new species is *D. Koordersii*.

Klebahn** publishes a series of twenty-six culture experiments with various Uredineæ. Some of these are amplifications or verifications of previous work, others deal with new questions of relationships and biological species. In his examination of *Phragmidium Rubi*, he remarks that though the many species of *Rubus* are closely related and difficult to separate, yet the fungus is very constantly selective in the species on which it grows, infecting some richly and dying out on others.

Rene Probst†† gives a series of results obtained with culture experiments of Uredineæ on Compositæ. He found four specialised forms within the species *Puccinia Hieracii*. He found also that *P. Leontodontis* grew only on *Leontodon hispidus*; that *P. Hypochœridis* was distinct

* Ann. Mycol., v. (1907) pp. 244–6.

† Acta Soc. F. & Fl. Fenn., xxix. No. 6 (1906) 25 pp. See also Ann. Mycol., v. (1907) p. 301.

‡ North American Flora, vii. (1907) pp. 83–100. See also Bot. Centralbl., cv. (1907) pp. 136–7.

§ Ber. Deutsch. Bot. Gesell., xxv. (1907) p. 340.

‖ Journ. Mycol., xiii. (1907) pp. 189–205.

¶ Hedwigia, xlvii. (1907) pp. 71–5 (4 figs.).

** Zeitschr. Pflanzenkr., xvii. (1907) pp. 129–57.

†† Centralbl. Bakt., xix. (1907) pp. 543–4.

from *P. Hieracii*, and also from *P. montevago*, a new form that grows only on *Hypochœris uniflora*. He established also two forms for *P. carduorum*.

Wilhelm Muller* has made an exhaustive study of the *Melampsoræ* on species of *Euphorbia*. He finds that they can be divided into definite classes according to the form of the teleutospore and the thickness of the wall. He divides them thus into five different types. He finds, further, that those with elongate spores and thickened apex belong to southern lands, while those with short thin-walled spores are found in Middle and North Europe. It is possible also that the length of the spores corresponds with the length of the palisade cells. Measurements and drawings of the teleutospores of many of the species are given, and the size of both teleutospores and uredospores are printed in tabular form.

Morphology of the Rusts.†—A. H. Christman reviews the theories held by successive workers on the origin of the different stages in the life-cycle of the Uredineæ, and then proceeds to give his own interpretations which he bases on the examination of certain spore types that do not originate in a fusion-cell. He finds one of these types in the secondary uredospores of *Phragmidium Potentillæ-canadensis*. They arise from a large basal cell which contains two nuclei, and is, he considers, equivalent to the basidium or basal cell of the *Æcidium* and teleutospore stages. Conjugate division of the basal cell-nuclei takes place, and an upper cell is cut off—the first spore initial cell. The division of this cell provides the stalk and the uredospore, the stalk corresponding to the sterile cell in the *Æcidium*. Meanwhile the basal-cell has budded out and formed another uredospore initial cell. The difference between this formation and that of the primary uredosorus is, that in the latter the underlying mycelium is uninucleate, while the mycelium from which the secondary spores arise is binucleate. Christman also examined a teleutospore form, *Puccinia Podophylli*, and found a similar series of phenomena to that already described. Occasionally trinucleate cells were observed, suggesting possible pathological migrations of nuclei.

Christman holds with Blackman that the sporophyte stage begins with the associated nuclei in the basal cell, and that there is a series of asexual reproductive cycles within the sporophyte generation. The gametophyte he considers to be the primitive original generation, and the autœcious rusts probably older than the heterœcious.

New Boletus.‡—S. Belli describes at some length *Boletus sardous* sp. n., which grows throughout Sardinia. The very bulbous stem, large pores, and the colour and form of the spores, differentiate it completely from the two species most nearly allied, *B. granulatus* and *B. badius*. It grows most abundantly under *Cistus* trees. The fungus is reproduced in a coloured plate.

Recent Work on Fungi.§—I. Gallaud continues his review of the different papers that have been published, especially on the cytology of

* Centralbl. Bakt., xix. (1907) pp. 544–63 (31 figs.).
† Bot. Gazette, xliv. (1907) pp. 81–100 (1 pl.).
‡ Atti Accad. Sci. Torino, xlii. (1907) pp. 1024–30 (1 col. pl.).
§ Rev. Gén. Bot., xix. (1907) pp. 459–64 and 506–12 (11 figs.).

this large group. In the two contributions cited he confines himself to the Basidiomycetes and Uredineæ. He finds that in the first group a much more extensive research is required before any certainty can be reached. He quotes largely from R. Maire, who described the associated nuclei of the Basidiomycetes as a synkarion, and who traces their history throughout the life of the plant. Galland also lays much stress on Blackman's research in the Uredineæ.

New Hymenomycetes.*—W. A. Setchell describes at some length two hypogæous Secotiaceæ. They are not entirely subterranean, but develop under a covering of dead leaves and other debris. *Secotium tenuipes* looks when uncovered like a *Bolbitius* or *Coprinus*, and is about 2 in. in height. The gleba is formed of anastomosing plates or gills; the spores are yellowish-brown. The second species, *Elasmomyces russuloides*, looks like a young *Russula*. A section shows the hymenogastroid nature of the pileus. The spores are colourless and reticulate.

Diseases of Plants. — F. L. Stevens † has investigated the *Chrysanthemum* Ray Blight, by cultivating the fungus on agar media, by infecting other plants, and following the development of the parasite. He finds it to be one of the Sphæropsideæ, *Ascochyta Chrysanthemi* sp. n. It attacks the flower often while in the bud, blackening the receptacle, peduncle, and stem. No higher fruiting form was distinguished.

E. Henry ‡ writes on the pine disease in the Jura forests. The branches affected by the disease become yellowish at the extremities, then red. The young branches alone are attacked; the mycelium penetrates to the cambium and kills it all round the branch. The pycnidia of the fungus, a species of *Phoma*, are produced in the cortex and pierce the bark. No trees have been killed, and, as the fungus has disappeared once, it is hoped that it will again die out. No remedy for it has been found.

A pine disease that has done considerable damage in the Jura has been diagnosed as due to the action of *Phoma* on the leaves. Prillieux and Maublanc § give an account of the fungus, and they recommend planting of beech-trees among the pines as an almost certain means of checking the spread of the disease.

Ch. Bernard ‖ describes a disease of coco-palms caused by *Pestalozzia palmarum*. The spores of the fungus were found to germinate very easily and quickly in cultures and to infect fresh plants with equal rapidity, which accounts for the spread of the disease. Only quite young plants suffered. An account is given of methods of killing the fungus.

Several instances of fungoid attacks have been notified to the Board of Agriculture.¶ *Helminthosporium gramineum* was found on wheat. Celery plants were suffering from the leaf-blight *Cercospora Apii.*

* Journ. Mycol. xiii. (1907) pp. 236–41 (1 pl.).
† Bot. Gazette, xliv. (1907) pp. 241–58 (15 figs.).
‡ Comptes Rendus, cxliv. (1907) pp. 725–7.
§ Tom. cit., pp. 699–701.
‖ Bull. Agric. Indes Neerland, ii. (1906). See also Bot. Centralbl., cv. (1907) pp. 433–4.
¶ Journ. Board of Agric., xiv. (1907) pp. 416–17.

These diseases can be checked or cured by suitable spraying. *Capnodium Footii* and *Sphærotheca Mali* were found on the same plum-tree, both of them leaf-fungi, the latter the more deadly of the two.

An account is given of gooseberry "cluster-cup disease." * The *Æcidia* going on the leaves and fruit, the uredo- and teleutospores on sedges. The disease rarely assumes the proportions of an epidemic.

L. Petri † has studied and described a malady of olives that has been attacking the plants in Tuscany for two years. It appears as pale, then reddish, yellow depressed spots on the fruit. He diagnosed the fungus causing the spots as *Cylindrosporium Olivæ* sp. n., one of the Melanconiaceæ. Petri found that it was not a wound parasite, but that the glands of the epicarp offer the points of attack.

The same writer ‡ describes a disease of pines due to the fungus *Cytosporella damnosa* sp. n. It attacks the twigs, and the leaves above the point of attack wither and die. The fruits of the fungus are deeply imbedded in the cortex, and do not at first show any disturbance of the bark. The cambial zone is destroyed by the mycelium, which also invades the tracheides of the wood, and disturbs the transport of water and salts to the apical regions.

In a further paper L. Petri§ describes the galls produced on the leaves of *Azalea indica* by *Exobasidium indica.* The extent of the deformation of the leaves depends on their state of maturity, the later the attack the less change takes place in the tissues. He describes the infection and the course of the mycelium within the plant. The principal change is the multiplication of the vascular elements, and still more the great development of the parenchyma, the latter accounting for the increase in size.

H. M. Quanjer ‖ gives an account of various organisms that are harmful to species of *Brassica.* He deals chiefly with insects, but he also describes the mischief done by the fungus *Phoma oleracea.* In the plants attacked, the wood-vessels became hard and filled with brown gum. It has been proved that infection is not conveyed with the seeds. Insects play a considerable part in carrying the spores.

J. Behrens ¶ renders a report of plant-diseases in Baden. Plums suffered from the attacks of *Monilia*, the weather in spring having been peculiarly favourable for the development of the fungus. The occurrence of rust and smut is also noted, though the harvest was not seriously impaired.

L. Mangin ** gives further information concerning the red disease of pines in the Jura. Several of the microfungi found on the trees have been satisfactorily proved to be saprophytes. There remain, however, some that are parasitic and harmful. Among these *Phoma abietina* and *Æcidium elatinum* are the most noteworthy, but none of them are of any serious importance.

* Journ. Board of Agric., pp. 428–9 (8 figs.).
† Ann. Mycol., v. (1907) pp. 320–5 (5 figs.).
‡ Tom. cit., pp. 326–32 (1 pl.). § Tom. cit., pp. 341–7 (8 figs.).
‖ Zeitschr. Pflanzenkr., xvii. (1907) pp. 258–67.
¶ Ber. Groszh. Bad. Landw. Vers. August (Karlsruhe, 1906) 109 pp. See also Zeitschr. Pflanzenkr., xvii. (1907) pp. 270–1.
** Comptes Rendus, cxlv. (1907) pp. 934–5.

Diseases of cereals due to *Sclerospora graminicola*, one of the Peronosporeæ, are described by E. T. Butler.* The fungus causes malformation of the host either in the flower or in the stem and leaves; a full description of the fungus is given, and a systematic account of the genus.

Black disease of peach-trees is due to *Cytospora rubescens*. F. M. Rolfs † has described its growth and action on the host. He concludes that it is the pycnidial form of *Valsa leucostoma*.

New or Rare Microfungi.‡—Under this title, A. Maublanc describes a number of new species of Pyrenomycetes and Fungi imperfecti, in some cases, following the germination of the spores and the development of the mycelium. A new genus, *Ceratopycnidium*, also one of the Fungi imperfecti (Excipulaceæ), is recorded. It grows on the excreta of insects on leaves. It does not enter the tissues nor affect the plant in any way. It forms small perithecia, with rather long, tapering beaks, and 2-celled colourless spores.

Mycology from the École de Pharmacie.—G. Bainier continues his studies of moulds, giving descriptions of a new species, and notes on species already known. Two new species of *Scopulariopsis* are described and figured. The conidiophore has the same type of branching as *Penicillium*, but the general habit of the plants is very different. *Gonatobotrys fuscum*; *G. simplex* and *Arthrobytrys superba* are also re-described, and their growth and development followed. In a third paper he gives an account of *Papulaspora aspergilliformis*, and of two new species of *Ascodesmis*. In these two genera the carpogonium is formed from a single mycelial branch. In the former other hyphæ grow out and form a covering; in *Ascodesmis* the asci are naked. All these fungi are carefully figured.

Preparation of Enzyme from a Fungus.‖—K. Okazaki describes a new species, *Aspergillus Okazakii*, and its economical value in the production of an enzyme. The fungus is entirely white and easily cultured; spores are mixed with prepared rice, which is then spread on boards and suspended in a suitable atmosphere. In a few days the substratum is covered with the white growth of the fungus. It is mixed with water, allowed to stand for a day, and then precipitated with absolute alcohol. The deposit is washed and dried in the usual manner, and placed on the market.

Localities of Fungi.¶—B. Studer-Steinhäuslin proposes two theories as to the occurrence of fungi in woods:—(1) That the mycelium of certain species is always associated with the roots of special trees, and therefore these fungi and the trees will always be found together. (2) That different fungi require different chemical constituents in the humus, which they find in the leaves of various trees. Some fungi grow

* Mem. Dept. Agric. India, ii. No. 1 (1907) 19 pp. (5 pls.). See also Bot. Centralbl., cv. (1907) pp. 573–4. † Science, xxvi. (1907) p. 87.
‡ Bull. Soc. Mycol. France, xxiii. (1907) pp. 141–9 (1 pl. and 7 figs.).
§ Tom. cit., pp. 125–40.
‖ Centralbl. Bakt., xix. (1907) pp. 481–4 (1 pl.).
¶ Mitth. Nat. Ges. Bern, 1906 (1907) xvii. pp. See also Ann. Mycol., v. (1907) pp. 381–2.

everywhere ; others prefer certain woodlands, but will also grow on other soil ; finally, a third group will only grow in certain special kinds of woods.

Staining of Fungus Spores.*—Josef Schorstein has been experimenting with spores of *Morchella esculenta* and their reaction to stains. The fungus was kept moist for a time, so that a number of spores germinated, then after some delay they were stained. It was found that the germinated spores alone had taken up the stain acid methyl-green, the germinating tube turning blue. After 12 hours the tube became green, and the remaining spores began to show coloration. Schorstein describes the physiological conditions inducing these differences in staining capacity.

FRIES, O. ROB.—**Anteckningar om svenska Hymenomyceter.** (Notes on Swedish Hymenomycetes.)
[Remarks on habitat and development of various Agaracineæ, Tremellineæ, etc.] *Ark. Bot.*, vi. No. 15 (1907) 31 pp.

KERN, F. DUNN—**New Western Species of Gymnosporangium and Roestelia.**
[Three new species of *Gymnosporangium* are described on juniper, and three species of *Roestelia* on *Cratægus* and *Amelanchier*.] *Bull. Torrey Bot. Club*, xxxiv. (1907) pp. 459–63.

MORGAN, A. P.—**North American Species of Agaricaceæ.**
[A continuation of the description of the Melanosporæ.] *Journ. Mycol.*, xiii. (1907) pp. 246–55.

MURRILL, W. A.—**Some Philippine Polyporaceæ.**
[A number of old and new species are described under Murrill's new nomenclature of the Polyporeæ.] *Bull. Torrey Bot. Club*, xiii. (1907) pp. 465–81.

PATOUILLARD, N.—**Basidiomycetes nouveaux du Brésil recuellis par F. Noack.** (Basidiomycetes collected in Brazil by F. Noack.)
[Seven new species are described.] *Ann. Mycol.*, v. (1907) pp. 364–6.

RICK—**Fungi Austro-Americani, Fasc. vii.–viii.**
[A list of 41 fungi, with notes. One new species is described.] *Tom. cit.*, pp. 335–8.

SACCARDO, P. A., & G. B. TRAVERSO—**Sulla disposizione e nomenclatura dei gruppi micologici da sequirsi nella "Flora italica cryptogamia."**
[The arrangement and nomenclature to be followed in the mycological groups of the "Italian Cryptogamic Flora."] *Tom. cit.*, pp. 315–19.

SYDOW, H. & P.—**Novæ fungorum Species. IV.**
[Ten new species described.] *Tom. cit.*, pp. 338–40.

" " **Verzeichnis der von Herrn Noack in Brasilien gesammelten Pilze.** (List of fungi collected by F. Noack in Brazil.)
[Some new species are included.] *Tom. cit.*, pp. 348–63 (1 fig.).

Lichens.

(By A. LORRAIN SMITH, F.L.S.)

Development of Lichen Apothecia.†—W. Nienburg has examined the apothecia of several forms of Lichens, and draws various interesting conclusions from the results of his research. He finds that in *Usnea* several carpogonia with trichogynes are developed under the cortex, all

* Ann. Mycol. v. (1907) pp. 323–4 (1 fig.).
† Flora, xcviii. (1907) pp. 1–40 (7 pls. and 3 figs.).

of them disappearing except one only, which forms the subhymenial layer. The hypothecium is entirely vegetative in origin and arises from the cortical cells. He contrasts this development with that of *Parmelia acetabulum*, in which the hypothecium is a product of the ascogonium, and the ascogenous hyphæ rise from the hypothecium through the subhymenium giving it a generative character as contrasted with its vegetative character in *Usnea*. The author concludes that *Parmelia* and *Usnea* are not so closely related as has been supposed, though he states that other *Parmeliæ* may not conform to this type.

A further study was made of *Cladonia* types with a view to throw light on the nature of the fruit in this family—whether the podetium is a secondary thallus or a highly developed excipulum. He quotes the work and views of various workers, and gives his own results. In *Bæomyces* he finds the stalk to be an elongate excipulum, in *Sphyridium* a small typical podetium or secondary thallus, and in *Icomadophila* a stage between the two forms. Further, he finds that *Bæomyces* is apogamous, since neither carpogonia nor trichogynes could be discovered. In *Icomaphila* he found both organs as well as numerous spermogonia, in *Sphyridium* carpogonia were much reduced and spermogonia were rare. Nienburg considers that there are not sufficient data to determine the nature of the *Cladonia* podetia.

Mycetozoa.

New Myxomycete.*—Louis Léger describes an organism allied to the Mycetozoa, or rather perhaps to the Acrasieæ. He found it living as a parasite in the bodies of *Coleoptera* from Algeria. The vegetative condition is to be found in or between the adipose cells of the insects, more particularly in the genital organs. The youngest stages are ovoid or spherical in form, with one nucleus ; later the form is amœboid and multinucleate, with from 2 to 8 nuclei. Nuclear division is by mitosis. The vegetative bodies increase by division. At the termination of this stage the substance breaks up into small uninucleate spores, though sometimes there are large multinucleate spores also. The Coleoptera do not seem to be seriously incommoded by the presence of the parasite. Léger names it *Sporomyxa scauri* g. et sp. n.

Cultural Experiments with Acrasieæ.†—Ernest Pinoy undertook a research to decide the connection, if any, between bacteria and mycetozoa. *Dictyostelium mucoroides* had been described as parasitic on bacterial colonies, and Pinoy proved this to be true. He isolated a fluorescent bacterium, and found that the spores of *D. mucoroides* would not germinate without the presence of this bacterium. He fonnd also that the myxamœbæ produced from the spores were nourished by the digestion of bacteria in their vacuoles, and that a diastase is formed which he calls *acrasidiastase*, by aid of which the bacteria are digested. The author examined by similar methods two other members of the group, *Dictyostelium purpureum* and *Polysphondylium violaceum*.

* Comptes Rendus, cxlv. (1907) pp. 837–8.
† Ann. Inst. Pasteur, xxi. (1907) pp. 622–56 (4 pls.).

He showed, among a series of corresponding results, the necessity for the presence of a bacterium in the culture, and the effects of different bacteria. He also followed the division of the nuclei and the formation of the spore heads.

Schizophyta.

Schizomycetes.

Morphology of Human Tubercle Bacilli in Saline Media.*— G. Péju and H. Rajat find that when tubercle bacilli are grown at 38° C. in peptone broth, to which has been added up to 4 p.c. of KI in a saturated aqueous atmosphere, and if after 15 to 18 days the growth is subcultured repeatedly into fresh similar medium, the bacilli of the later (5th to 6th) generations have become elongated, some forming filaments 50–60 μ long, some having lateral buddings : these buds appear to elongate into filaments which also have lateral buds, a mycelial appearance resulting ; but dichotomous division was never observed.

Subcutaneous Fibro-granulomata in Cattle.† — P. G. Woolley describes cases of subcutaneous granulomata occurring in Chinese cows, with appearances resembling actinomycosis. The tumours consisted of a fibrous envelope inclosing granulomatous tissue and a central cavity containing pus, from which on every occasion the author obtained, after a week or more, by culture on glycerin-agar, minute fine granular grey colonies of non-motile short thin rods ; these stained by the ordinary dyes, but not by Gram's method ; they were not acid-fast, but when stained with carbol-thionin or with 10 p.c. carbol-fuchsin they showed a beaded appearance. Growth was slow, and only obtainable on glycerin-agar. The organism was not pathogenic to monkeys.

Three Iron Bacteria.‡—D. Ellis describes three thread bacteria, that are covered with the red hydroxide of iron, and constitute the red deposit in the streams of the neighbourhood of Glasgow. 1. *Leptothrix ochracea* consists of a number of straight filaments often with unsymmetrical ends, and having a sharply contoured membrane ; they vary in width from 1·5–2 μ, though when covered with ferric oxide the width may be 3 μ or more, and the length attains 300 μ or over. Conidia arise by budding, the buds separating by constriction, though this is often delayed and the buds elongate to form new threads. The conidia are oval, 1·5 by 1 μ. Multiplication by cell-division also occurs. Motility was never observed. 2. *Gallionella ferruginea* is usually associated with the preceding, and is seldom found alone. In appearance it resembles a hairpin spirally twisted round itself ; the thickness of the threads varies from 0·5–1 μ. The author was not able to distinguish any definite membrane. Multiplication takes place by the cutting off of small portions which elongate into new individuals. Conidia formation also occurs. Motility was never observed. 3. *Spirophyllum ferrugineum*, the body of the cell is elongated and flattened

* C.R. Soc. Biol. Paris, lxiii. (1907) p. 427.
† Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) p. 214.
‡ Op. cit., 2te Abt., xix. (1907) p. 502.

and spirally twisted, the number of turns varying from a quarter turn up to fifteen or more turns; the width varies from 1–6 μ, the length reaching 200 μ or more; the middle portion of the cell has a thickness of only about 0·25 μ, whilst the edges are thickened up to 0·5 μ; there is no definite membrane; the ends are irregular and unsymmetrical; conidia formation takes place as in the two previous organisms; only one doubtful case of vegetative division was observed. Referring to the layer of iron on the membrane that surrounds these organisms, the author considers it to be an instance of the property possessed by vegetable protoplasm of attracting certain non-living substances, and he repudiates the idea that the attraction of the iron has any biological significance.

Susceptibility to Plague of Rats of Diverse Races.*—E. Klein has found that the common sewer rat is considerably less susceptible to plague than the tame or white rat. Experimenting on the brown and grey ship rat from South America, the brown and white ship rat from Norway, and the black rat from New Zealand, India, and South Africa, the author found that cultures of white rat *B. pestis* are by far the most virulent; next comes *B. pestis* of the black rat; but the *B. pestis* obtained through the brown South American ship rat and the Norway rat was in each case of lesser virulence.

Staphylococci Pathogenic to Man.†—F. W. Andrewes and M. H. Gordon, for purposes of differentiation and classification, have subjected a large number of staphylococci, obtained from various sources, to a series of observations, which included besides those dealing with morphological, tinctorial, and cultural characters, eight physiological tests, viz. (1) the clotting of milk within one week at 37° C.; (2) the liquefaction of gelatin within one week at 22° C.; (3) the reduction of neutral red within 48 hours at 37° C. under anaerobic conditions; (4) the reduction of nitrate to nitrite within three days at 37° C.; (5) the production of acid when cultivated for one week at 37° C. in Lemco-litmus medium containing 1 p.c. maltose; (6) ditto with lactose instead of maltose; (7) ditto with glycerin; (8) ditto with mannite.

The authors conclude that staphylococci fall into two groups: (1) Gram-negative cocci (*M. catarrhalis*, *meningococcus*, *gonococcus*); (2) Gram-positive staphylococci, of which *S. pyogenes* is the commonest example. It exists either as *S. aureus*, *S. citreus*, or *S. albus*, according to the partial or complete suppression of its chromogenic properties. The common saprophytic coccus of the skin, *S. epidermidis albus*, is perfectly distinct biologically, and is identical with the *Micrococcus neoformans* of Doyen.

Micrococcus of Epidemic Cerebrospinal Meningitis.‡—M. H. Gordon reviews the evidence associating the meningococcus of Weichelbaum with epidemic meningitis. The organism is found to be present in pure culture both in the cerebrospinal exudate and in the cerebral ventricles; the coccus, which is negative to Gram's stain, is in the form of flattened

* Rep. Med. Officer Local Govt. Board, 1905–6, p. 431.
† Tom. cit., p. 543. ‡ Tom. cit., p. 435.

bean-like diplococci, or as single cocci, chiefly inclosed in the leucocytes of the exudate ; it is an obligate aerobe ; it grows best on agar containing ascitic fluid ; the author found that nutrose ascitic agar (" nasgar ") was specially suitable ; it also grows well in broth to which 10 p.c. fresh sterile ascitic fluid has been added, and in this medium it lives longer (up to a fortnight) than on solid media ; it is killed by a temperature of 65° C. for 30 minutes. The colonies formed on nasgar, in strong contrast to colonies of Gram-positive cocci, after 24 hours at 37° C., appear as smooth, translucent, regular, circular, or oval disks, resembling young colonies of *B. coli* ; the optimum temperature of growth is 36–37° C. ; growth is arrested at 42° C. ; and at 25° C. its pathogenic action is exerted by an endotoxin.

Serum of patients suffering from the disease agglutinated the coccus in dilutions of 1 in 10 to 1 in 100, and some cases up to a dilution of 1 in 400, but the commencement of the agglutination reaction bears no definite relation to the onset of the disease.

The reactions of the meningococcus and other Gram-negative cocci to glucose, galactose, maltose, and saccharose, are given in a table, and the results show the value of these reactions in differentiating the meningococcus from the other Gram-negative cocci liable to occur in the upper respiratory passages.

The organism has also been isolated from the blood, from nasal secretion, and saliva, and has been located in the middle ear, in joints, and in the eye when inflamed during the disease.

Its detection in the secretion of the upper respiratory passages is important as indicating the route by which infection has been acquired, or is imparted to others ; but the identification is difficult owing to the presence of other Gram-negative cocci from which the meningococcus has to be differentiated by cultivation.

New Plague Prophylactic.*—E. Klein has prepared from the necrotic nodules of the bubo or other affected organs, a plague prophylactic material of uniform value, and which is readily standardised and preserved. The author claims that by using bacillary masses from the animal direct, a material is secured of greater uniformity and activity than that obtained from artificial medium, and that since the specific toxin produced by the microbe is presumably stored up in the organs of the animal dying of plague, it might be possible by injecting into the animals subfatal doses of this tissue toxin, to confer on them an immunity against *B. pestis*. As the result of numerous experiments with material obtained from the raw or the heated filtrate of emulsion of dried plague organs, it appeared that appropriate doses injected into rats, were protective in as short a period as seven days, and persisted for many weeks.

Micrococcus producing a Yellow-brown Colour on Cheese.† — H. Huss describes the morphological and cultural characters of a micrococcus isolated from a cheese, the rind of which was stained a yellow-brown colour by the organism. The cheese affected had come from a

* Rep. Med. Officer Local Govt. Board, 1905–6, p. 392.
† Centralbl. Bakt., 2te Abt., xiv. (1907) p. 518.

factory in Saxony. The organism was isolated from the cheese itself, and also from splinters of the wood on which the cheese had stood. It appeared together with many other organisms on plates of nutrient gelatin and agar inoculated from the washings of the samples in sterile water. The author has named the organism *Micrococcus chromoflavus*; the coccus measured $0 \cdot 9-1 \cdot 05 \mu$ in diameter; it was not motile; it stained well with carbol-fuchsin, but not by Gram's method; an obligate aerobe, it grew better at 35° C. than at 20° C., and growth was less vigorous on acid than on alkaline media; gelatin was liquefied; superficial colonies are round, having a greenish-yellow colour (becoming brown) and a granular appearance; broth is clouded, and forms an abundant thready yellow deposit after four days at 20° C. Portions of Tilsit cheese placed on filter paper that had been used in filtering a broth culture (24 hours old), showed after a week a yellow-brown coloration.

Etiology of Whooping Cough.*—H. and A. Soulima have obtained from each of a number of cases of whooping cough cultures of a small rod-like organism, which appears identical in its morphology and biology with the bacillus of Eppendorf, and also with the microbe of Bordet and Genou. To isolate the organism with certainty, it was necessary to select patients in which the disease had developed without rise of temperature. The expectoration was collected during paroxysms of cough, repeatedly washed in warm sterile "eau physiologique," and used to inoculate freshly prepared blood-agar plates.

Mammitis produced by Acid-fast Bacilli.†—L. N. Larrier and P. Bovéri inoculated the mammæ of female guinea-pigs with various acid-fast bacilli, and compared the resulting mammitis with that produced by Koch's tubercle bacillus. The authors found that, whereas the tubercle bacillus caused a suppurative and ulcerative mammitis accompanied by "adenopathie," which was manifested by the 8th to 10th day, the mammitis produced by the other acid-fast bacilli occurred earlier, was transitory, having ceased by the 9th day, and was benign and unaccompanied by tegumentary ulceration or adenopathy. Tubercle bacilli can be demonstrated in the milk from 10 to 15 days after inoculation, but in the benign mammitis the milk was free from acid-fast bacilli after the 8th day.

Tropism of Bacillus Zopfii.‡—E. Sergent has observed the directions assumed by the filaments of growth in cultures of *B. zopfii* on gelatin. The author found that this organism is particularly sensitive to the elastic property of the gelatin. When the gelatin is stretched the filaments take the direction of the force of tension; when the gelatin is compressed, the filaments follow a direction perpendicular to the force of compression. Since gravity is the commonest cause actuating the elasticity of the gelatin, the tropism of *B. zopfii* may be regarded as geotropic.

* C.R. Soc. Biol. Paris, lxiii. (1907) p. 11. † Tom. cit., p. 15.
‡ Ann. Inst. Pasteur, lxiii. (1907) p. 427.

Identity of the Rogna Bacillus (tubercle) of the Olive-tree.*—L. Petri obtained on peptone-glucose agar-plate cultures made from the contents of a young olive tubercle an abundant production of yellow colonies of *Ascobacterium luteum* Babés; cultures made from other tubercles developed chiefly the sporing bacillus of Schiff-Giorgini; but in other cultures, besides these two organisms, were the colourless colonies of a third organism, which soon assumed a milk-white colour, and consisted of non-sporing rods corresponding to Smith's bacillus. The author found that these three organisms are always simultaneously present in the olive tubercles in varying proportions, and he compares their morphological and cultural characters. From the results of many inoculation experiments on healthy plants, the author found that only pure cultures of Smith's bacillus caused positive infection, and he considers that the positive results obtained by other workers with the other two organisms were due to the use of impure cultures.

Renal Infection by a Microbe originating from the Blood.†—Jungano has isolated from a case of cystitis, besides many other bacterial forms, a small anaerobic motile bacillus, $3–4\mu$ long by $0 \cdot 5\mu$, with rounded ends, staining badly by aniline dyes, and not by Gram's method, and having no capsule, and forming no spores; in broth it clouded the medium, but formed no deposit; it grew well on agar, forming small round yellow-coloured colonies; it produced no gas; it grew on gelatin without causing liquefaction; after 18 days at 22° C. it formed typical stalactite cultures. It was not pathogenic to rabbits, but produced subcutaneous abscesses in guinea-pigs. The author has named the organism *B. albarran*. Owing to the peculiar conditions of the case, the author considers that the renal infection originated from the blood.

Anaerobic Bacteria and Gall-stones.‡—A. Gilbert and A. Lippmann report that by making anaerobic cultivations from the core of gall-stones they have obtained evidence in 82 p.c. of the cases examined of the presence of anaerobic bacteria, of which *Bacillus funduliformis* was the most frequent. Aerobic control cultures only gave *B. coli*, or were sterile.

* Centralbl. Bakt., 2te Abt., xix. (1907) p. 531.
† C.R. Soc. Biol. Paris, lxiii. (1907) p. 302. ‡ Tom. cit., pp. 405–7.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

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

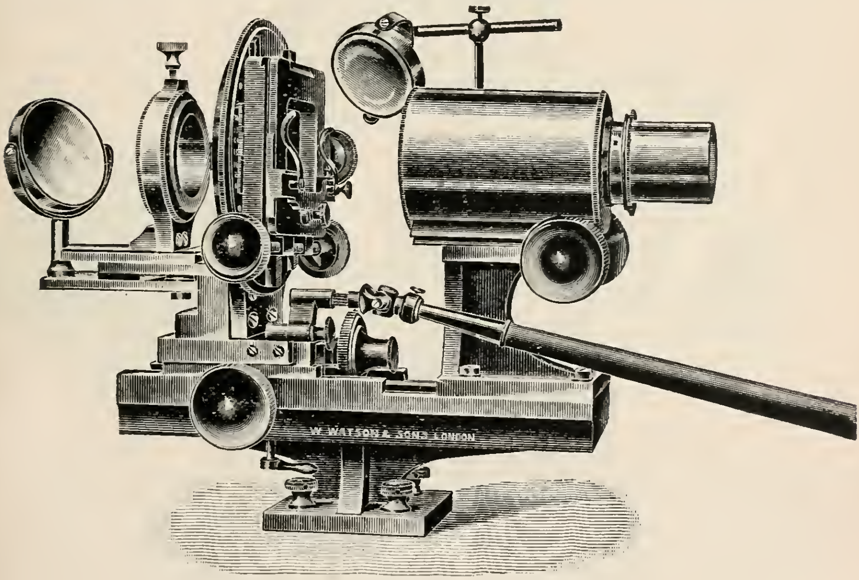


Fig. 7.

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

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

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

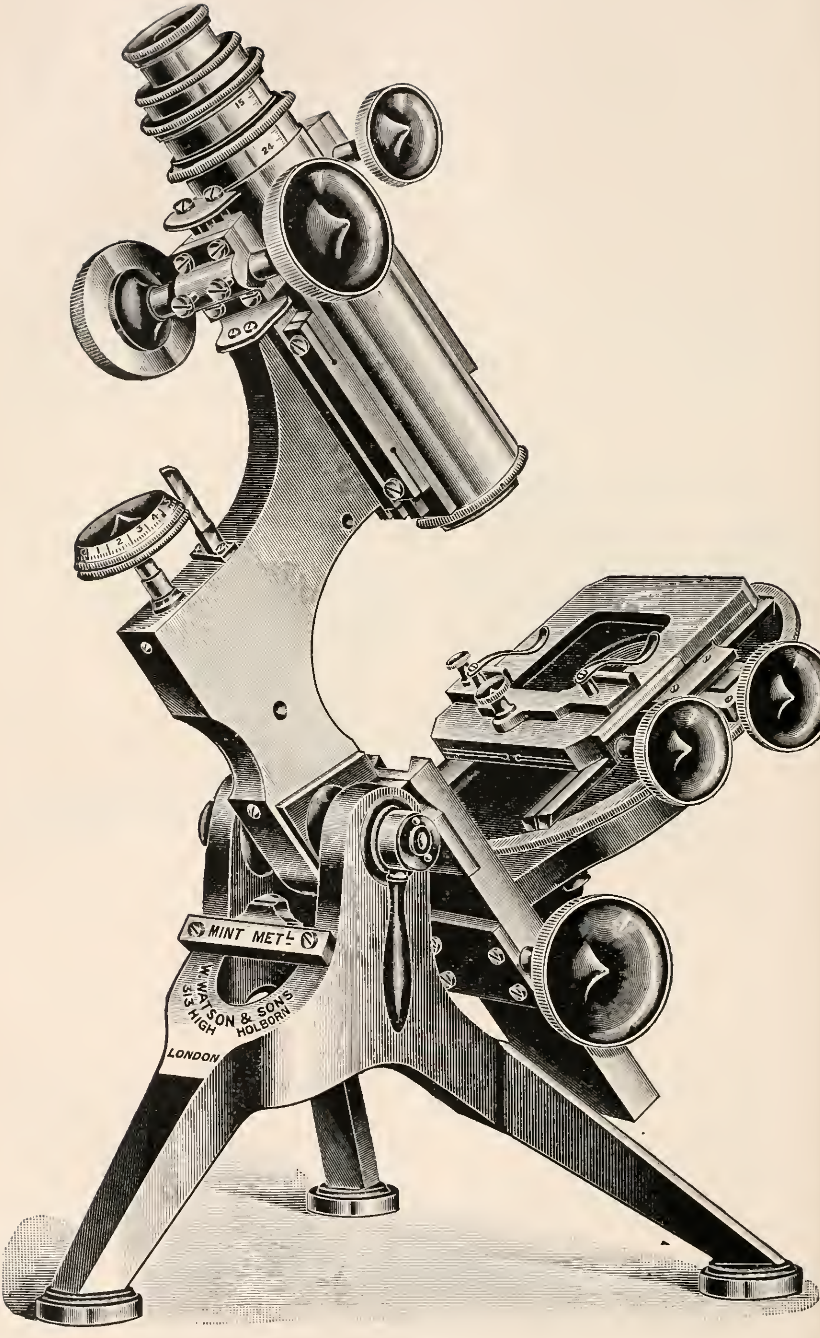


Fig. 8.

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

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

Watson and Sons' Laboratory Dissecting Microscope.‡ — The frame of this instrument (fig. 9) is constructed of mahogany; the sides slope at a convenient angle; the glass stage, $4\frac{1}{2}$ in. square, is removable. The arm, which carries lenses, has a spiral rack-and-pinion adjustment. The mirror is on gimbals.

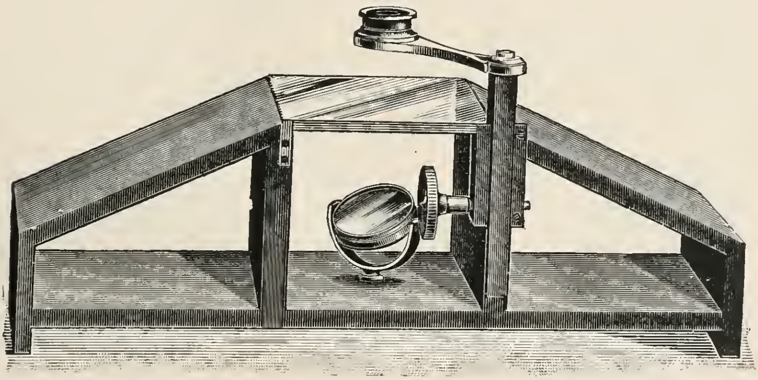


Fig. 9.

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

(2) Eye-pieces and Objectives.

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

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

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

(3) Illuminating and other Apparatus.

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

Fig. 10.

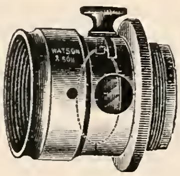


Fig. 11.

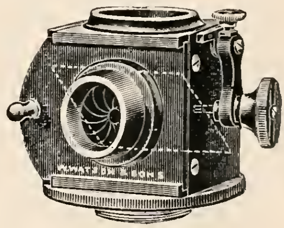


Fig. 12.

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

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

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

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

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

FIG. 13.

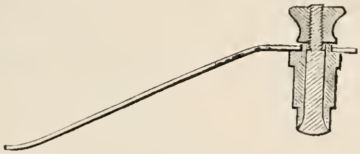


FIG. 14.

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

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

FIG. 15.

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

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

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

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

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

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

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

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

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

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

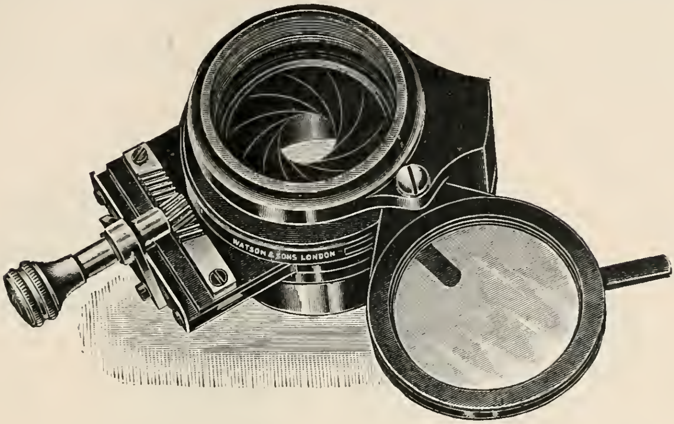


FIG. 16.

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

Watson and Sons' Aplanatic Low-power Condenser.† — This condenser (fig. 17) is suitable for low and medium powers, up to a numerical aperture of 0·65. It has a power of ⅔ in., and a numerical

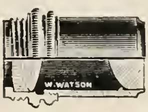


FIG. 17.

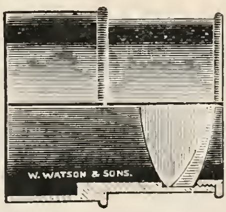


FIG. 18.

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

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

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

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

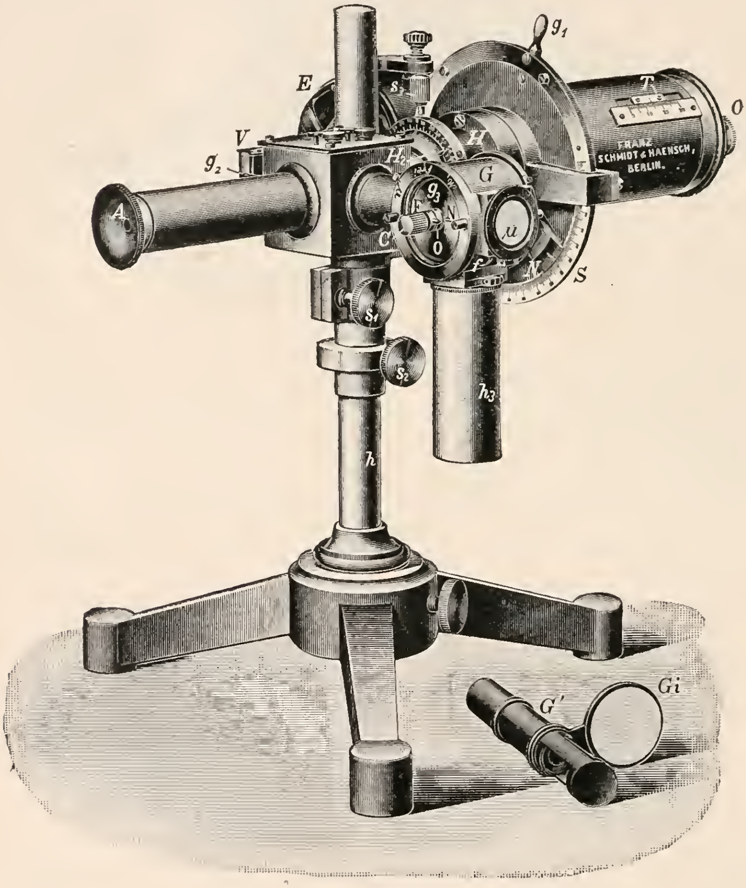


FIG. 19.

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

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

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

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

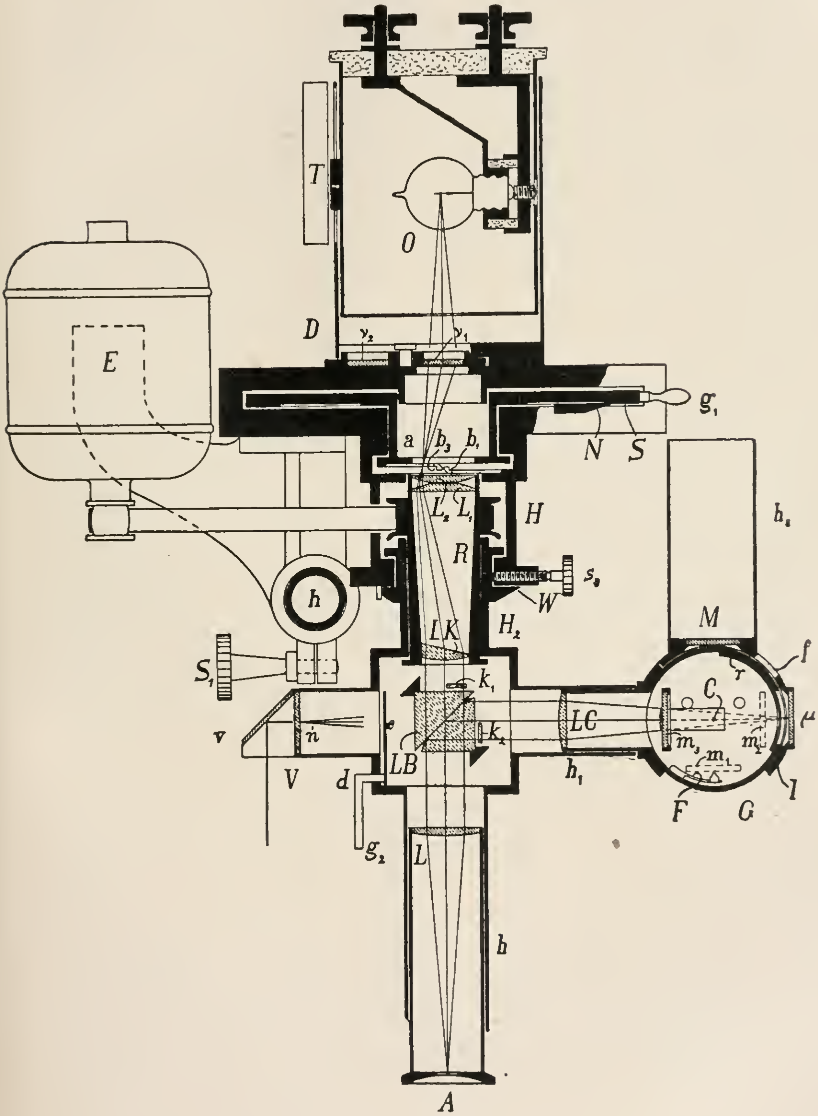


FIG. 20.

P. adjustable both for equality as well as for equality and contrast; (3) of a tube h_3 (fig. 20) for the reception of the light to be measured and of the apparatus G′ (fig. 19) necessary for the decimal enlargement of the measuring-scale; and finally (4) of an inspection contrivance V for the purpose of the proper adjustment of the light-source to be measured. The weakening of the light emitted from the electric comparison light-source O, and diffusely refracted through the three plates ν_1, ν_2, ν_3, set in the light-and-dust proof revolver D, is effected by the fixed sector and rotating light-beam. The sector-measuring apparatus consists of two equally large detached sectors operated by a handle *g* and symmetrically arranged about a diameter; they rotate over another pair similarly arranged but of different size. Between the sectors are slits forming the four arms of a cross. The opalescent glass plate ν_1 (fig. 20), regarded as self-luminous, is focused through the lens-combination L_1, L_2, sharply on to the wedge-shaped lens IK. The plane formed by the sectors coincides with the focal plane of IK; the eye-cap with the aperture A is in the focus of the lens L, adjustable in the tube *h*. Thus at A the sector-slits above referred to are sharply defined. For fuller explanation the course of the rays must now be considered in a reversed direction, i.e., originating from A. A sharp image of the eye-cap would now be formed at *a* (fig. 20), but, on account of the refraction of wedge-lens IK this image would be laterally displaced from the principal axis. If rotation be imparted to the lenses IK, L_2, L_1, which are all set in a tube rotatory about the principal axis, the image at *a* will describe a circular path in a direction opposite to that of rotation. In its subsequent course the light falls on the plate ν_1, whose illumination would be intermittent on account of the slits between the sectors; but this illumination could be made uniform to the eye if sufficient velocity of rotation were imparted, and the intensity of illumination would be proportional to the aperture-angle of the sectors. The lenses L_1, L_2, which take part in the rotation, are continuously penetrated at the same distance by the rays, and could not affect the proportionality. The sector-adjustment can be read off on the circle S by means of the index N. The graduation extends to 10, each main graduation being divided into tenths. A small electric motor rotates R.

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

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

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

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

Proc. Amer. Acad. Arts and Sci., xlviii. (1907)pp. 77–96 (6 figs.)
Reprinted as a separate pamphlet.

(4) Photomicrography.

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

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

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

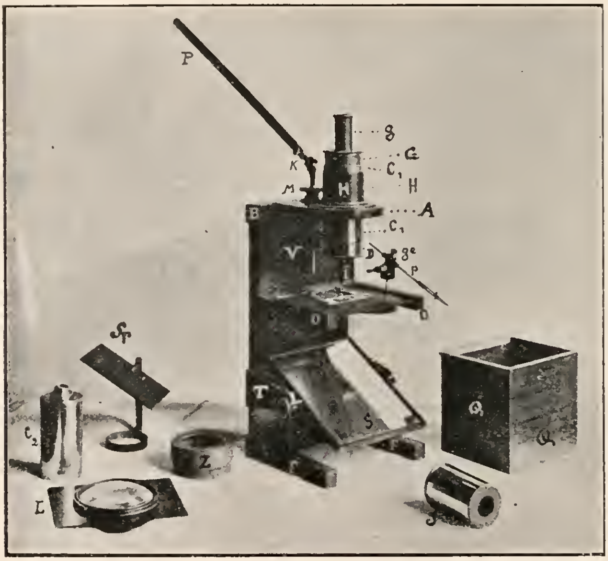


Fig. 21.

with increased bellows extension. Thus the fine-adjustment is attained by movement of the object-stage, which has the advantage that for a selected objective and a selected bellows length the magnification is a known quantity. The arrangement of the upper part of the apparatus closely resembles that of a Microscope. A sleeve H fitted to the horizontal slab A carries a tube C_1, 57 mm. wide and 105 mm. long, within which, on its under side, a second tube D, cloth covered, is inserted, its lower end being threaded for the reception of an ordinary micro-objective, or projection-objective, E. For diminutions or for photography in natural size, other tubes C_2 of similar width and thread can be inserted. At the upper end of the tube C_1 a short tube G can be used for carrying the narrower tube *g* of an ocular. This arrangement, of course, reproduces a Microscope, but is useful for determining the most convenient position of the object. When it is required to produce photographs by the objective alone, a special tube J is provided, 75 cm. long, open at its upper end, but carrying at its lower end a diaphragm of 25 mm. diameter. The tube is controlled by push-movement, and can be manipulated until a perfect image is obtained. The object-stage is 12·5 by 15 cm., and has three grooves at its narrow sides for various exchangeable accessories. A blackened metal plate R, with object-clamps, inserted into the uppermost groove, forms the object-stage proper. The second groove is for an opal disk to secure uniformity of illumination. The third groove is for obtaining a dark background, the mirror S being removed and the wooden box Q (blackened inside) put in its place. In the case of larger objects, dark-ground illumination is secured by removal of the box and by placing the object on black card-board. For transparent objects on a bright ground, the mirror itself serves as an object-stage, and is placed in the uppermost groove. For opaque objects on a bright ground, a strong illumination is directed from above on to the object, whilst the mirror (now an opal glass plate) is illuminated from a weaker source. This method has the advantage of almost eliminating the shadow.

(5) Microscopical Optics and Manipulation.

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

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

* Mem. Acad. Sci. Toulouse, vi. (1906) pp. 142–9.
† Proc. Roy. Soc., Series A, lxxix. (1907) pp. 440–2 (1 fig.).

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

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

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

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

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

* Proc. Roy. Soc., 1906.

† See this Journal, 1894, pp. 164–7, and 1895, pp. 145–7.

‡ Journ. Roy. Photo. Soc., 1895.

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

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

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

(6) Miscellaneous.

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

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

B. Technique.*

(1) Collecting Objects, including Culture Processes.

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

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

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

† Science, xxv. (1907) pp. 912–15.

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

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

Simple Method of Sterilising Blood for Cultural Purposes.*—E. P. Bernstein and A. A. Epstein place 400 c.cm. of fresh ox-blood in a sterile Erlenmayer's flask of 500 c.cm. capacity, in which have been previously placed 30 c.cm. of 1 p.c. ammonium oxalate solution and ½ c.cm. of 40 p.c. formalin. After shaking, and then allowing to stand for ½ hour, an equal quantity of sterile physiological salt solution is added to the blood. After 24 hours the blood may be used for cultural purposes. One part of the diluted blood is added to 15 parts agar or broth, so that the tubes contain about 1 : 36000 formalin.

Cultivation and Preparation of Myxomycetes.†—E. Pinoy cultivated *Dictyostelium mucoroides* on a medium composed of 20 grm. agar, 50 grm. linseed, and 1 litre of water. This was heated to 117° C., and after having been distributed into glass vessels was sterilised at 115° C. for ¼ hour. As the medium could not be filtered, the impurities were got rid of by keeping the medium at 37° C. until the extraneous matters had sedimented. When the agar had set, the clear portion was cut off and was used. On this medium spores were sown, and cultures associated with bacteria were obtained. The presence of one or more kinds of bacteria seems to be indispensable for the nutrition of the fungi, and all, with the exception of *B. pyocyaneus*, were Gram-negative.

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

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

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

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

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

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

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

The foregoing embraces the general principles, but for certain details

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

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

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

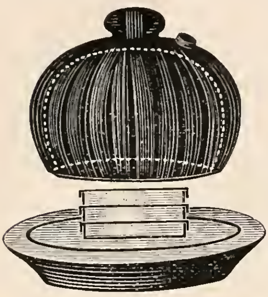


Fig. 22.

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

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

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

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

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

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

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

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

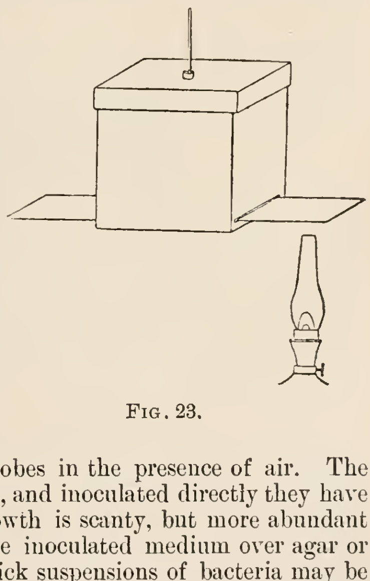


Fig. 23.

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

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

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

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

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

(2) Preparing Objects.

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

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

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

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

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

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

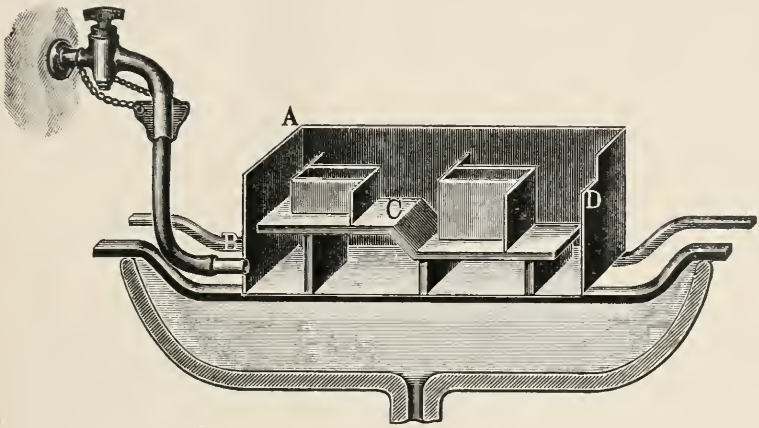


Fig. 24.

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

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

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

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

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

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

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

Fixation of Insect Larvæ.‡—W. D. van Leeuwen has devised a mixture which he has found very useful for fixing insects, especially during metamorphosis. It consists of 1 p.c. picric acid in absolute alcohol 6, chloroform 1, formalin 1, acetic acid $\frac{1}{2}$ part, or less. The mixture should be freshly prepared. The insects, pupæ, larvæ, imagos are left in the fluid for 24 hours or so, and then transferred to 90 p.c. alcohol for 3 days, and afterwards preserved or further treated in any desired manner. Good sections can be obtained by the benzol-paraffin method.

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

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

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

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

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

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

(3) Cutting, including Imbedding and Microtomes.

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

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

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

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

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

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

(4) Staining and Injecting.

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

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

New Method of Staining Micro-organisms.†—F. Loeffler describes the following methods for staining micro-organisms, especially spirochætæ, gonococci and diphtheria bacilli. The film is fixed with ethyl-alcohol, and then treated with 3 drops of 0·5 p.c. solution of sodium arsenate and 1 drop of 0·5 p.c. solution of malachite-green-zinc-chloride (Höchst). This is warmed for one minute and then the preparation is carefully washed. 5–10 drops of Giemsa stain are mixed with 5 c.cm. of $\frac{1}{2}$ p.c. glycerin, and brought to the boil. The film is then treated for 4–5 minutes with the hot solution, and afterwards washed with a stream of water.

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

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

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

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

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

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

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

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

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

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

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) pp. 91–4 (1 pl.).
† Rev. Clin. Med. Florence, 1907, pp. 321 and 337. See also Brit. Med. Journ., 1907, ii., epit. 108.
‡ Ann. Inst. Pasteur, xxi. (1907) pp. 633–4.
§ Johns Hopkins Hosp., Bull. xviii. (1907) p. 281.

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

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

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

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

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

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

* Centralbl. Bakt., 1te Abt. Ref., xi. (1907) p. 78.
† Arch. Mikr. Anat., lxxi. (1907) pp. 254–83 (2 pls.).
‡ C R. Soc. Biol. Paris, lxiii. (1907) pp. 485–7 (2 figs.).
§ Folia hämatologica, iii. (1906) 7 pp. See also Zeitschr. Wiss. Mikrosk., xxiv. (1907) pp. 301–2.

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

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

(6) Miscellaneous.

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

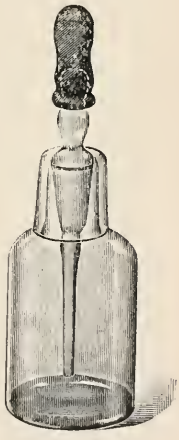


Fig. 25.

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

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

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

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

Metallography, etc.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 18th of December, 1907, at 20 Hanover Square, W. Mr. Conrad Beck, Vice-President, in the Chair.

The Minutes of the Meeting of the 20th of November, 1907, were read and confirmed.

The List of Donations to the Society since the last Meeting, exclusive of exchanges and reprints, was read, and the thanks of the Society were voted to the donors.

	From
Bernard Rawitz, Lehrbuch der Mikroskopischen Technik. (8vo, Leipzig, 1907)	*The Publisher.*
Eug. Warming, Dansk Plantevækst. 2 Klitterne, Første Halvbind. (8vo, Copenhagen, 1907)..	*The Author.*
$\frac{1}{8}$-in. Objective by Andrew Ross, date about 1842	*Mr. J. E. Ingpen.*

Mr. Eustace Large described a number of slides of natural twin-crystals of selenite exhibited under Microscopes in the room. The way in which the specimens had been prepared and the effects produced by the varying angles at which the twin-plane cut the cleavage-plane were further illustrated by diagrams and models. Some large reflecting polariscopes with horizontal stages were also exhibited, and a description of these was appended to the paper.

Mr. Large said: "I propose to assume a general knowledge of the action of polarised light, and will only briefly refer to two points, viz.: 1. That the thickness of a plate of selenite, or mica, determines the particular wave-length that, by interference, will be cancelled; leaving the residue of wave-lengths, of the particular light we may be working by to combine and form the actual colour seen, which colour will be complementary to that cancelled; and (2) That if an even plate be cut in half, and one half placed over the other parallel, the colour will be that of a plate double the thickness, but if one be crossed at right angles on the other the action in the one will exactly counteract that in the other, and darkness will be restored, that is, assuming the nicols to be crossed, giving a dark field. Consequently, if two pieces of *unequal* thickness be crossed the colour will be that of a plate equal to their *difference* in thickness. Selenite is the natural crystallised form of gypsum, and consists of the metal calcium + sulphuric acid + 2 equivalents of water. If 1 part of the water be driven off by heat plaster of Paris remains. If both, the plaster produced will not "set." The crystals occur naturally of all sizes. They do not appear to have been produced artificially of any useful size. They belong to the oblique system, and have a plane of very easy cleavage parallel to the flat sides of the crystal. There are other planes of cleavage, or at least of easy fracture, which are probably connected with the formation of the features which are about to be described.

"If a normal twin-plate—showing, say red—is laid on a rotating stage, between crossed nicols, there will be four positions in which one area (A) will be red and the other (B) black, and at nearly 30° from each position these colours will be reversed. (? 28° 16′.) Between the two areas A and B there will be merely a boundary. This boundary may be quite irregular, perfectly straight, or zigzag with beautiful regular angles. But, in addition, this boundary, which is called the twin-plane, may *not* be perpendicular to the cleavage-plane. The result then will be that the twin-plate is practically made up of two opposed wedges, and if the plate is rotated so that one of these is dark the other will shine out in bands of colours, showing Newton's orders of thin film colours. The angle of this twin-plane may be more or less acute, giving the orders in thin lines or spread into broad bands. Instead of an angle the junction may be a series of steps, or alternate steps and angles. Also these variations may occur lengthwise, and all these in every possible combination. The most striking forms may be classified into broad or narrow wedges, parallel bands, bands cut up into rhomboids, mitred angles, and a very beautiful zigzag form. Specimens of each are shown under the Microscopes. Some beautiful effects result from crossing two wedge twins on each other. Another interesting feature is that whereas the two halves of some twins are at about 30°, all that I have myself obtained from the London clay are at about 75°, so within $7\frac{1}{2}°$ either way of cancelling each other, and therefore when wedged they give a nearly dark band with Newton's orders running *both* ways. Most of the features are best seen by from 1-in. to 2-in. objectives, but some are large enough to show well on the table polariscopes, or projected on the screen.

"This form of reflecting polariscope, as constructed for me by Messrs. Baker, is a most useful appliance for workers in thin films. The analysing reflector can be used for general observation of large surfaces and for display of finished work, while a Nicol, with low-power lens, is easily substituted for actual exact marking and cutting on the large horizontal glass stage. Also, a mirror and single glass plate converts it, in a moment, into a Norremburg doubler, so useful for gauging the thickness of $\frac{1}{4}$- and $\frac{1}{8}$-wave films in mica work. A revolving $\frac{1}{2}$-wave mica plate under the stage gives change of colour (plus and minus), or a pair of $\frac{1}{4}$-wave plates would give change by actual rotation of the polarised beam.

"I have also a small appliance, consisting of a fragment of Iceland spar, mounted on the nose of objective. This gives a double image, and if diagonal cross lines are ruled on a blackened slip on the stage, with a selenite plate, two complementary coloured images appear of the network superposed, and wherever the lines cross, the coloured lights re-combine into white light.

"Small clear pieces of Iceland spar about $\frac{1}{8}$-in. thick can be selected, that only require mounting between two thin glass covers with balsam, and the experiment is pretty and instructive."

The thanks of the Meeting were voted to Mr. Large for his very interesting exhibit and description.

Mr. J. E. Barnard exhibited some specimens of luminous Bacteria contained in a number of culture tubes, and also in large quantities in a solution in a flask. On the lights in the room being turned off, the light given off by these organisms was at once seen. The contents of the flask whilst undisturbed remained dark, but became very luminous when agitated. It was explained that the light produced was nearly monochromatic, and in position was between the lines F and G in the spectrum. The whole of the energy of these bacteria seemed to be utilised in producing light, as no heat whatever could be detected. Mr. Barnard did not propose to give any description of the organisms producing the light, nor as to the preparation of the examples before the Meeting, but intimated his willingness to do so on a future occasion if the matter was of interest to the Fellows of the Society. (A further exhibition of the tubes was given in a dark room at the close of the Meeting.)

The Chairman said they must give a very hearty vote of thanks to Mr. Barnard for his very interesting exhibit, and expressed a hope that he would tell them something more about the subject at some future date. He said it seemed almost to suggest that when their coal and gas gave out, they might perhaps be growing bacteria to light their rooms!

Mr. E. M. Nelson's paper, "Gregory and Wright's Microscope," was read by Dr. Hebb, a photograph of the instrument being handed round for inspection.

Mr. Nelson's paper, "A Correction for a Spectroscope," was also read by Dr. Hebb, and was illustrated by a diagram.

The thanks of the Society were unanimously voted to Mr. Nelson for these communications.

A paper by Mr. James Murray upon "Some African Rotifers," was read by Mr. Rousselet, and was illustrated by drawings of the species mentioned as having been collected in Cape Colony, Uganda, and Madagascar.

Mr. Rousselet mentioned that at the present time Mr. Murray was on his way to the Antarctic regions on board the *Nimrod*, sent out by the British Antarctic Expedition, 1907, and was intending to spend twelve months there. He had daily devoted some of his time during the voyage to the Cape in endeavouring to procure marine rotifera from the Atlantic, but had failed to find any. Mr. Rousselet further stated that this agreed with the experience of the German Plankton Expedition of 1889, who found no rotifers in the Atlantic except in two limited and widely separated areas, the one in the North Atlantic midway between North Britain and Greenland, where two species (*Synchæta* and *Rattulus*) were found in enormous numbers, and the other off Bermuda, where the same two species were again encountered.

The Chairman thought the paper was one of great interest, which they would be very pleased to see in the Journal. As regards the occasional presence of large numbers of rotifers, he might say he had a similar experience some time ago in Westmorland; on one occasion he found the lakes swarming with certain forms of animalculæ, while a short time afterwards he was unable to find any.

Mr. Wesché said that one of the forms illustrated showed some lateral appendages, which he thought very remarkable, and so far as he knew, were absolutely unique amongst the Bdelloids; it was numbered 5 on the plate, and described under the name of *Callidina pinniger*. The appendages, he thought, might be of similar function to the blades on the shoulders of the common species *Polyarthra platyptera* Ehr., giving a sudden movement to the animal to enable it to escape the jaws of some predacious enemy. In the matter of finding large numbers of a species in a particular place at one time, and none whatever at another, would be the experience of every collector, as it had often been his.

Mr. Barnard remarked that *Bacterium indicum* was phosphorescent in the tropics, and sometimes appeared in very large quantities, which he thought might possibly be accounted for by the presence of nutriment.

The thanks of the Society were unanimously voted to Mr. Murray for his paper, and to Mr. Rousselet for reading it.

The Chairman reminded the Fellows that their next Meeting would be their Anniversary, at which they usually had an address from their President. He regretted to say, however, that this time they would be without this, as Lord Avebury found he would be quite unable to be present owing to his having to be elsewhere to receive an additional honour conferred upon him, the date of which function could not be altered. His Lordship had expressed his great regret at not being able to be present at the Annual Meeting, but had intimated that the Society should not lose the benefit of his address, which he hoped to give them on a future occasion. In substitution for the address, they had arranged for a paper to be read, "On the Microscope as an Aid to the Study of Biology in Entomology, with special reference to the Food of Insects," by Mr. W. Wesché.

As the next would be their Annual Meeting, it was necessary to elect two Auditors of the Society's accounts, and on behalf of the Council he nominated Mr. J. M. Allen.

Mr. C. L. Curties was then proposed by Mr. Marshall, and seconded by Mr. Ersser, as Auditor, on behalf of the Fellows.

The names of these two gentlemen having been submitted to the Meeting, they were declared to have been duly elected as Auditors.

The following list of Fellows, proposed by the Council as the Officers and Council of the Society for the ensuing year, was then read by the Secretary, and would be submitted for election at the Annual Meeting on January 15th, 1908:—

President—Lord Avebury.

Vice-Presidents—Mr. Beck, Dr. Dallinger, Dr. Eyre, and Sir Ford North.

Treasurer—Mr. W. E. Baxter.

Secretaries—Mr. J. W. Gordon and Dr. R. G. Hebb.

Ordinary Members of Council—Messrs. Carr, Cheshire, Disney, Karop, Plimmer, Powell, Price-Jones, Radley, Rousselet, Scales, Scourfield, and Spitta.

Librarian—Mr. P. E. Radley.

Curator of Instruments—Mr. C. F. Rousselet.

„ *Slides*—Mr. F. S. Scales.

The thanks of the Society were cordially voted to Messrs. Baker for the loan of the Microscopes under which the slides of Selenite were exhibited that evening.

It was announced that the Rooms of the Society would be closed from Tuesday, December 24th, to Monday, December 30th.

New Fellow.—The following was balloted for and duly elected an *Ordinary* Fellow of the Society :—Mr. Chas. R. Scriven.

The following Instruments, Objects, etc., were exhibited :—

Mr. J. E. Barnard :—Luminous Bacteria.

Mr. Eustace Large :—Twin Selenites, two crystals, crossed ; ditto, angled ; ditto, zig-zag, narrow ; ditto, ditto, broad ; ditto, mitred angle ; ditto, double mitre ; ditto, rhomboid ; ditto, compound rhomboid ; ditto, natural and artificial wedge ; Double-image prism on Objective ; Reflecting Table Polariscopes, under two of which were selenite designs lent by Mr. C. L. Curties.

Mr. J. Inderwick Pigg :—Microphotograph, front page of 'Daily Mail.'

The Society :—$\frac{1}{8}$ in. Objective, by Andrew Ross.

ANNIVERSARY MEETING

Held on the 15th of January, 1908, at 20 Hanover Square, W., E. J. Spitta, Esq., L.R.C.P., etc., in the Chair.

The **Minutes** of the Meeting of the 18th of December, 1907, were read and confirmed, and were signed by the Chairman.

Messrs. T. D. Aldous and F. Orfeur having been appointed to act as Scrutineers, the ballot for the election of Officers and Council for the ensuing year was proceeded with.

An old Microscope, presented to the Society by Mr. Michie, per Sir Frank Crisp, was exhibited by Mr. Rousselet, who read a description of the instrument and assigned it to Jones, the successor of Adams, as the maker, who probably constructed it about 100 years ago.

The thanks of the Meeting were unanimously voted to Mr. Michie for his donation, to Sir F. Crisp for having forwarded it, and to Mr. Rousselet for his description of it.

Mr. C. Beck exhibited and described a new method of showing bacteria by dark-ground illumination, being a modification of the parabolic illuminator, used in conjunction with a Nernst lamp and monochromatic blue light. The new apparatus was devised by him to obviate the inconvenience caused by the oil running down the reflecting surfaces of the illuminator and allow a perfect focusing adjustment for the light. It was pointed out that when bacteria were shown on a bright ground they appeared only like black lines, whilst when seen on a dark ground they were rendered far more distinct, although their appearance varied somewhat according to what parts reflected light most brilliantly. In general the appearance seen was that of a brilliantly illuminated envelope and bright nuclei ; if there was a twist in the specimen under observation they would get nodes of light at the twists, whilst in other cases an extremely brilliant circular patch would be seen in one place. In employing this method it was important to have a perfectly clean slide only containing the creatures it was desired to examine, since every particle in the field would be strongly reflective and a mass of brilliant material in the background prevented the examination of objects in the foreground. He thought this method of illumination was well worth considering, as being much more likely to give a correct idea of what was being seen, than if the ordinary method was employed. The construction and action of the parabola was explained by means of diagrams on the board.

The Chairman said there could be no question as to the difficulty of getting photographs of unstained bacteria seen in the ordinary way, and the process described by Mr. Beck certainly seemed to be worth attention. The only difficulty which occurred to him in connection with the matter was that it was limited to a numerical aperture of 1, but he thought their hearty congratulations were due to Mr. Beck for what he had accomplished. Everything new was of value, for even if it was not apparent at the moment it might be in the future, when it was most convenient to find a piece of apparatus, just what you wanted, ready to hand.

Mr. Beck said the angular aperture was limited by the fact that in looking at bacteria they were seen in water which had a refractive index of 1·33. The actual angle of the illuminator was from 1·1 to 1·5, but this was cut down by the water. If seen in oil the angle would, of course, be higher.

The thanks of the Society were voted to Mr. Beck for his communication.

Mr. J. W. Ogilvy exhibited and described a new Microscope by Leitz ; diagrams showing the mechanism of the fine-adjustment were placed upon the table.

The Annual Report of the Society for 1907 was then read by Dr. Hebb.

REPORT OF THE COUNCIL FOR 1907.

FELLOWS.

Ordinary.—During the year 1907, 15 new Fellows have been elected, and 2 reinstated, whilst 11 have died, 14 have resigned, and 6 have been removed. Among the deaths the Council regrets to notice the names of two distinguished Fellows, Dr. Czapski, of whom an obituary notice has already appeared in the Journal, and of Professor Charles Stewart, who was Secretary from 1878–82.

The list of Fellows now contains the names of 395 Ordinary, 1 Corresponding, 42 Honorary, and 81 Ex-Officio Fellows, being a total of 519.

FINANCE.

Subscriptions have been paid with the usual regularity.

To avoid a repetition of a debit balance at the end of the year, £163 19*s.* 7*d.* India 3 per Cent. Stock has been sold, realising £139 14*s.* 8*d.* This is part of £1033 13*s.* 9*d.* invested during the past 7 years. It is hoped that it will not be necessary to part with more of the invested funds, but to prevent this it becomes important to maintain the roll of Members at its normal strength by electing Fellows in the place of those who cease to be such by death and resignation.

JOURNAL.

In the Transactions are recorded 17 important papers, of which 11 deal with optical and microscopical subjects, the remaining 6 being biological.

The valuable summary of current researches relating to Zoology, Botany and Microscopy has maintained its accustomed high standard of excellence, for which the Society is indebted to the continued care and energy of the editorial staff.

LIBRARY.

The Library is in good order; the number of volumes has been increased by the donation and purchase of some important works.

The Shelf Catalogue is in progress, and it is hoped to complete it by the end of the current year.

INSTRUMENTS AND APPARATUS.

The Instruments and Apparatus in the Society's Collection continue to be in good condition.

During the past year the following additions have been made:—

Feb. 20, 1907.—A Powell and Lealand Microscope, No. 2, of 1885, and Accessories; a Powell and Lealand Microscope, No. 3, of 1848, and Accessories; a Hugh Powell Tank Microscope and Accessories; a W. J. Salmon Microscope, with Eye-piece; a W. Mathews Microscope, with Eye-piece; Portion of a Goniometer, by Powell and Lealand; Five Low-power Objectives, by S. Highley; Miscellaneous Apparatus. All presented by Mr. Peyton T. B. Beale.

March 20.—A Solar Microscope, by Nairne. Presented by Mr. F. R. Tindall Lucas.

May 15.—A Traviss Expanding Stop for Dark-ground Illumination Presented by Mr. H. Ausbuttel.

Oct. 16.—A Warington's Universal Microscope. Presented by Mr. J. E. Ingpen.

Dec. 18.—An old Object Glass, ⅛ in., by Andrew Ross, made in 1842, and said to be the second made. Presented by Mr. J. E. Ingpen.

CABINET.

The slides, many of them unnamed, presented to the Society by Dr. J. W. C. Glaisher, have been overhauled and classified; and great progress has been made in the examination and classification of the extensive collection of Mr. James Hilton. It is proposed to make a complete examination of the whole of the Society's Collection of Slides, and eventually to supply a classified Catalogue.

TOOLS.

The Society's standard sizing gauges for nose-pieces and objectives, with the plug and ring gauges, are in good condition, as are the plug and ring gauges for eye-pieces and substage fittings.

There are in stock, for sale, 5 pairs of sizing gauges and 6 pairs of hand chasers.

The Treasurer presented his Cash Statement and duly audited Balance Sheet for the year 1907. He called attention to the fact that there was a considerable falling off in the number of the Ordinary Fellows of the Society. Their high-water mark in this respect was reached in 1891, when they numbered 663, since which time they had been decreasing, until now they had rather less than 400. He hoped everyone would do his best to increase the number during the coming year. He might mention that though their finances had gone to the bad by about £18, they must consider that they had an increase of books in the library, as well as an increased stock of Journals for whatever these might be worth.

Mr. J. M. Offord said they had heard the Report and the Treasurer's statement, and though they must regret to hear that their numbers were falling off, he thought they would agree that in other respects the account given was satisfactory. He had much pleasure in moving that the Report and Balance Sheet be received and adopted, and that they be printed and circulated in the usual way.

Mr. Imboden having seconded the motion, it was put to the Meeting and carried unanimously.

A vote of thanks to the Honorary Officers of the Society for their services during the year was proposed by Mr. D. J. Scourfield and seconded by Mr. Ersser.

The Chairman said he was quite sure he need say nothing to commend this vote to the Fellows present, who were all well aware of how much they owed to the labours of their officers and especially to their Honorary Secretary. Fellows were often quite unconscious of the work which every "evening" entailed, and he did not think there were many present who would not especially couple with this vote of thanks—and with considerable pleasure too—the name of Dr. Hebb, their much esteemed Secretary.

The motion was then put to the Meeting and carried by acclamation.

Dr. Hebb, in responding, said he was much obliged to those present

Dr. CASH STATEMENT FOR THE YEAR ENDING 31ST DEC. 1907. Cr.

Dr.		£ s. d.
1907.		
To Admission Fees		33 12 0
„ Annual Subscriptions—		
1903	£0 10 6	
1904	3 11 5	
1905	16 5 6	
1906	30 16 6	
1907	542 3 9	
1908	17 12 6	
1909	0 7 6	
		611 7 8
„ Interest on Investments		62 5 9
„ Sale of Journal		289 3 0
„ Advertisements		60 0 0
„ Sale of Surplus Books		3 10 0
„ „ Reprints and List of Fellows		2 19 2
„ Income Tax returned		3 0 8
„ Sale of 163*l.* India Three per Cents.		139 14 8
„ „ Tools		0 2 6
		£1205 15 5

Cr.		£ s. d.
1907.		
By Balance from 1906		20 10 5
„ Rent, Coals, etc.		132 10 0
„ Salaries and Reporting		162 7 0
„ Books and Periodicals purchased		109 10 2
„ Bookbinding		4 12 7
„ Expenses of Journal—		
Editing	£161 19 9	
Illustrations	35 4 4	
Printing and Postage	402 9 11	
		599 14 0
„ Purchase of 45*l.* 14*s.* 8*d.* New South Wales Three and a Half per Cents.		46 4 0
„ Refreshments at Meetings		13 10 0
„ Stationery		20 3 10
„ Fire Insurance		3 5 0
„ Postage and Petty Disbursements		32 18 6
„ Rent of Stock of Journals		2 7 3
„ Repairs		3 17 5
„ Purchase of Tools		1 1 0
„ Balance to 1908		53 4 3
		£1205 15 5

Investments.

	£ s. d.
North British Railway	400 0 0
Nottingham Corporation Stock Three per Cents.	400 0 0
New South Wales Three per Cents.	361 5 9
India Three per Cents.	700 0 0
Metropolitan Water Board B Stock	120 0 0
	£1981 5 9

WYNNE E. BAXTER, *Treasurer.*

We have examined the foregoing Account, and compared the same with the Vouchers in the possession of the Society; we have also verified its Securities as above mentioned, and find the same correct.

J. MASON ALLEN } *Auditors.*
C. LEES CURTIES }

January 8, 1908.

for their vote of sympathy and thanks, but thought he ought to ask them to include their Assistant-Secretary, Mr. Parsons, without whose help it would be quite impossible for him to carry on the work.

A vote of thanks to the Auditors and Scrutineers was then proposed by Mr. Gardner and seconded by Mr. Pigg.

The Chairman in putting this to the Meeting remarked that Auditors and Scrutineers were very important people and well deserving of their thanks. The work they undertook was a labour of love, and he was afraid like most labours of love was very likely to be easily forgotten, so he hoped the Fellows present would receive the motion with pronounced acclamation.

The motion was unanimously carried.

The Scrutineers having handed in their report as to the result of the Ballot, the Chairman declared the following gentlemen to have been duly elected as the Officers and Council of the Society for the ensuing year :—

President—The Right Hon. Lord Avebury, P.C. F.R.S., etc.

Vice-Presidents—Conrad Beck ; Rev. W. H. Dallinger, LL.D. D.Sc. D.C.L. F.R.S. F.L.S. F.Z.S. ; J. W. H. Eyre, M.D. F.R.S. (Edin.) ; The Right Hon. Sir Ford North, P.C. F.R.S.

Treasurer—Wynne E. Baxter, J.P. F.G.S. F.R.G.S.

Secretaries—J. W. Gordon ; R. G. Hebb, M.A. M.D. F.R.C.P.

Ordinary Members of Council—Rev. Edmund Carr, M.A. F.R.Met.S. ; Frederic J. Cheshire ; A. N. Disney, M.A. B.Sc. ; George C. Karop, M.R.C.S, ; Henry Geo. Plimmer, F.L.S. ; Thomas H. Powell ; C. Price-Jones, M.B. (Lond.) ; P. E. Radley ; Charles F. Rousselet ; F. Shillington Scales ; David J. Scourfield ; E. J. Spitta, L.R.C.P. (Lond. M.R.C.S. (Eng.).

Librarian—Percy E. Radley.

Curator of Instruments, etc.—Charles F. Rousselet.

Curator of Slides—F. Shillington Scales, B.A. (Cantab).

The Chairman then called attention to what might, he said, be termed a novel situation. For some years past the Meeting, instead of having two Secretaries present had never had more than one, upon whom, they all were aware, had fallen the heat and burden of the day. To-night, however, the novel situation to which he had referred would take place, for the Fellows were about to see the vacant chair once more filled, and filled he was glad to say, by one whom he believed would be a very active worker in the interests of the Society. He therefore, without further delay, would at once ask Mr. Gordon, whom the Fellows had elected to the vacant chair, to come upon the platform and take it. He hoped sincerely that Dr. Hebb would start his co-secretary to work at once, and give him plenty of it too, so that the numerous details of the secretarial office might be shared for the future in a more fitting and appropriate manner.

Mr. Gordon in suitable terms expressed his thanks to the Chairman for his kind words and to the Fellows of the Society for his election.

The Chairman said they were to have had a paper that evening read by Mr. Wesché, " On the Microscope as an Aid to the Study of Biology in

Entomology, with particular reference to the Food of Insects." Unfortunately—and he knew they would all regret it—Mr. Wesché was unable to be with them, having been laid aside by severe illness. He had, however, sent in his paper that afternoon, and a number of slides in illustration of the subject to be exhibited under Microscopes in the room, whilst five lantern slides were ready for the lantern to be shown upon the screen.

Dr. Hebb having read some portions of the paper which had been marked by the Author,

The Chairman, in moving a vote of thanks to Mr. Wesché for this communication, again expressed his regret at the enforced absence of its Author, whose work was always so thorough that his papers were necessarily long and rather difficult to epitomise, so that the one before them would have to be read to be properly understood. The thanks of the Meeting were also voted to Dr. Hebb for reading the extracts and to Mr. Imboden for preparing the slides which had been shown on the screen, as well as to Messrs. Baker for the loan of the Microscopes under which the mounted preparations had been exhibited.

Mr. J. E. Barnard's paper "On an improved type of Mercury Vapour Lamp" was deferred to a future Meeting, as the Author was unable to be present in consequence of a severe cold.

It was announced that at the Meeting of the Society on March 18 the President would give the Annual Address, entitled "On Seeds, with special Reference to British Plants."

The following Instruments, Objects, etc., were exhibited :—

The Society :—An old Microscope, Jones' most improved type, presented by Mr. A. S. Michie.

Messrs. R. & J. Beck :—Living Bacteria under ordinary illumination ; Living Bacteria under dark-ground illumination.

Mr. J. W. Ogilvy :—Five Microscopes by Messrs. E. Leitz, stands A B C D F fitted with their new fine-adjustment.

Mr. W. Wesché :—The following slides under Microscopes in illustration of his paper. Portion of abdomen of a dragon-fly, Archibasis ? from Borneo, showing fragments of an Anthomyid ; Portion of abdomen of earwig, *Forficula auricularia*, showing fragments of Aphides ; Portion of abdomen of dragon-fly, *Enallagma civilis*, from Indiana, U.S.A., showing fragments of lepidopterous larva ; Abdomen of *Oncodes gibbosus*, showing intestine—these insects are without mouth-parts and this food was taken while in the larval stage, and is only found in the female insect ; Portion of thorax of Rhantus ? water beetle, showing the eye of a fly, Chironomus ; Extremity of abdomen of fly, *Syrphus balteatus*, showing pollen granules ; Portion of abdomen of fly, *Empis livida*, showing hairs and scales of gnat, *Culex* ; Portion of abdomen of fly, *Norrellia spinimana*, showing hairs and scales of gnat, *Culex* ; Portion of abdomen of bee, *Apis melifica*, Ligurian variety, showing pollen of several flowers ; Abdomen of fly, *Nycteribia hermanii*, parasitic on bats, showing blood ; Portion of abdomen of fly, *Scataphila despecta*, showing diatoms ; Portion of abdomen of fly, *Hylemyia strigosa*, showing spores of fungus. Also the following lantern slides : Broken-up Aphides in the stomach of earwig ; Remains of fly in dragon-fly, *Enallagma civilis* ; Remains of caterpillar in same ; ditto, ditto, another place ; Pollen in abdomen of fly, *Syrphus balteatus*.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL, 1908.

TRANSACTIONS OF THE SOCIETY.

V.—*Francis Watkins' Microscope.*

By Edward M. Nelson.

(*Read November* 20, 1907.)

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

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

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

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

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

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

Fig. 26.

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

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

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

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

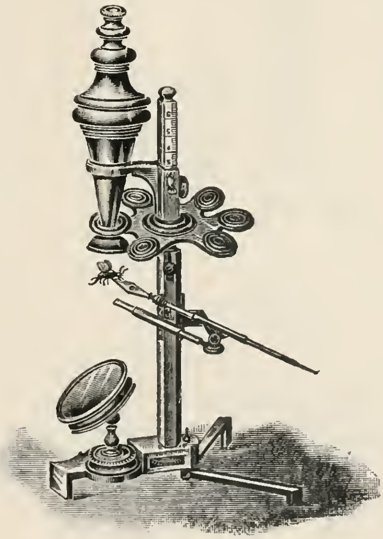


Fig. 27.

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

* Micrographia Illustrata, ed. 4, plate ii.

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

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

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

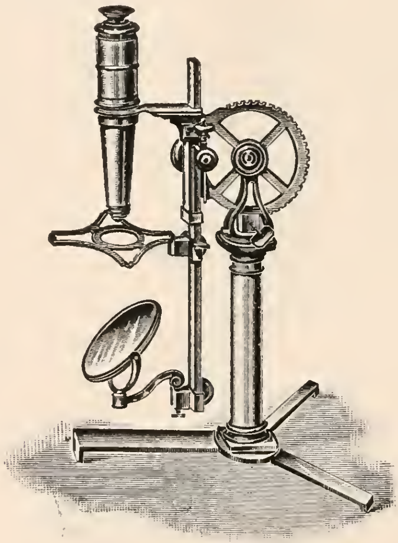


Fig. 28.

balance; the difficulty, therefore, of bringing this Microscope, on account of its instability, to a correct focus can be imagined. The arm which holds the body, and which is at right angles to the limb, is a thin plate of silver, far too weak for its work. It is important thus to trace the faults of this old Microscope, for by doing so we are enabled to find out what influence the design had in Microscope construction; for if we examine the Microscope that next followed it, viz. Adams' "Variable" (fig. 28), we shall see what points in Watkins' design were retained, and what rejected as faulty. We find, then, that the folding tripod, vertical pillar, and the inclinable limb are retained, but the limb has now a much stouter form of joint,* and the point of its attachment is in the best position for stability. The plate by which the body is attached to the limb has a strengthening bracket below it. One cannot help thinking that the noble designer of the "Variable" Microscope must have been acquainted not only with this design of Watkins', but also with its faults, which he specially corrects while following the Watkins' design in the main.

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

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

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

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

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

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

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

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

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

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

This is an improvement upon Lindsay's plan of a single conical speculum, which had to do duty for all the powers. Dr. Lieberkühn's compass Microscope, made by Cuff (1743) had a separate spherical mirror adjusted to each of its four powers, thus pre-dating Watkins'. The body of Watkins' Microscope is 6 in. long, 1½ in. diameter at its widest part, and elegantly tapered. Adams' "New Universal" (fig. 27) is probably the earliest Microscope to possess a body with this kind of taper. This taper survived a long time, for it is found in Coddington's Microscope of 1830,† and in 1843 a remnant of it is left by Hugh Powell at the bottom of the tube;‡ Beck and Ross never tapered the body, but the Lister-Tulley, made by Smith in 1826, was tapered at the bottom; so tapered bodies lasted about 100 years.

The eye-piece is Huyghenian, and a very good one; the eye-lens is a plano-convex of 1 in. focus, and the field-lens an equi-convex of 2 in. focus, the distance between them being 1¾ in. Calculation shows that to obtain the best results the eye-lens ought to have a focal length of 0·865 in., and the distance between the lenses ought to have been 1·785 in., so the old eye-piece is not so far wrong after all.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

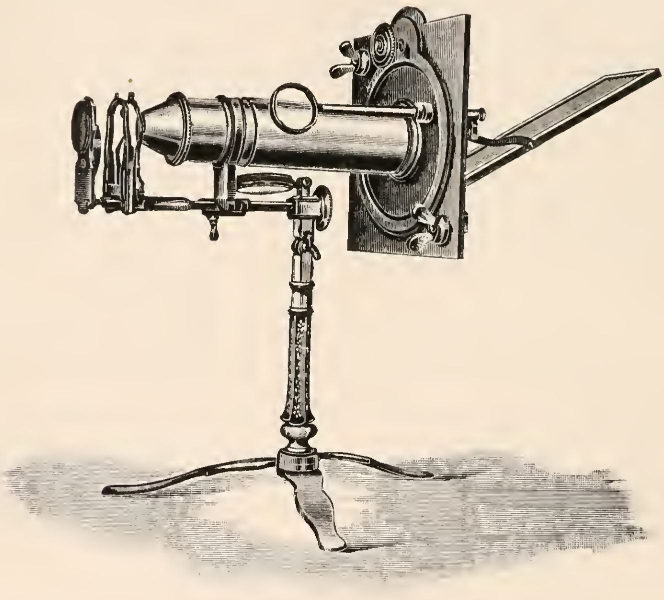


Fig. 29.

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

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

APPENDIX.

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

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

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

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

VI.—*Eye-pieces for the Microscope.*

By Edward M. Nelson.

(*Read February* 19, 1908.)

Having been informed by Messrs. Zeiss that the glass 0·82 had been taken out of Messrs. Schott and Co.'s list, I selected another glass, viz. that used for the prisms in the best quality of binoculars, and have recomputed the table of eye-pieces for that glass. This glass is of a permanent nature, clear, and of low dispersion, so it is in every way suitable for eye-pieces.

To repeat the explanation of terms, s is the radius of the surface of the eye-lens next the eye, and r the radius of that towards the object glass, b being the diameter of the eye-lens; S, R, and B have a similar meaning with reference to the field-lens; d' is the distance between the surfaces of the lenses, h the diameter of the hole in the diaphragm, t is the distance the incident surface R is to be below the top of the tube of the Microscope, and F is the equivalent focus of the eye-piece.

For the formulæ upon which these eye-pieces have been calculated, the reader is referred to the original paper in this Journal, 1900, p. 165. The following are additional formulæ to those given in that paper:—

$$b = 0\cdot 575 f'; \qquad B = \frac{a\,b}{1 - \frac{f'}{10}}; \qquad q = \frac{d\,f}{f + f' - d};$$

$$t = q - \left(1 - \frac{F}{10}\right) F - 0\cdot 3 \text{ in.}$$

These formulæ give the theoretical values of b and B; in practice either b must be a little reduced, or B increased. In Table I., for the short tube, alternative values of b, h, B, and d' are given for R.M.S. standard gauge No. 1, and in Table II. values are given for R.M.S. gauge No. 4.

Instead of designating the eye-pieces by letters, or by numbers, such as I., II., III., etc., other numbers are placed at the head of the columns. These numbers represent the magnifying power of the eye-piece when a certain tube-length is employed. As every object requires a different tube-length, the magnifying power of the entire Microscope is a variable quantity; consequently, when accuracy is required, the magnifying power must be determined for each separate case, but for rough estimations the number at the head of each column will be useful as a multiplier.

Table I.—LONG TUBE.

Glass 0·3832 E.B.; $n = 1{\cdot}5163$; $\nu = 64{\cdot}0$.

Number	5		6		8		10		12		15		20		25		30		35	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
Focus	2·00	50·8	1·66	42·3	1·25	31·7	1·00	25·4	0·83	21·2	0·67	16·9	0·50	12·7	0·40	10·2	0·33	8·5	0·29	7·3
s	2·414	61·30	2·050	52·04	1·574	39·96	1·277	32·42	1·074	27·27	0·866	21·99	0·654	16·61	0·525	13·33	0·438	11·12	0·375	9·52
r	0·805	20·44	0·683	17·34	0·525	13·33	0·426	10·82	0·358	9·09	0·289	7·34	0·218	5·53	0·175	4·44	0·146	3·71	0·125	3·17
b and h	0·510	12·95	0·541	13·74	0·415	10·55	0·337	8·56	0·283	7·19	0·229	5·80	0·173	4·38	0·139	3·52	0·116	2·93	0·099	2·51
S	3·608	91·62	3·670	93·18	3·469	88·08	3·234	82·10	3·032	76·98	2·762	70·13	2·391	60·70	2·120	53·82	1·900	48·24	1·723	43·75
R	2·534	64·34	2·025	51·41	1·503	38·16	1·202	30·52	1·008	25·59	0·811	20·60	0·617	15·67	0·500	12·70	0·422	10·72	0·366	9·29
B	1·300	33·01	1·286	32·65	0·967	24·55	0·777	19·73	0·650	16·50	0·522	13·25	0·395	10·03	0·318	8·07	0·268	6·80	0·230	5·84
d'	2·283	57·97	1·944	49·36	1·500	38·09	1·223	31·05	1·033	26·23	0·839	21·31	0·642	16·29	0·521	13·23	0·440	11·16	0·381	9·67
t	2·15	54·59	1·68	42·64	1·17	29·70	0·86	21·84	0·65	16·50	0·46	11·68	0·28	7·11	0·17	4·32	0·10	2·54	0·04	1·02

Short Tube.

Number	4		6		8		10		12		15		20		25		30		35	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
Focus	1·85	46·9	1·23	31·25	0·92	23·4	0·74	18·8	0·62	15·6	0·49	12·5	0·37	9·4	0·30	7·5	0·25	6·3	0·21	5·4
s	2·158	54·79	1·505	38·21	1·154	29·30	0·935	23·74	0·785	19·93	0·632	16·05	0·476	12·09	0·381	9·67	0·317	8·05	0·271	6·88
r	0·719	18·26	0·502	12·75	0·385	9·77	0·312	7·92	0·262	6·65	0·211	5·36	0·159	4·04	0·127	3·22	0·106	2·69	0·090	2·29
b and h	0·525	13·33	0·397	10·08	0·305	7·73	0·247	6·26	0·207	5·26	0·167	4·24	0·126	3·19	0·101	2·55	0·084	2·13	0·072	1·82
S	2·627	66·70	2·662	67·58	2·457	62·37	2·398	60·88	2·252	57·17	2·062	52·35	1·804	45·79	1·607	40·80	1·452	36·87	1·330	33·77
R	2·515	63·85	1·532	38·90	1·052	26·70	0·910	23·10	0·763	19·38	0·618	15·69	0·474	12·03	0·387	9·84	0·330	8·37	0·289	7·33
B	1·300	33·01	0·928	23·57	0·706	17·91	0·570	14·48	0·480	12·18	0·388	9·85	0·296	7·52	0·241	6·12	0·204	5·18	0·178	4·51
d'	2·054	52·15	1·439	36·54	1·118	28·39	0·914	23·21	0·774	19·66	0·631	16·03	0·486	12·34	0·397	10·08	0·337	8·56	0·294	7·47
t	1·96	49·63	1·15	29·20	0·86	21·80	0·56	14·12	0·42	10·72	0·28	7·16	0·15	3·81	0·07	1·85	0·02	0·51	0·0	0·0
b and h	0·300	7·62	0·330	8·38																
B	0·788	20·00	0·788	20·00																
d'	2·104	53·42	1·458	37·02																

Table II.—LONG AND SHORT TUBES.

Glass 0·3832 E.B.; $n = 1·5163$; $\nu = 64·0$.

s and $S = \infty$

Number	5	3¾	6	4½	8	6	10	7½	12	9	15	11¼	20	15	25	18¾	30	22½	35	26¼
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
Focus	2·00	50·8	1·66	42·3	1·25	31·7	1·00	25·4	0·83	21·2	0·67	16·9	0·50	12·7	0·40	10·2	0·33	8·5	0·29	7·3
r	0·604	15·33	0·513	13·01	0·394	9·99	0·319	8·11	0·268	6·81	0·217	5·50	0·164	4·15	0·131	3·33	0·109	2·78	0·094	2·38
b and h	0·300	7·62	0·300	7·62	0·310	7·87	0·337	8·56	0·283	7·19	0·229	5·80	0·173	4·38	0·139	3·52	0·116	2·93	0·099	2·51
R	1·489	37·79	1·305	33·13	1·049	26·64	0·877	22·26	0·756	19·21	0·627	15·93	0·491	12·45	0·404	10·27	0·345	8·77	0·302	7·67
B	0·788	20·00	0·788	20·00	0·788	20·00	0·777	19·73	0·650	16·50	0·522	13·25	0·395	10·03	0·318	8·07	0·268	6·80	0·230	5·84
d'	2·313	58·72	1·954	49·60	1·478	37·52	1·177	29·88	0·993	25·21	0·813	20·64	0·625	15·87	0·507	12·87	0·429	10·89	0·372	9·44
t	2·15	54·59	1·68	42·64	1·17	29·70	0·86	21·84	0·65	16·50	0·46	11·68	0·28	7·11	0·17	4·32	0·10	2·54	0·04	1·02
b and h	0·520	13·20	0·520	13·20	0·400	10·16														
B	1·300	33·01	1·286	32·65	0·967	24·55														
d'	2·268	57·58	1·903	48·32	1·477	37·50														

In Table II., the figure over the inches column relates to the long tube, and that over the millimetre column to the short tube. Rings are to be placed over the eye-piece tubes to maintain the value of t; the eye-pieces are therefore "parfocal." As stated previously, "parfocal" eye-pieces were, in 1839, made by Powell, who has continued to make them ever since. It was probably Cornelius Varley who suggested this idea to Powell.

A correction is needed with regard to the statement in my previous paper that Varley was the first to fit a draw-tube adjustment between the eye-lens and the field-lens of the Huyghenian eye-piece, for subsequently, while cleaning a signed Benj. Martin Microscope, I discovered a similar draw-tube which clearly pre-dates Varley's design.

My acknowledgments are due to Mr. W. B. Stokes for corrections and useful suggestions.

VII.—*A Correction for a Spectroscope.*

By Edward M. Nelson.

(*Read December* 18, 1907.)

It is the common experience of everyone who has worked with a spectroscope that the image of the slit is represented by curved lines, especially when high up in the spectrum. Now curved images are due to the spherical aberration of an oblique pencil. Therefore we know by the curved image upon the plate that we are dealing with an oblique pencil; and although rays which have been parallelized by the collimator and passed through the prism are supposed to fall upon the telescope in a direct manner, a little consideration will show that the prism has, by its refraction, nevertheless rendered their incidence oblique. The correction for this error is obvious. The telescope objective should be mounted upon

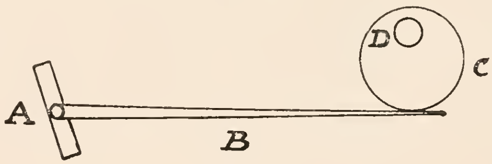


Fig. 30.

a pivot so as to be capable of rotation about a vertical axis; an indicator pointing to an arc, graduated in wave-lengths, would be convenient for setting the objective at any required position. It would be desirable and very simple to make this adjustment automatic (see fig. 30), by fixing an arm B to the pivot A, carrying the object-glass of the telescope, and by means of a spring making this arm bear upon a horizontal excentric, C, fixed to the axis of the pillar D.

Then, as the telescope was rotated round the axis D of the pillar, the arm B would be moved by the excentric C, and the object-glass turned upon its pivot A.

By this means, the lines in a spectrum would be rendered perfectly straight, because the incidence would be always direct, and what is more important, the lines would be made critically sharp.

It is difficult to understand why spectroscopists have for so long been content with a curved image of a straight object, and fuzzy images.

VIII.—*On Dimorphism in the Recent Foraminifer, Alveolina boscii Defr. sp.*

By Frederick Chapman, A.L.S., F.R.M.S.,
Palæontologist to the National Museum, Melbourne.

(*Read February* 19, 1908.)

Plates II. and III.

Preliminary Remarks.—The spindle-shaped tests of *Alveolina boscii* will be familiar to all who have examined dredgings from moderately shallow water in tropical regions. In the fossil state, species of the same genus are found in Cretaceous, Eocene, and Miocene limestones in various parts of the world.

With regard to the occurrence of dimorphism in this genus—the phenomenon of the two stages in the life-history of the organism, in which the shell commences either with a large central chamber (form A), or a small one (form B)—our knowledge is limited to one instance, for the form B seems only to have been noticed, by Munier Chalmas, in a fossil species.* In that example the microspheric form was distinguished by a very small central chamber, surrounded by five simple chambers, which were not subdivided.

Occurrence and Description.—The usual form of the test in *Alveolina boscii*, as found in our coral beach sands and shallow water dredgings, is that having a comparatively short fusiform shell with a large central chamber.

It has lately been my good fortune to meet with the form B of this species in some material kindly handed to me by Messrs. Charles Hedley, F.L.S., and C. J. Gabriel, who dredged it from the Great Barrier Reef, at Cairns Reef, near the Hope Islands, Queensland. These dredgings consisted mainly of large foraminiferal tests belonging to the genera *Orbitolites* (*O. complanata*, Lam.), *Alveolina* (*A. boscii*, Defr. sp.), *Polystomella* (*P. craticulata*, F. and M. sp.), and *Polytrema* (*P. miniaceum*, L. sp.). The *Alveolinæ* were nearly all of the usual type (form A), but a few exceptions occurred in which the test was of extraordinary length. Since the microspheric shell is generally larger than the megalospheric, it seemed highly probable that at last we had met with examples

* Schlumberger, Ch., "Sur le Biloculina depressa d'Orb., au point de vue du dimorphisme des Foraminifères." Assoc. Franç. pour l'Avan. des Sciences, Congrès de Rouen, 1883, p. 526. See also Lister, in Ray Lankester's Treatise of Zoology, pt. i. 1903, p. 111.

[I am indebted to my friend, Mr. F. W. Millett, for a copy of this paper, which does not appear to be in any of the Melbourne Libraries.]

of the microspheric form. Some careful preparations of these tests confirmed that opinion, and photographs of the sections are now reproduced.

In form A the central chamber, or megalosphere, is ovoid or kidney-shape, and in the present example has a longer diameter of 250 μ. The succeeding chamber is nearly spherical in optical section, and is immediately followed by a series of shallow chambers lengthened along the principal axial line, and secondarily subdivided into chamberlets, at first in a single row, and afterwards increasing to two or three superposed series with intermediate floors. The increasing complexity of the serial arrangement of chamberlets with the growth of the shell is seen on the apertural face of the test, which has a generally cribrate appearance.

In form B the central chamber, or microsphere, has a diameter of 33 μ, succeeded by two fairly short and shallow crescentic

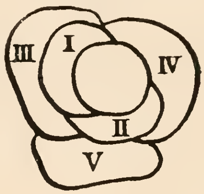


Fig. 31.—Triloculine series of the central disk in *Alveolina boscii* (form B).

chambers, and three larger, all of which are simple, as previously stated of Munier Chalmas' fossil example. These chambers of the central disk are arranged on the triloculine plan (see fig. 31), and not on the peneropline, as Lister * infers from Schlumberger's note on the fossil occurrence. Following upon these are the normal chambers of the test, which extend the whole length of the shell, and are subdivided into several rows of chamberlets, as in form A, and showing successional increase in the number of floors or horizontal partitions, as in the megalospheric type. In form A, however, the segments of the convolutions are compara-

* Loc. supra cit.

EXPLANATION OF PLATES II. and III.

Fig. 1.—The two forms of *Alveolina boscii* Defr. sp. From the Great Barrier Reef, (Cairns Reef), Queensland. × 1½.

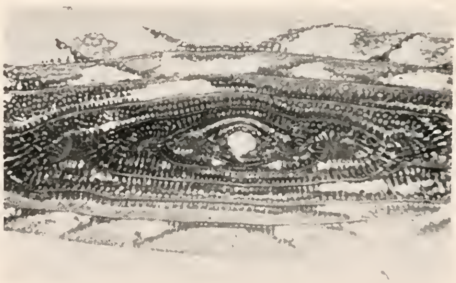
,, 2.—A longitudinal, median section through a megalospheric test of *A. boscii.* Great Barrier Reef. × 16.

,, 3.—A longitudinal, median section through a microspheric test of *A. boscii.* Great Barrier Reef. × 16.

,, 4.—Central area of the megalospheric form (A) of *A boscii.* × 184.

,, 5.—Central area of the microspheric form (B) of *A. boscii.* × 184.

1  × 1½

2  × 16

Form A

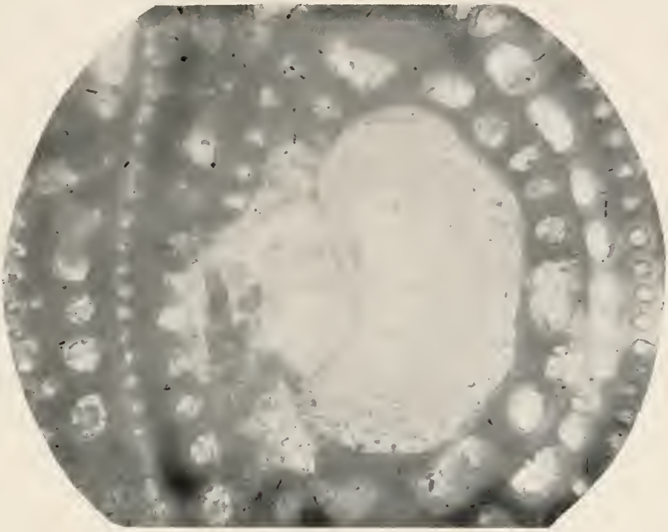
3  × 16

Form B

F.C. photomicr.

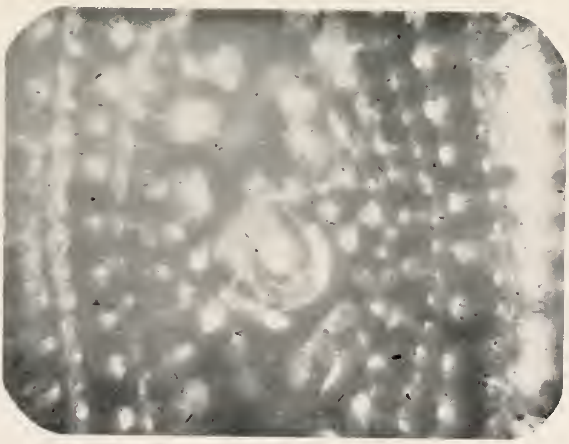
DIMORPHISM IN ALVEOLINA BOSCII, Defr. sp.

4



Form A

5



Form B

F.C. photomicr.

DIMORPHISM IN ALVEOLINA BOSCII, Defr. sp.

The megalosphere and microsphere. × 184.

tively higher and shorter, and consequently the chamberlets are elongated in a vertical direction, or coincident with the minor axis of the test. This peculiarity of its internal structure is seen externally in the general shape, which is constant throughout the growth of the foraminifer; as will be readily recognised from an inspection of the two photographs (Plate II. figs. 2, 3). The lengths of the tests in forms A and B, of which slightly enlarged photographs are now given, measure 7·5 mm. and 18·25 mm. respectively.

Concluding Observations.—It is already well recognised that, whilst almost every type of rhizopod shell can be readily referred to the asexual stage A, the alternating sexual stage, characterised by the microsphere, is undoubtedly rare, and often extremely so. Schaudinn, Lister, and others, who have contributed so much to our knowledge of the life-history of this group, conclusively show that the megalospheric form is the stage fitted for a quiescent-conditioned reproduction of the species, and that the megalospheric form can repeatedly give rise to other asexual, megalospheric individuals. When, however, non-related individuals of the same species are introduced, the zoospores of different parentage can conjugate, and result in the production of microspheric examples.

In the case of *Alveolina* the same rule holds good, and in a very marked degree, for individuals of the melagospheric form occur out of all ordinary proportion to the microspheric form, which, as has already been shown, is known for certain only in two solitary instances, one as a fossil, the other as a recent form; although it is probable that in some instances the long slender tests of the microspheric shell of the living species may have been passed over unnoticed as merely abnormally elongate examples. *Apropos* of the last remark, it is of interest to note that W. B. Carpenter, in his "Introduction,"* says: "The length of the longest complete specimen in my possession is 0·35 of an inch, but I have a specimen whose shape is nearly cylindrical (the *A. quoyii* of d'Orbigny), which, though incomplete at one end, measures 0·50 of an inch." The *A. quoyii*† referred to by Carpenter is, in all probability, another instance of form B, as may have been Carpenter's own imperfect specimen.

* Introduction to the Study of the Foraminifera, 1862, p. 99.
† Ann. Sci. Nat., vii. (1826) p. 307.

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

By Edward M. Nelson.

(*Read December* 18, 1907.)

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

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

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

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

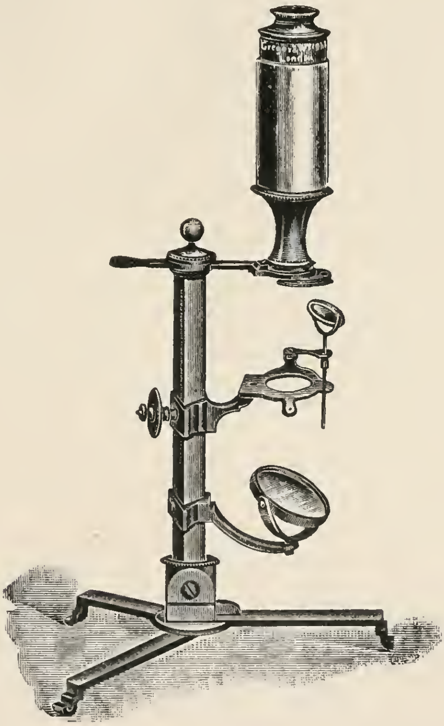


Fig. 32.

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

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

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

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

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

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

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

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

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

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

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

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

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

X.—*Biddulphia Mobiliensis.*

By Edward M. Nelson.

(*Read February* 19, 1908.)

This diatom may be popularly described as being of the well-known *Isthmia* type, and consequently much like a pocket cigar-case. Probably a diatomist would say that the *Isthmia* was a *Biddulphia*, but as this note is written for microscopists in general, and not for diatomists only, it will be better to describe this *Biddulphia* as being like an *Isthmia*, a common microscopical object.

Upon the side of this diatom striæ, which count 41,000 and 32,000 per inch (1,610 and 1,260 per mm.), can be seen with a low power, but with any lens of moderate aperture the diatom can easily be dotted.

When the object is examined under the most critical conditions, with a very large axial solid cone of illumination, a suitable blue-green screen, and a power of not less than 2,000 diameters, the primary areolations will be found to contain a very minute secondary structure.

This structure is so delicate that it is not possible to hold the image for long at a time. In general, four small dots will be perceived in each primary, and if this had been all, it would have been better not to mention the fact, because the image might merely be a diffraction phenomenon; but the investigation was continued until some primaries which had five, and even six, secondary dots in them had been found, thus proving that this secondary structure is an entity.

The diatom was sent to Mr. Merlin, who has kindly examined it, and has confirmed the observation that all the primaries do not have the same number of secondary dots.

It is to be regretted that this note is not accompanied by even a rough drawing of these secondaries. The image is excessively difficult, and cannot be held long enough to draw; the eye has repeatedly to be rested in order to get even a momentary glimpse of this tenuous structure.

This is, so far as I know, the smallest primary in which any secondary structure has been seen. There can be no doubt that secondary structures which have been found to be present in so many species of diatoms are of great importance to the organism, and it may be suggested that they are placed there to guard the internal plasma from bacterial attacks.

The subject is of some interest to microscopy, as these secondaries have only been seen with long-tube Microscopes, and it is very probable that this resolution will never be reached by a short-tube Microscope.

It has often been asked, Which is the better instrument of the two? A decisive answer can at once be given to this question. If the instrument is required for the examination of the most minute structures, the long-tube is the better; but if it is required for other things, such as portability or cheapness, then a short-tube may be preferable. But so long as a Microscope is employed for the highest purpose, such as the revelation of the minute unknown, then a long-tube has no rival.

The ultimate appeal concerning any very minute structure must go to a long-tube Microscope.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Correlation of Ovarian and Uterine Functions.‡—E. S. Carmichael and F. H. A. Marshall find that the removal of the ovaries of young animals (rodents) prevents the development of the uterus and Fallopian tubes, which remain in an infantile condition. The subsequent growth and general nutrition of the animals seem to be unaffected. The removal of the ovaries in adult rodents leads to fibrous degeneration of the uterus and Fallopian tubes (most marked in the mucous membrane). The animals' subsequent health and nutrition remain good. These observations for the most part support the evidence obtained clinically in the human subject after surgical operation.

The removal of the uterus in a young animal has no influence in preventing the further development of the ovaries, which are capable of ovulating and forming corpora lutea after adult life has been reached. The removal of the uterus in an adult animal does not give rise to any degenerative change in the ovaries, if the vascular connections of the latter remain intact. These latter observations do not support the contentions of those surgeons who advocate sub-total hysterectomy, believing that the functional activity of the ovary is in some way dependent on the presence of the uterus.

Early Placenta in Macacus nemestrinus.§—W. L. H. Duckworth finds that the decidual formation in this case is that known as decidua

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Proc. Roy. Soc. London, Series B, lxxix. (1907) pp. 387–94.

§ Proc. Cambridge Phil. Soc., xiv. (1907) pp. 299–312 (8 pls.).

compacta basalis, no decidua reflexa being present. The "wall" or circumvallation described by Selenka in Semnopithecidæ is not present. The uterine tissues immediately beneath the area of attachment of the blastocyst, and also for some distance on either side of this, are œdematous. Immediately beneath the blastocyst there is even an accumulation of a fibrinous exudation, by which the apparently degenerating cells of the uterine epithelium are thrust off. There is no evidence of the transformation of cells either of the uterine epithelium or of the glandular lining into syncytial masses. The evidence of the sections leads to the conclusion that the intervillous spaces are not lined by any derivatives of maternal cells, but by embryonic ectodermal cells. The epithelial lining cells of the uterine glands seem to play no permanent part in the formation of placental tissues. The embryonic tissue which has permanent relations in the placenta as ultimately constituted is identified with Voigt's Grundschicht of the villous processes (? cytotrophoblast of other authors). In the stage described there was no mesoderm in the embryonic villi.

Formation of Red Blood Corpuscles in Placenta of Galeopithecus.* A. A. W. Hubrecht finds clear evidence of hæmatopoiesis, not only in the maternal mucosa, but also in the embryonic trophoblast. He finds that the blood corpuscles thus formed circulate in the maternal blood-vessels only. Incidentally he adds evidence in favour of the view that the red blood corpuscles in mammals are not equivalent with cells, but must be regarded as nuclear derivatives.

Growth of Testes in Birds and Mammals.†—R. Disselhorst calls attention to various facts which show that the growth of the testes in birds and mammals is for a long time relatively independent of that of the body generally. While other organs are showing their maximum rate of growth, the testes remain in a latent state. This condition is paralleled by that of the testes in hibernating animals, and in birds outside of the breeding season. The author refers to a paper which he published in 1898,‡ in which he discussed the changes of weight in the gonads at different periods of life.

Incubation in Doves.§—Xavier Raspail notes that a turtle-dove (*Turtur auritus*) twice in succession left its eggs on the eighteenth day, the eggs not developing. A carrier pigeon did the same four times on the eighteenth day, the eggs not developing. He concludes that the birds become aware of the futility of brooding any longer. The turtle-dove is very sensitive, knowing when "a profane hand" has, in its absence, touched the eggs or the young, and leaving them in consequence; it is surprising that it does not become sooner aware that the eggs are not developing.

Amitosis in Pigeon's Egg.‖—J. T. Patterson finds that amitosis plays an important role in the development of the pigeon's blastoderm.

* Proc. Acad. Amsterdam, Section of Sciences, ix. (1907) pp. 873–8.
† Anat. Anzeig., xxxii. (1908) pp. 113–17.
‡ Arch. wiss. Tierheilkunde, xxiv. (1898) heft 6.
§ Bull. Soc. Zool. France, xxxii. (1907) pp. 89–90.
‖ Anat. Anzeig., xxxii. (1908). pp. 117–25 (24 figs.).

A study of the regional occurrence of mitosis and amitosis reveals the fact that the former is found mainly in slowly and the latter in rapidly growing parts of the blastoderm. The idea that the cells which divide by amitosis are on the road to degeneration receives no support from the facts here recorded. Amitosis is probably the result of special physiological conditions which create a stimulus to cell-division, but what these conditions are we are unable to say.

Post-embryonic Development of Ardeidæ.*—S. Schaub has studied *Ardea purpurea*, *A. cinerea* and *Nycticorax griseus*, with special reference to the changes in the proportions of the body during post-embryonic development, the changes in the scales of the feet, and the distribution of the feathers. He discusses the pterylography in its developmental and phyletic aspects. Emphasis is laid on the primary geometrically precise disposition of the feathers, which is interpreted in correlation with the strains on the skin. There may have been a primitive diffuseness of distribution from which the geometrically orderly arrangements have evolved, but a secondary diffuseness may arise in the definite plumage. Powder-down feathers are peculiarly specialised down-feathers forming a dust whose function seems to be analogous to that of the preen gland. There is no fat about the powder: the greasy feeling is due to the mechanical nature of very flexible minute horny plates. The powder is formed by the degeneration of a cellular sheath around the barbs. But the powder-down feathers of different birds are very diverse, and are rather analogous than homologous structures.

Complementary Spiracles in Anura.†—P. Wintrebert has corroborated in *Alytes obstetricans* and *Rana temporaria* the observation of H. Brauss (on *Bombinator*) that the opening from the branchial chamber at the beginning of the metamorphosis occurs even in the absence of the anterior limbs. He does not regard this as an "ontogenetic reminiscence," but gives an ingenious interpretation of the growth-conditions which lead to the perforation.

Development of Lymph-sacs in Hind Limb of Frog.‡—Gizela Goldfinger has studied this on the developing and regenerating limb, and finds that lymph-capillaries ramify, form a network, and coalesce with obliteration of their walls, so that sacs result—a confirmation of Ranvier's view.

Gastrulation in Teleosteans.§—J. Boeke maintains that in Teleosteans (murænoids) the process of gastrulation is ended as soon as the prostomial thickening has been formed, viz. at the beginning of the covering of the yolk. At that moment the "Anlage" of the entoderm is clearly differentiated, and the ectodermal cells begin to invaginate to form the chorda and mesodermic plates; the concentration of the cells towards the median line begins; the long and slender embryo is formed out of the broad and short embryonic shield. The blastula cavity, in

* Zool. Jahrb., xxv. (1907) pp. 305–404 (2 pls. and 18 figs.).
† C.R. Soc. Biol. Paris, lxiii. (1907) pp. 439–41.
‡ Bull. Acad. Sci. Cracovie, No. 4 (1907) pp. 259–76 (1 pl.).
§ Proc. Acad. Amsterdam, Section of Sciences, ix. (1907) pp. 800–8 (2 pls.).

the cases in which it is developed, has disappeared as such; all the following processes, the longitudinal growth of the embryo, the covering of the yolk by the blastoderm ring, the closure of the yolk blastopore, belong to the notogenesis, and we are no more entitled to reckon these processes to gastrulation proper than we are to do that of the covering of the yolk by the entoderm in Sauropsids.

Early Stages of Fresh-water Fishes.*—F. B. Browne gives a brief account of the early stages in the life-history of the pike, the perch, the bream, the roach, and the stickleback.

Monstrosities.†—Paul Ernst discusses numerous human monstrosities in the light of experimental embryology and phylogeny. He shows in an instructive way how recent researches on the influence of abnormal conditions on ova and embryos throw light on familiar teratological phenomena in man. There is less light to be got from phylogenetic considerations, but illustrations of arrested development are common. The paper is illustrated by a grim series of plates showing monstrosities.

b. Histology.

Structure of Cilia.‡—L. W. Williams has studied the action of cilia, especially on Gastropoda larva, and has been led to a modification of the theory of their structure. All protoplasmic processes, cilia, flagella, pseudopodia, and Acinetarian tentacles, are of essentially the same structure, and consist of a contractile protoplasmic sheath enclosing a solid or fluid non-contractile core. Primitively the sheath is contractile throughout, and is not marked off structurally or functionally from the rest of the ectoplasm. Secondarily the sheath becomes differentiated into contractile and non-contractile portions.

The contractile protoplasm of velar cilia and ctenophore plates is practically confined to the base of the cilium. Parker has shown that in reversible cilia, e.g. in *Metridium*, the contractile substance must occur in two bands on opposite sides, and that irreversible cilia have probably only one band. Ballowitz has shown that spermatozoan flagella have a fibrillar axial structure surrounded by a sheath of uneven thickness; others have shown that the axial rod supports an irregular contractile protoplasmic sheath.

The core of the pseudopodium, which is to be regarded as the simplest cilium, is fluid. In higher stages of ciliary development a solid, which is elastic in cilia and flagella and inelastic in pendulous pseudopodia, replaces the fluid core.

Development of Cartilage.§—Ed. Retterer finds that in embryonic development the first trabeculæ of fundamental substance are elaborated by the chromophilous protoplasm of the cellular syncytium which represents the primordium of the cartilage. From their first appearance they show zones or lamellæ, alternately light and dark. To begin with, the

* Trans. Norfolk and Norwich Nat. Soc., viii. (1907) pp. 478–88 (2 pls.).
† Verh. Schw. Nat. Ges., 89th Jahres. in St. Gallen, 1907, pp. 129–69 (19 figs., mostly plates).
‡ Amer. Nat., xli. (1907) pp. 545–61 (2 figs.).
§ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 3–6.

trabeculæ run from cell to cell-forming an alveolar system. Later on, the cells begin to elaborate concentric layers around each cell, and the cartilage takes on the features of the adult cartilage.

Neuroglia Syncytium.*—R. J. Terry finds that the neuroglia of the brain of *Batrachus* (*opsanus*) *tau* is a syncytium comparable in form and structure with that of human and pig embryos.

Theory of Malignant Tumours.†—Emil v. Dungern and Richard Werner discuss the influence of external stimuli on the growth and multiplication of cells, and expound the following thesis. All cells have in themselves several regulation-mechanisms which inhibit a persistent increase of the growth and multiplication. By diverse stimuli these inhibitory arrangements may be temporarily weakened or put out of gear, so that exaggerated assimilation and proliferation set in. The inhibitory arrangements may be regenerated, but it is not possible experimentally to render them permanently futile without destroying the rest of the cellular organisation. Thus it is not possible to induce experimentally an unlimited proliferation of cells, such as occurs in malignant tumours.

Æsthetic Aspect of Animals.‡—Karl Möbius discusses the æsthetic value of the various forms of animal life. A pleasant æsthetic emotion at the sight of a beautiful animal has an objective and a subjective basis, both very complex. On the one hand, there are definable qualities of symmetry, proportion, balance, coloration, which please us; on the other hand, we read into the animal the qualities of a human artist, and we praise the freedom and individuality, the unity and harmony, and frequently the effectiveness and significance which its beauty expresses. In estimating an animal's æsthetic value, it is very important to see it in its natural setting and to see it alive. Beauty of form pleases us more than beauty of colour—it goes deeper, it has more meaning. A large part of Möbius's beautifully illustrated book is devoted to a consideration of what might be called the canons of animal architecture. All styles are not equally pleasing, and there are reasons for this. Thus the human eye does not like to look, we are told, at animals which are unsymmetrical, whose bodies lack unity, whose parts are monotonously repeated, which lack a centre for the eye to rest on, which are so unconventional, like crabs, as to be broader than they are long. Whether one agrees or not with the illustrious author, who has been for so long familiar with beautiful animals, and with the display of them in the museum at Berlin, one cannot but be interested in his discussion of a fascinating subject.

Weight of Brain in Man and Woman.§—L. Lapicque notes that the average weights of the brains in adult Europeans are 1360 grm. for men and 1220 for women. But the average weights of the body are

* Anat. Anzeig., xxxi. (1907) pp. 27–30 (2 figs.).

† Das Wesen der bösartigen Geschwülste, eine biologische Studie. Leipzig: 1907, 159 pp. See Biol. Centralbl., xxvii. (1907) pp. 767–8.

‡ Ästhetik der Tierwelt. By Prof. Karl Möbius. Jena: Fischer (1908) 128 pp., (3 pls., 195 figs.).

§ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 432–5.

66 and 54 kilogrm. When this is taken into account, the result is practically equality between the sexes.

Eighth Cerebral Nerve.*—C. Winkler discusses the central course of the nervus octavus, and its influence on motility. Previous researches have shown that the distribution of the eighth nerve is much more complicated than was surmised before, and Ewald has shown that disturbances of locomotion in pigeons follow the removal of the labyrinth on one side or on both sides. Winkler finds that the course of the octavus fibres and their distribution towards different centres in the medulla oblongata, pons, and mesencephalon is different in detail in pigeon, rabbit, dog, cat, mouse, and man, and that the functional troubles, consequent on section of the octavus in pigeon, rabbit, dog, and cat are also different in detail. The mode of the central distribution of the eighth nerve does not warrant a sharp distinction between that of the *N. cochlearis* and that of the *N. vestibularis*. It is necessary to ask whether the cochlear, whose end-organ is endowed with the function of hearing, does not exert a certain influence upon the muscular system, and whether the vestibular, endowed with important significance for motor functions, does not contribute also to the function of hearing. Winkler thinks that by the octavus-fibres, centres are innervated, whence originate long tracts towards the lateral and anterior columns of the medulla providing the motor centres with fibres, and that even primary octavus fibres, though in a slight degree, follow the same path. We cannot do more than indicate the general nature of this memoir, in which the author seeks to establish a correlation between the distribution of the octavus fibres and the physiological role of the nerve.

Dentition of Mammals.†—W. Leche continues his important investigations on the ontogeny and phylogeny of mammalian dentitions. In the present instalment he deals with the families Centetidæ, Solenodontidæ, and Chrysochloridæ, which he discusses not only as regards their teeth, but in respect to the entirety of their characters.

His most general result is that the Insectivora should be classified as follows :—

I. Sub-order Centetoidea	Family	1.	Chrysochloridæ.
	,,	2.	Centetidæ.
	,,	3.	Solenodontidæ.
II. Sub-order Erinacoidea	,,	4.	Leptictidæ.
	,,	5.	Erinaceidæ.
III. Sub-order Soricoidea	,,	6.	Soricidæ.
	,,	7.	Talpidæ.

Leche gives some interesting illustrations of convergence, e.g. between *Erinaceus* and *Ericulus*, *Notoryctes* and *Chrysochloris* ; in the special sesamoid associated with the flexor digitorum profundus in *Chrysochloris*, compared with *Notoryctes* and *Necrolestes*, he finds an illustration of progressive evolution ; in *Chrysochloris*, again, he sees an example of the preservation of a primitive type by specialisation ; *Hemicentetes* may be

* Verh. k. Akad. Wetensch. Amsterdam, xiv. (1907) pp. 1–202 (24 pls.).
† Zoologica, xx. Heft 49 (1907) pp. 1–157 (4 pls. and 108 figs.).

described as a persistent young stage of *Centetes*; in the history of the 4th deciduous premolar of *Hemicentetes nigriceps*, there is a good instance of "function-change," and among other interesting points emphasized is the evolution of similar forms of teeth along different paths and the persistence of a hypobasal chorda dorsalis in the skull of *Centetes* and *Ericulus*.

New Acanthoglossus.*— Oldfield Thomas describes a new long-nosed Echidna (*Acanthoglossus goodfellowi* sp. n.) obtained by Walter Goodfellow in the island of Salawatti. The genus has not hitherto been recorded out of New Guinea itself, and there mainly or entirely at high altitudes, for which the thick coat of *A. bruignii* is admirably suited. The island of Salawatti is throughout comparatively low, and it is not surprising that the species of *Acanthoglossus* occurring there should have a coat much more spinous and less hairy than in any of the forms of *A. bruignii*.

Relationships of Sparassodonta.†—W. D. Matthew discusses this interesting group of extinct mammals found in the Tertiary formations of Patagonia. They appear to have taken the place of true Carnivora in South America during most of the Tertiary period, as the carnivorous Marsupials do in the modern fauna of Australia. The Sparassodonts appear to be related to Marsupials, such as *Thylacinus*, rather than to Placentals, such as the Creodonts and modern Carnivora.

Kidney of Elephant.‡—A. Pettit describes the kidney of *Elephas* (*Loxodon*) *africanus*, which consists of a variable number of lobes surrounded by a sort of muscular sacking. In some other mammals smooth muscle-fibres have been found associated with the capsule and calices of the kidney, and even in the renal parenchyma. It is possible that the marked development in the African elephant may have to do with the evacuation of the urine from the immense organ, but there are no facts to prove this. The kidney of the elephant has, as usual, a "pluri-reniculate" stage, but the peculiarity is that this persists, though with a tendency to a reduction of the number of lobes, in the adult. It is intermediate between the "conglobate" and "pluri-reniculate" types, and is remarkable for the system of contractile partitions.

Comparative Anatomy of Tongue of Woodpecker.§—A. Leiber publishes a monograph dealing with the structure, comparative anatomy, mechanism and phylogeny of the woodpecker's tongue. He deduces the somewhat complicated anatomy of this organ from the simpler relations observed in the genera *Citta* and *Certhia*, where the development is less extreme but in the same direction.

Circulatory Mechanism in Teleosteans.‖—Wilhelmina Kolff finds that the propulsion of the blood is due not merely to the action of the heart, but to numerous subsidiary factors—the negative pericardial pres-

* Ann. Nat. Hist., xx. (1907) pp. 498–9.
† Geol. Mag., iv. (1907) pp. 531–5.
‡ Arch. Zool. Expér., vii. (1907) Notes et Revue, No. 4, pp. ciii.–xi. (2 figs.).
§ Zoologica, xx. Heft 51 (Stuttgart, 1907) pp. 1–79 (6 pls. and 13 figs.).
‖ Atti R. Accad. Lincei Roma, xxi. (1907) pp. 479–90 (5 figs.).

sure, the respiratory movements, and the muscular contractions in swimming. In the eel the normal frequency of beats is greater than that of the respiratory movements, in *Barbus fluviatilis* and *Telestes muticellus* it is less. Stimulation of the vagus nerve produces diastolic arrest; cutting it results in acceleration. Warming the water results in increasing the rapidity of the cardiac rhythm up to a maximum which is not exceeded; when the temperature is lowered, the frequency diminishes.

Mutation-phenomena in Animals.*—M. Nussbaum calls attention to cases such as the differences in the optic chiasma in nearly related species of fishes. In one the right is uppermost, in another the left is uppermost; and there are many similar instances in regard to which an apparent abruptness of change must be postulated. In other words, there is a certain discontinuity in the adult results, though these results are reached by continuous ontogenetic development. But it is hardly to details of this sort that de Vries' concept of mutation refers.

Natural History of the Lumpsucker.†—Theodore Gill gives an interesting account of the peculiarities, habits, and relationships of the lumpsucker. The skeleton is very remarkable because of the extreme reduction of the bones and the inverse development of cartilage. All the bones, however, are there, but existent in a reduced state or as thin membrane-like pieces fastened to the cartilaginous mass. The relationships of Cyclopterids are with the Sculpins or Cottidæ, which have the bones firm and well ossified, and very little persistent cartilage. A review is taken of the different genera.

The lumpsucker is widely distributed in the North Atlantic, both horizontally and vertically. It frequents cold waters; it is a "bottom fish," though it may be found swimming freely; it is rather lethargic, but very active and fierce in the breeding season; it feeds on crustaceans, medusæ, worms, and shell-less molluscs.

The spawning season lasts from February to June. The male keeps a watchful guard over the eggs, not merely defending them from intruders, but aerating them by waving his pectoral fins and spouting water from his mouth, as Fulton has shown. An account of the larvæ is given, and the vivid paper ends with a discussion of the lumpsucker's dubious palatability.

Respiratory Mechanism in Elasmobranchs.‡—A. D. Darbishire has elucidated several interesting facts in connection with the breathing in various types. In the dogfish, water is drawn into the mouth and spiracle by the expansion of the whole phargyngeal region; water is prevented from entering the gill slits by their automatic closure, the gill covers being in part passive agents in determining the respiratory current. The differences between the dogfish and ray in their respiratory mechanism all relate to the flat shape and ground habitat of the ray. In the former the greater part of the inhaled water enters through the mouth, in the latter through the spiracle—solely through it when the fish is at rest. In the dogfish water never enters solely through the

* Mutationserscheinungen bei Tieren. (Bonn, 1906) 24 pp.
† Smithsonian Misc. Coll., iv. (1907) pp. 175–94 (16 figs.).
‡ Journ. Linn. Soc., xxx. (1907) pp. 86–94 (3 figs.).

spiracle: it is occasionally ejected from it; in the ray the current can be definitely reversed for a considerable number of respiratory acts. In *Rhina* the water is drawn into the mouth by the undulation of the gill covers, which are thus active agents in determining the respiratory current. The spiracle in *Rhina* is only capable of slow and imperceptible opening and closing; it does not open and shut rhythmically as in the case of the ray and dogfish.

New Deep-sea Fishes from South-west of Ireland.*—E. W. L. Holt and L. W. Byrne describe the following new species collected by the 'Helga'—*Læmonema latifrons*, from 720 fathoms; *Cyttosoma helgæ*, from 540–660 fathoms; *Oneirodes megaceros*, from 775–795 fathoms.

Labyrinth Organ of Labyrinthici.†—G. Henninger describes the structure and position of this accessory respiratory organ in *Anabas scandens*, *Macropodus viridi-auratus*, and *Trichogaster fasciatus*, and relates experiments which show that atmospheric air is used by these fishes. He discusses the afferent and efferent blood-vessels and the rete mirabile in the organ, as also the fact that the heart contains "mixed blood."

Freshwater Fishes of New Guinea.‡—Max Weber points out that the river fishes of New Guinea belong to two groups:—(1) a fluvio-marine group, which is Indo-Australian, or Indo-Pacific, and which may be met with, also, for instance, in Ambon or Celebes, and (2) a characteristic Australian contingent. Of the latter, 24 in number, none is known from the sea. Of the 12 species of Melanotæniidæ known from New Guinea, and of the 12 species from tropical or sub-tropical Australia, not one is common to the two regions, although the differences between some of the species are very small. The author concludes that the connection between Australia and New Guinea must have been not earlier than in the Pliocene, and the breaking up of it in the Pleistocene.

Swim-bladder in Sciænidæ.§—L. Cohn describes the complications of the swim-bladder in *Collichthys lucida*, *Otolithus argenteus*, and other Sciænids. In some genera, e.g. *Corvina*, there are species with swim-bladders without diverticula, with simple cornua, with dichotomously forked cornua, and with dendriform outgrowths. In *Otolithus gracilis* the first pair of diverticula form 3 to 4 branches, and extend forwards to the auditory capsule, with which the branches are closely connected; the second pair grow dorsally, and surround with their branches the under side of the first and second vertebræ: then follow numerous outgrowths, extending downwards to right and left; each outgrowth divides into a dorsal branch and a ventral branch, the former branching much more than the latter.

Poison-glands of Catfishes.‖—H. D. Reed describes the poison-glands of the "stone cats" and "mad toms," species of *Noturus* and

* Ann. Nat. Hist., ser. 8, i. (1908) pp. 86–95 (1 pl. and 1 fig.).
† Zool. Jahrb., xxv. (1907) pp. 251–304 (4 pls. and 3 figs.).
‡ Proc. Acad. Amsterdam, Section of Sciences, ix. (1907) pp. 462–5.
§ Zool. Anzeig., xxxii. (1907) pp. 433–40 (4 figs.).
‖ Amer. Nat., xli. (1907) pp. 533–66 (5 figs.).

Schilbeodes found in North American streams. These catfishes have an axillary pore, which is the opening of a gland. Experiments with *S. gyrinus* indicate that the secretion of the gland is poisonous. In addition to the axillary glands, *S. gyrinus* and *S. nocturnus* have similar glands developed about the pectoral and dorsal spines, with ends projecting slightly through a slit in the epidermis. Spine-glands are not found in those species which possess well developed serræ upon the spines.

The glands are invaginations of the epidermis; the gland-sheath is modified corium; the clavate cells of the skin become the secretory cells; the ordinary epidermal cells form a supporting network; there are no muscles for forcing out the secretion; the cell-walls are evidently ruptured by the pressure of their contents, and in this way the spines are constantly anointed with the poisonous secretion.

Poison Apparatus of Weever.*—J. O. Borley describes the poison-glands of *Trachinus draco* and *T. vipera*, which are lodged in five or six rays of the dorsal fin and in a spinous outgrowth of the opercular bone. The opercular gland consists of a capsule of connective-tissue, a rich network of capillaries, and very large secretory cells in radiating columns. The secretion appears in two states: masses of finely granular material, and highly refringent colloidal substance, either two secretions or two stages of one secretion. It is highly probable that there is a perpetual waste of secretion into the sea, though this is minimised by the closeness with which the sheath fits the spine. Where the spine issues from the substance of the operculum it is still at the bottom of a tube sunk in the operculum, this tube being the sheath. This tube wrinkles down about the spine as the latter enters a victim until about one-third of the spine is uncovered.

H. Muir Evans † has made some experiments on the action of the weever's poison. He refers to the previous investigations of Bottard‡ and Briot,§ but his own work was independent of these. An injection of the poison into gold-fish, frog, mouse, and guinea-pig, produced local paralysis. Marked hæmolysis was seen in the blood of pigeons and various mammals. The poison is probably an "amboceptor," which unites with the endocomplements of the blood-cells.

Food of Birds.‖—Cecil H. Hooper has gathered together a number of facts in regard to the food of birds, especially of those that are important practically. A few examples may be given. The amount of insect-food eaten by sparrows is comparatively small. Bullfinches do much harm to fruit-buds, especially gooseberries. Blackbirds destroy much fruit, but are harmless or useful at other times, eating worms, grubs, etc. Starlings devour leather-jackets and wireworms, but destroy much fruit. Missel-thrushes eat many fruits, but outside the fruit season they do no harm. The song-thrush devours fruits, but also insects, snails, and worms. Greenfinches are a terrible pest among hops;

* Trans. Norfolk and Norwich Nat. Soc., viii. (1907) pp. 369–73 (1 fig.).
† Tom. cit., pp. 355–68 (1 fig.). ‡ Les Poissons Venimeux, 1889.
§ C.R. Soc. Biol. Paris, 1902–4.
‖ Journ. Board of Agriculture, xiv. (1907) pp. 402–12.

they eat newly sown and sprouting seeds, and fruit-buds: they eat very few insects, but many weeds. Chaffinches eat various kinds of larvæ, green-fly, etc., but destroy fruit-buds, freshly sown and sprouting crops. Rooks destroy leather-jackets, chafer larvæ, wireworms, caterpillars, slugs, young voles, but also eggs and young of fowls and partridge, certain fruits, and freshly sown seeds. The jackdaw eats cockchafer grubs, wireworms, and leather-jackets; like the rook, it will strip trees of walnuts, and where numerous, is destructive to peas and grain crops. It is a very destructive bird to the eggs and young of game-birds and poultry, and will completely clear the nests of small birds of their eggs and young. The wood-pigeon seems to have no redeeming feature from the farmer's point of view. Blue-tits are great insect-eaters; they collect caterpillars from fruit trees, but they also spoil apples, pears, and other fruits. The blackcap, whitethroat, and robin are insect-eaters, but levy some toll on fruits. The wren, willow-wren, goldcrest, hedge-sparrow, tree-creeper, spotted flycatcher, pied wagtail, goatsucker, martin, swallow, swift, etc., are all useful and above reproach. The goldfinch is very useful as a weed seed-eater, as it splits the seeds before eating them. Larks seem to do considerable damage to growing crops, strawberries, peas, cabbage, and green crops. Of course the author points out that in many cases the verdict is still indecisive; the facts require to be more numerous and precise. Particular attention is given to the black-headed gull, which eats earthworms, wireworms, leather-jackets, slugs, and much vegetable and animal matter considered "neutral" from a practical point of view. If it gets plenty of insects and worms, it does not take to fish or cereals.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Large Cuttlefish at St. Andrews.*—W. C. M'Intosh, in his recent contribution of notes from the Gatty Marine Laboratory, records the occurrence of a large specimen of *Ommastrephes sagittatus*, d'Orb., stranded on the rocks near St. Andrews. The length of the mantle from the tip of the tail to the collar was 25 in., the pen measured 23 in., the eight arms had an average length of 13¼ in.; the tentacles were unfortunately absent. A description of the suckers is given.

β. Gastropoda.

New Parasitic Gastropod.†—Paul Bartsch describes *Eulima ptilocrinicola* sp. n. found on *Ptilocrinus pinnatus*, dredged by the 'Albatross' in 1588 fathoms off British Columbia. The three specimens had the proboscis deeply inserted in the side of the body of the Crinoid, and it was necessary to sever it in order to release the shell. The parasitic habit, the texture, and weak malleations of the surface, recall certain forms of *Stylifer*, but the absence of the mucronate apex and the presence of the operculum make it necessary to refer the new form to *Eulima*.

* Ann. Nat. Hist., xx. (1907) pp. 172–5 (3 figs.).
† Proc. U.S. Nat. Mus., xxxii. (1907) pp. 555–6 (1 pl.).

Larval Stages of Cyclostoma elegans.* — C. Barbieri gives an account of the larvæ of this common terrestrial Prosobranch. There is a well developed velar region, without cilia, covered by a layer of vacuolated epithelial cells. There are two vitelline sacs, right and left, the latter the larger. Both are composed of vacuolated cells. The liver develops in the right vitelline sac and in the proximal portion of the left. The more differentiated part of the left vitelline sac atrophies. A considerable tract of the œsophagus consists solely of vacuolated cells. The kidney and the pericardium develop from a common rudiment, and the heart arises as an introflexion of the pericardial wall. At an early stage the pedal gland is formed, and has two distinct ducts and openings, but the proximal parts of the ducts afterwards coalesce. The supra-pedal gland is formed much later and independently of the pedal gland. There are folds on the dorsal surface of the mantle which may be regarded as a rudimentary branchia.

Orthogenesis in Gastropods.†—Amadeus W. Grabau discusses the occurrence of orthogenetic variation, i.e. progressive variation along definite and determinate lines, in various Gastropod types, such as *Fulgur* and *Melania*. The *Melanias*, to which he refers in most detail, form a group of highly "accelerated" Gastropods in which the spines, a specialised feature, appearing late in the phylogeny of most Gastropods, have become a dominant character, appearing before the ribs have disappeared. Many "phylogerontic" members of this group, forming terminals of genetic series, retain their ornamentation only in the young, the adults becoming smooth. In several lines extreme accentuation of certain characters at the expense of others has resulted in grotesque forms. All the characters, however, appear and disappear in a regular progressive manner both in ontogeny and in phylogeny. The *Melanias* therefore constitute an excellent group from which illustrations of ortho-ontogenesis and ortho-phylogenesis may be obtained.

Minute Structure of Ganglion-cells of Tethys leporina.‡—Hugo Merton describes the canalicular system within the ganglion-cells of *Tethys*. There is a genuine network which penetrates the entire endoplasm, and forms a meshwork around the nucleus. The close relations between the chromophilous substance and the network point to a reciprocal interaction between the two, which is probably of importance in the metabolism of the ganglion-cell.

Gastropods of the Magellan Province.§—H. Strebel completes his survey which includes 236 species and varieties, of which 209 are marine. In the present instalment he deals with *Acmæa*, *Fissurella*, *Patinella*, *Siphonaria*, *Stephanoda*, etc. The characteristic species are *Trophon geversianus*, *laciniatus* and *decolor*, *Voluta ancilla*, *Photinula violacea*, *Patinella magellanica*, *Nacella cymbularia*, *Fissurella alba*, *Euthria plumbea* and *magellanica*.

* Zool. Anzeig., xxxii. (1907) pp. 257–84 (21 figs.).
† Amer. Naturalist, xli. (1907) pp. 607–46 (3 pls.).
‡ Zeitschr. Wiss. Zool., lxxxviii. (1907) pp. 327–57 (2 pls.).
§ Zool. Jahrb., xxv. (1907) pp. 79–196 (8 pls. and 6 figs.).

New Australian Chiton.*—R. A. Bastow and J. H. Gatliff describe *Enoplochiton torri* sp. n. from the coast of Queensland. If the reference to *Enoplochiton* is correct the species is very interesting geographically, for the other species of the rare genus, *E. niger* Barnes, occurs on the coast of Peru. "The head-valve is studded with numerous bright, clear, amber eyes, not ocelli, but real and very human-looking eyes; these also occur on the lateral areas and on the posterior valve. . . . The girdle, with its radially striated scales, is unmistakably well secured to the very numerous and deeply-cleft teeth in the insertion plates. . . . The whole of the dorsal sculpture is granulate."

Arthropoda.

a. Insecta.

Senses of Ants.†—O. C. Silverlock has made a number of interesting experiments on the reactions of ants to heat and light. He shows that some ants at least feel a rise in temperature of not more than ·3° C. He confirms Lord Avebury's conclusion that the ultra-violet rays affect the ants as true light rays. The ants change their position by reason of their dislike to the colour of the ultra-violet rays, and also by reason of the smaller amount of heat transmitted through the violet end of the spectrum.

Nests of Wanderer Ants.‡—E. Wasmann has been able to obtain some information from E. Luja in the Congo regarding the hitherto unknown nest of *Dorylus* (*Anomma*) *wilverthi*. It was found at the foot of a tree in the forest; it included in its upper portions numerous myrmecophilous beetles quite different from those which accompany the armies on the march; the latter were found in the deeper parts of the nest. A number of interesting details are given, and the author refers to some other records of the nests of wanderer ants.

Clasping Organs on Wings of Hymenoptera.§—L. Walter gives a thorough description of the interlocking of the fore and hind wings in ants, bees, wasps, and other Hymenoptera. The hind wing bears clasping hooks (distal and sub-basal) and marginal bristles. The hooks are inserted into a groove formed by a recurving and folding in of the posterior margin of the fore-wing. But the details of the arrangement are intricate. The development has been worked out, and the precise function in flight is analysed.

Salivary Glands of Hemiptera.‖—E. Bugnion describes the principal and the accessory salivary glands of *Pentatoma grisea*, *Graphosoma lineatum*, *Syromastes marginatus* and *Pyrrhocoris apterus*, besides giving an account of the salivary pump and the excretory ducts.

Insects Injurious to Books.—P. S. de Magalhaes¶ makes some notes on a species of *Lepisma*, a small beetle somewhat like *Anobium biblio-*

* Proc. R. Soc. Victoria, xx. (1907) pp. 27–30 (2 pls.).
† Nature Notes, xviii. (1907) pp. 165–9.
‡ Atti Pontif. Acad. Rom., lx. (1907) pp. 224–9.
§ Smithsonian Misc. Coll., iv. (1907) pp. 65–87 (4 pls.).
‖ Arch. Sci. Phys. Nat., xxiv. (1907) pp. 639–42.
¶ Bull. Zool. Soc. France, xxxii. (1907) pp. 95–100.

thecarum, and a small species of *Tinea*. The small beetle is described as *Dorcatoma bibliophagum*. It sometimes bores through a row of several volumes. Carbon sulphide is the best remedy, but as the fumes injure the colour of the books and are not without danger, F. Secques* suggests placing the infected books for two or three days in an air-tight receptacle, containing vapour of formol at a temperature of 50° or 60°. To remove the insects from inaccessible nooks in the library, small vessels with formol may be placed in the vicinity, or even powder of trioxymethylene. It is noted, however, that the vapour does not kill the cocoons.

Scale Insects of Date Palm.†—T. D. A. Cockerell describes *Parlatoria blanchardi*, found on date-palms transported from Africa to Arizona. The female is dormant through the winter; the male seems to be very short-lived, dying after impregnating the female. The larvæ, which crawl about restlessly for some time, are probably carried from tree to tree by insects and birds. Attention is also directed to the marlatt scale (*Phœnicococcus marlatti*), discovered many years ago by C. L. Marlatt on date-palms imported from Algeria. R. H. Forbes ‡ discusses methods of exterminating these date-palm scales, recommending especially good pruning and firing infected trees with gasoline.

Pests of the Olive.§—F. Silvestri continues his account of the injurious insects which infest the olive. He deals in detail with the important *Prays oleellus*, one of the Hyponomeutidæ, and more briefly with numerous other pests.

Mating of Rivellia boscii.‖—W. H. Piersol describes the curious mating habit of this fly, which he studied near Toronto. The female runs about on the leaves in small circles or spirals, varied by an occasional straight course. The wings are moved slowly up and down, with occasional pauses for a second or two. The much smaller male follows closely, and when the pace admits touches the female on the abdomen with his proboscis, or with an anterior leg. Sooner or later he mounts, the penis is extended and taps the abdomen of the female two or three times, when the latter also becomes extended (automatically, for it happens even when the male's attentions are not acceptable), and copulation begins. The wings keep in constant motion, great excitement is exhibited, and a droplet of colourless fluid from the male's proboscis is transferred to the female, who eats it. This transference of a globule is repeated many times before the pair separate. There are many curious details in this connection. There is some evidence of choice on the female's part. The author refers to the passage of some secretion from the mouth of the male pigeon to his mate as a possibly analogous case.

Blood-sucking Flies.¶—Mario Bezzi takes a survey of the species in the genera *Stomoxys*, *Glossina*, *Glossinella*, *Siphona* (*Hæmatobia*) and *Lyperosia*, and describes a few new forms.

* Bull. Zool. Soc. France, xxxii. (1907) pp. 100–1.
† Bull. Agric. Exper. Station Univ. Arizona, No. 56 (1907) pp. 185–92 (5 pls.).
‡ Tom, cit., pp. 193–207 (5 figs.).
§ Boll. Lab. Zool. Scuola Agric. Portici, ii. (1907) pp. 83–184 (68 figs.).
‖ Amer. Nat., xli. (1907) pp. 465–7.
¶ Rend. R. Ist. Lombardo, xl. (1907) pp. 433–60.

Structure and Behaviour of Larva of Anopheles maculipennis.* A. D. Imms gives a preliminary account of the larvæ of this mosquito, collected in the neighbourhood of Cambridge. The various systems in the body are described. The large œnocytes are segmentally arranged in clusters; the small œnocytes, which are very numerous, have no definite arrangement. The imaginal buds are well developed and easy to discover. They are superficial in position, being situated just below the hypodermis, and the primitive invaginations of the buds remain permanently open.

In another paper † he describes the external features, digestive and respiratory systems. Perhaps the most interesting structure in the digestive system is the peritrophic membrane, a thin, probably chitinous tube which completely incloses the food as it passes through the mesenteron. It appears to protect the mesenteric epithelium from abrasion by hard and resisting particles of food. Like other chitinous mid-gut linings, it is shed at ecdysis. On the respiratory system certain tracheal branches are described which are very thin-walled, and which by enveloping the terminal chamber of the heart probably enable the blood to come into close contact with their contained oxygen, and in this way form a kind of "lung." Tracheal anal gills are also present, which are well supplied with blood, and probably function as accessory respiratory organs.

Shell-bearing Mycetophila Larva.‡ — Nils Holmgren describes the anatomy of the larva of *Mycetophila ancyliformans* sp. n. which carries a black shell, and which was at first mistaken for an *Ancylus*. It occurs on the leaves of a species of *Bambus* in the primeval forests of Bolivia and Peru. A diagnostic description of the imago is also given.

Relation of Fleas to Plague Dissemination.§— Carlo Tiraboschi gives a very full discussion of this subject, bringing together all the known facts regarding the role of rats and mice, their distribution, and the morphology of their fleas. The paper also contains a systematic account of the families Pulicidæ and Sarcopsyllidæ, together with notes on the Pediculi and Acarid parasites of the rat. Rats and mice play an important part in disseminating plague; it is quite established that fleas are disseminated from rat to rat, from rat to man, and from man to man. The fleas concerned in plague dissemination are *Pulex cheopis* Roth., *Ceratophyllus fasciatus* Bosc., *Ctenopsylla musculi* Dugès, *Ctenocephalus felis* Bouché, and *Ctenocephalus canis* Curtis; the most probable species in transference from rat to man are *P. cheopis*, *P. irritans*, *Ctenocephalus felis*, *C. canis*, and, perhaps, *Ceratophyllus fasciata*, but chiefly *P. cheopis*. This last-named species is widely distributed on rats in the plague-infested regions of India and Australia. The facility with which it is transported naturally by man in the absence of rats renders it very important. Neither the Sarcopsyllidæ, lice, nor Acarids are of significance in this connection, and bugs ordinarily do not play an important role in the dissemination of plague.

* Proc. Cambridge Phil. Soc., xiv. (1907) pp. 292–5.
† Journ. Hygiene, vii. (1907) pp. 291–318 (2 pls. and 1 fig.).
‡ Zeitschr. Wiss. Zool., lxxxviii. (1907) pp. 1–77 (5 pls. and 2 figs.).
§ Arch. de Parasitol., xi. (1907) pp. 545–620 (15 figs.).

Dimorphism in Australian Agrionidæ.*—R. J. Tillyard records dimorphism of the females in two Australian genera. These two contain the smallest and weakest species of the dragon-flies known in Australia, a point which the author regards as strengthening the contention that the existence of dimorphic females is in some manner or other connected with the preservation of the species. The forms exhibiting dimorphism are *Ischnura delicata* Selys ♀ and *Agriocnemis splendida* Martin ♀. The two genera referred to, though differing widely in their wing-structure, have many points of similarity.

New Order of Apterygota.†—F. Silvestri describes *Acerentomon* g.n., represented by *A. doderoi* sp. n. It was found in humus at Genoa and other localities in Italy. Antennæ and cerci are absent; the oral apparatus is suctorial; there are eleven abdominal segments and a very primitive anal segment; the genital aperture is unpaired on the eleventh urosternite; there is a supra-anal and a sub-anal lamina; there are no eyes, but there are two ocelli (?). It is the most primitive insect as yet discovered, and requires a special order—Protura.

δ. Arachnida.

Maturation and Fertilisation in Theridium.‡—T. H. Montgomery, jun., has studied the eggs of a common spider, *Theridium tepidariorum*, and describes the ovarian ova, the stage of the first maturation spindle, the stage of the second polar spindle, the pronuclei and cleavage nuclei, and the frequent occurrence of polyspermy.

Studies on Mites.§ — Nathan Banks has made a catalogue, with bibliographical references, of the mites of the United States, which will be of great service to those working at this group. A preliminary list by Osborn and Underwood, published in 1886, included 99 species in 28 genera. The present list gives 450 species in 133 genera, "yet this is probably less than a third of the entire Acarid fauna of the United States." It may be noted that a synopsis of genera ‖ was published in 1904.

Hydrachnids.—C. Maglio ¶ gives a list, revised and criticised, of Italian Hydrachnids. He has made a number of new records, and the total number of species amounts to 86.

W. Williamson** records 18 species (in 12 genera) from Scottish Lakes; *Lebertia porosa* Sig Thor, and *Oxus ovalis* Müller are additions to the two previous lists for Scotland, and *Huitfeldtia rectipes* Sig Thor is a new British record, the genus having been hitherto recorded from Norway only.

New Species of Eurypterus.††—Henry Woodward describes, from the Coal-measures to the north-west of Ilkeston, *Eurypterus moyseyi* sp. n. and *E. derbiensis* sp. n.

* Proc. Linn. Soc. N.S. Wales, 1907, pt. 2, pp. 382–90.
† Boll. Labor. Zool. Scuola Agric. Portici, i. (1907) pp. 296–311 (18 figs.).
‡ Zool. Jahrb., xxv. (1907) pp. 237–50 (2 pls.).
§ Proc. U.S. Nat. Mus., xxxii. (1907) pp. 595–625.
‖ Op. cit., xxviii. (1904) pp. 1–114.
¶ Rend. R. Ist. Lombardo, xl. (1907) pp. 953–74.
** Proc. R. Soc. Edinburgh, xxvii. (1907) pp. 302–7 (7 figs.).
†† Geol. Mag., iv. (1907) pp. 277–82 (1 pl.).

ε. Crustacea.

Primitive Malacostracan.*—O. A. Sayce describes *Koonunga cursor* g. et sp. n., a remarkable Crustacean from fresh-water reedy pools near Melbourne. He regards it as the most primitive sessile-eyed Malacostracan hitherto known. Its nearest ally is the stalk-eyed *Anaspides tasmaniæ* G. M. Thomson, which it resembles in general appearance, but it requires the definition of a new family (Koonungidæ). The thorax has its anterior segment fused with the head, leaving seven distinct subequal segments. The eyes are sessile, there is no antennary scale, the mandibles have a single dentate cutting-edge and molar expansion without any "spine-row" or its equivalent. The maxillipeds are like those of *Anaspis*, but without any trace of gnatho-basic lobes. The branchiæ and the swimming branches of the legs are like those of Anaspidæ. The last pair of legs is flexed in the opposite direction to the preceding ones. The pleopods are uniramous, except the first two pairs in the male.

As is well known, *Anaspides* differs from other Schizopods in having no vestige of a carapace, and in having eight distinct thoracic somites. This new form differs markedly in having sessile eyes, in having no antennary scale, and in the coalescence of the first thoracic segment with the head. The loss of stalked eyes, carapace, and scale-like exopodite on the antenna, marks *Koonungia* as the most primitive sessile-eyed Malacostracan at present known, and it is no doubt a very ancient type. It is remarkably active—running, swimming, and springing forcibly forwards. It shuns strong light.

Brachyura and Anomura from the North Pacific.†—William Stimpson, who died in 1872, made an important report on the crabs and hermit-crabs collected by the North Pacific Exploration, 1853–6. This report was at first supposed to have been destroyed by a fire in 1871, in which much valuable material was lost, but it was afterwards found at the Navy Department, and has lain for many years unpublished at the Smithsonian Institution. It is now published as an historical document, under the able editorship of M. J. Rathbun, who has given the current or accepted names where these differ from Stimpson's. The illustrations are from pencil drawings, made, it is supposed, by Stimpson himself.

Pygocephalus cooperi.‡—Henry Woodward discusses this primitive Schizopod crustacean from the Coal-measures, devoting particular attention to the marsupial plates of the adult female. There are six or seven broad, scale-like, imbricated plates or oostegites forming the marsupium in which the eggs and the immature young were carried.

Male of Dexamine thea.§—Alexander Patience describes this form, which has hitherto escaped observation. The reason is probably due

* Victorian Naturalist, xxiv. (1907) pp. 117–20.
† Smithsonian Misc. Coll., xlix. (1907) 240 pp. (26 pls.).
‡ Geol. Mag., iv. (1907) pp. 400–7 (1 pl. and 2 figs.).
§ Ann. Nat. Hist., series 8, i. (1908) pp. 117–22 (1 pl.).

to the fact that the male being apparently always smaller than the female might be passed over as a younger specimen, and to the fact that the distinctive first gnathopod (with a somewhat deep sinus on the upper margin) seems to be habitually tucked away among the mouth-organs when it is not in use.

The author gives a synoptic table for the discrimination of *Tritæta gibbosa*, *Dexamine thea*, and *D. spinosa*, and notes that the first two are widely distributed in the Clyde sea-area in depths up to 35 fathoms. It is also shown that *D. dolichonyx* is the male of *Tritæta gibbosa*.

Reduction of the Eye in New Gammarid from Ireland.*—Fr. Vejdovsky describes *Bathyonyx de Vimesi* g. et sp. n., discovered by W. F. de Vismes Kane, from 130–150 ft. deep, in Lough Mask. It is intermediate between *Crangonyx* and *Gammarus*, and is peculiarly interesting in showing what may be regarded as the first stage in the degeneration of the eye.

Crustacea of East Norfolk Rivers.†—R. Gurney gives an interesting account of the Crustaceans in the tidal regions of these rivers, and shows that a number of marine forms have become habituated to a considerable proportion of fresh-water. The brackish-water species, *Heterotanais gurneyi* Norman, was found in abundance in fresh-water. Good figures are given of *Cyathura carinata* Kroyer, a new record for Britain.

Notes on Development of Argulidæ.‡—C. B. Wilson gives for the first time an account of the newly-hatched larvæ of two of the common American Argulids, *Argulus funduli*, a salt-water form, and *A. maculosus*, a fresh-water form. He also gives a description and figure of the male of *A. catostomi*. In each case the form described is the only one needed to complete a full account of the species.

Nephrocytes of Caprellids.§—L. Bruntz describes in *Protella phasma* three pairs of cephalic and six pairs of thoracic nephrocytes. There are also nephro-phagocytes all along the thorax and above the heart. They eliminate carminate of ammonia when that is injected into the general cavity of the body, and they are able to capture particles of Chinese ink. These cells and the blood-corpuscles are the only phagocytic elements in Caprellids. There is no phagocytic organ analogous to that in Gammarids.

Antarctic Cirripedia.‖—A. Gruvel makes a preliminary report on the operculate Cirripeds collected by the 'Gauss.' He notes *Pachylasma giganteum*, from near the Cape of Good Hope, hitherto recorded only from the Mediterranean, various species of *Balanus*, *Tubicinella trachealis*, *Tetraclita porosa*, and a single new species, *Elminius cristallinus*, so named because of the transparent walls and opercular pieces.

* Ann. Nat. Hist., xx. (1907) pp. 227–45 (2 pls.).
† Trans. Norfolk and Norwich Nat Soc., viii. (1907) pp. 410–38 (1 pl. and 1 fig.).
‡ Proc. U.S. Nat. Museum, xxxii. (1907) pp. 411–24 (4 pls.).
§ Arch. Zool. Expér., vi. (1907) Notes et Revue, No. 3, pp. lvi.–ix.
‖ Bull. Soc. Zool. France, xxxii. (1907) pp. 104–6.

Boring Cirripedia.*— W. Berndt proposes a revised classification of the Acrothoracica, or boring Cirripedia. The sub-order Pygophora includes the family Cryptophialidæ (*Cryptophialus*) and the family Kochlorinidæ (*Kochlorine*, *Lithoglyptus*, and *Weltneria*). The sub-order Apygophora includes the family Alcippidæ (*Alcippe*).

Barnacles of the United States National Museum. †—Henry A. Pilsbry gives an account of the pedunculate Cirripedes and the sessile family Verrucidæ in the United States National Museum. He deals with the following genera :—*Mitella*, *Lithotrya*, *Scalpellum*, *Oxynaspis*, *Lepas*, *Pœcilasma*, *Megalasma*, *Octolasmis*, *Conchoderma*, *Heteralepas*, *Alepas*, and *Verruca*. The Pedunculata from North American coasts number 56 species. and the Verrucidæ 5 species. The pelagic forms, with one exception, are widely distributed forms, already known from many Atlantic and Pacific localities. One pelagic species, *Alepas pacifica*, is an interesting form commensal on large medusæ. The deep-water forms, both of Lepadidæ and Verrucidæ, support the opinion advanced by Hoek, Annandale, and others, that deep-sea Cirripedes have a very wide distribution.

Notes on Cirripedes.—Henry A. Pilsbry ‡ describes some new Japanese and North-Western Pacific Cirripedes—*Scalpellum gonionotum*, *S. weltnerianum*, and *Balanus orcutti*.

In another paper, Pilsbry § discusses the genus *Megalasma*, which is distinguished from *Pœcilasma* by the structure of the carina, which has wide sides near the base, and a well-developed oblique plate or septum within the base, bridging across the cavity of the carina, and terminating above in two projections or teeth. The species of *Pœcilasma* occur chiefly on the carapaces of crabs, while *Megalasma* has been found mainly on sea-urchin spines and on other Cirripedes. A key to the various species is given.

North American Species of Diaptomus. ‖—C. Dwight Mason has made a useful revision of the North American species of this cosmopolitan genus, which is so prominently represented in fresh-water plankton. All the North American species (34) are peculiar to the country, and some have a relatively restricted habitat. Isolation has probably had an important role in the evolution of the species, and it seems likely that *Diaptomus* is very susceptible to environmental stimuli. Peculiar bizarre characters are more apt to appear in species living in shallow waters, and with a narrow range of habitat. There is a marked distinction between deep-water and shallow-water species. There is no reason to think that, under ordinary circumstances, the species are distributed in any way except by water carriage. Various groups of species—*oregonensis*, *tenuicaudatus*, *leptopus*, *signicauda*, and *albuquerquensis*—are distinguished, and a systematic description is given of all the species.

* Arch. Natur., lxxiii. (1907) pp. 287–9.
† U.S. Nat. Museum, Bull. No. 60 (1907) x. and 122 pp. 11 pls. and 36 figs.).
‡ Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 360–2.
§ Tom. cit., pp. 408–16 (1 pl. and 7 figs.).
‖ Trans. Wisconsin Acad. Sci., xv. (1907) pp. 381–516 (14 pls.).

Annulata.

Notes on Polychæts.*—W. C. M'Intosh describes *Genetyllis citrina*, a new Phyllodocid, which approaches *G. lutea* Malmgren. The setigerous region is supported by a black spine and carries shorter bristles with shorter terminal processes than in *G. lutea*.

The author also discusses in some detail the reproduction of *Nereis diversicolor*, and finds that, so far as observed at St. Andrews, there is no foundation for the statement that the Scotch representatives are hermaphrodite, and still less that they are viviparous, as mentioned by Max Schultze, by the "Cambridge Natural History," and by Gravier.

Nervous System of Saccocirrus papillocercus.†—W. D. Lepeschkin finds that each metamere has two pairs of ganglia, with a cross-shaped commissure between each pair; that each metamere has six pairs of nerves, of which i. ii. and iv. are motor, while iii. v. and vi. are sensory; that the 6th nerve has associated with it a strongly refractive body, probably a sense-organ; that the lateral sense-organs in each segment are well developed; that there is a setose glandular sensory region along the back; and that the ventral cord includes colossal nerve-fibres and giant ganglion-cells. The complexity of the nervous system is against the view that *Saccocirrus* is a primitive type.

Regeneration in Podarke obscura.‡—Sergius Morguli notes that when this Polychæt regrows a posterior half, the regrown part is for a time transparent and without chitinous cuticle. Gradually the old tissue has its chitinous layer thinned off, and the new part becomes chitinised. Finally, the old and new parts are covered by a continuous layer of uniform thickness. The author finds in this "a case of transmission of materials from all parts of the old tissue to provide for the building up of the new tissue," but his facts are not convincing. He concludes that it is the organism as a whole, and not the exposed cut surface, that is concerned with the regeneration of the lost tissue.

By interesting experiments in *Lumbriculus*, the author§ has convinced himself that little worms grown from parts which have a high regenerative capacity have a similar capacity. The ratio between the rates of posterior regeneration in the mother-pieces is very nearly like that between the rates of regeneration in their regenerated offspring. "The property of regeneration passes over to the new tissue, together with the protoplasmic material it is built of."

Respiration in Earthworms.‖—M. Konopacki has made an elaborate physiological study of the respiratory processes in various species of *Lumbricus*, in normal and in peculiar conditions. The intensity of the respiration differs in different species; it is directly proportional to the temperature. Earthworms can live for 6 to 30 hours without

* Ann. Nat. Hist., xx. (1907) pp. 175–85 (1 pl.).
† MT. Ges. Freund. Naturw. Moskau, xcviii. (1907). Tagebuch Zool. Abth., iii. pp. 1–9 (2 pls.). See also Zool. Zentralbl., xiv. (1907) p. 435.
‡ Ohio Nat., viii. (1907) pp. 217–19. § Tom. cit., pp. 219–21.
‖ Bull. Acad. Sci. Cracovie, No. 5 (1907) pp. 357–431 (15 figs.).

oxygen, but go on excreting carbon dioxide during that time almost at the normal rate. The intramolecular respiration is very important, and there is evidence of enzymatic processes in the respiration, and of a certain regulative power in abnormal conditions. But most of the results are of a technical physiological character, and not readily summarised here.

Nematohelminthes.

Toxins Secreted by Parasites.*—M. Weinberg has already maintained that the species of *Sclerostomum* infesting the horse secretes toxic substances which dissolve the red-blood corpuscles, hinder coagulation, and produce a precipitate in the serum. He seeks to extend this to œsophagostomiasis," of which he has studied thirty cases in monkeys, and to ankylostomiasis.

Platyhelminthes.

Notes on Cestodes.—Edwin Linton † describes *Calyptrobothrium minus* sp. n., from the Torpedo. The bothria are in pairs, prominent, very flexible in life, with the relatively large suckers characteristic of the genus. The general plan of a mature segment is like that of *C. occidentale*. Figures are given of two free segments in coitu, and of the everted cirrus with spermatozoa issuing from the apex. It is noted that free segments are capable of making progressive movements, during which the anterior end is elongated so as to resemble the neck of certain distomes. The resemblance is heightened by the almost constant presence of a rounded knob at the anterior end. The surface of the joint is slightly roughened by very minute serrations which project posteriorly, so that the spasmodic contractions, aided by a kind of flowing peristalsis, constantly propel the segment forward.

M. Kowalewski ‡ briefly discusses two avian Cestodes, *Aploparaxis penetrans* Clerc, from the intestine of *Limnocryptes gallinula*, and *Hymenolepis compressa* Linton.

Pearl-forming Flukes.§ — Alfred Giard discusses *Gymnophallus somateriæ* Levinsen, the young form of which he has found in *Donax* and Tellinaceæ at Boulogne, the adult probably occurring in *Oedemia* or some other sea-bird. He also deals with *G. bursicola* from mussels and *Saxicava rugosa*, the adult form of which occurs in the eider-duck.

Trematodes from British Birds.‖—W. Nicoll describes a large number of forms—*Spelotrema excellens* sp. n., from the herring-gull; *S. feriatum* sp. n., from *Pelidna alpina*, *Totanus calidris* and *Ægialites hiaticula*: *Tocotrema jejunum* sp. n., from *Totanus calidris*; *Gymnophallus dapsilis* sp. n., from *Oedemia fusca* and *O. nigra*, *Maritrema gratiosum*, and two other new species of this new genus.

* Ann. Soc. Biol. Paris, lxiv. (1908) pp. 25–7.
† Proc. U.S. Nat. Museum, xxxii. (1907) pp. 275–84 (7 figs.).
‡ Bull. Acad. Sci. Cracovie, No. 7 (1907) pp. 774–6 (1 pl.).
§ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 416–20.
‖ Ann. Nat. Hist., xx. (1907) pp. 245–71.

Structure of Haplodiscus.*—W. Salensky describes certain parts of this interesting and very primitive representative of the Turbellaria Acœla. The subject of his study was *H. ussowii* from Messina and Naples. The parenchyma is discussed in detail. The central parenchyma consists of two epithelial layers, a dorsal and a ventral, which meet in the horizontal plasma; these two layers correspond to the dorsal and ventral walls of the alimentary canal of other Turbellaria; the oral or digestive parenchyma is a part of the central parenchyma and presumably of endodermic origin. The frontal organ is an aggregate of skin-glands opening at the anterior tip of the body; the secretion is probably offensive and defensive. Delage's suggestion that the organ is sensory is not, however, dismissed, for a strong nerve passes to the organ from the brain. The post-cerebral cell-mass is very like an aggregate of ovarian cells, but it seems to have no connection with the gonads, and is probably glandular. The vas deferens and the seminal vesicle are described.

Incertæ Sedis.

New Species of Myzostoma.†—J. F. McClendon describes three new species—*M. cubanum*, *M. evermanni*, and *M. cerriferoideum*, found on Crinoids and Ophiuroids in the Smithsonian Institution. Previously ‡ he gave an account of those collected on the 'Albatross' expedition to Japan.

Notes on some British Polyzoa.§—A. M. Norman discusses *Micropora impressa* (Moll.) from Guernsey, *Terebripora ditrupæ* sp. n. from the calcareous shell of the Annelid genus *Ditrupa* from Shetland, *Schizoporella alderi* (Busk) which show considerable variation in its mode of growth, *Escharina dutertrei* (Audouin), *Phylactella pygmæa* (Norman) from Shetland, of which a figure is given for the first time, and *Cellepora surcularis* (Packard).

Genus Aucella.||—A. P. Pavlow gives a monographic account of this Brachiopod genus, discussing the relationship and distribution of the numerous species, and taking account of *Aucellina* and other related types.

Rotifera.

New Rotifera.¶—C. F. Rousselet gives a description and figures of *Brachionus sericus*, a new species characterised by the structure of the lorica, which is covered all over with fine longitudinal wavy lines giving the appearance of watered silk, and also by a posterior overhanging, more or less pointed, projection of the carapace. The author further describes *Brachionus quadratus* var. *rotundus*, a new variety, and gives accurate figures of *Brachionus rubens* Ehrenbg., which appears to have been wrongly figured and described in Hudson and Gosse's monograph.

* Bull. Acad. Sci. St. Pétersbourg, No. 18 (1907) pp. 819–42 (8 figs.).
† Proc. U.S. Nat. Museum, xxxii. (1907) pp. 63–5 (2 figs.).
‡ Bull. Amer. Mus. Nat. Hist., xxiii. (1906) pp. 119–30 (3 pls.).
§ Ann. Nat. Hist., xx. (1907) pp. 207–12 (1 pl. and 1 fig.).
|| Nouv. Mem. Soc. Imp. Nat. Moscou, xvii. (1907) pp. 1–84 (6 pls.).
¶ Journ. Quekett Micr. Club, (1907) pp. 147–54 (2 pls.).

Echinoderma.

New Echinoid from Indian Ocean.*—A. R. S. Anderson describes *Breynia vredenburgi* sp. n. from the Andamans. It agrees in some respects very closely with *B. carinata* and *B. multituberculata* from the Indian Oligocene. It is distinguishable in many respects from *B. australasiæ*, and is remarkable for the large number of ambulacral plates traversed by the sub-anal fasciole, which includes no less than eight modified pairs of pores, a larger number than is known in any other Spatangoid.

Cidaridæ.†—H. L. Clark has revised this family, giving diagnoses of the genera and the recent species, with the usual artificial keys and bibliographic references. It seems that *Cidaris* is nearest to the ancestral form and the centre from which the different genera have come. Whether *Tylocidaris* represents a more primitive type, because of its imperforate tubercles, is an open question. The other genera (21 are recognised) fall into three groups, but the lines between these groups are not clear enough to warrant any recognition of subfamilies.

New Crinoids.—Austin H. Clark‡ describes *Ptilocrinus pinnatus* g. et sp. n. from the North Pacific, near Moresby Island, 1588 fathoms. It is remarkable in being the only stalked Crinoid known from the Eastern Pacific (see *infra*), with the exception of the closely related *Calamocrinus diomedæ* from the Galapagos Islands. The basals are completely anchylosed into a funnel-shaped cup as in *Bathycrinus*; the arms are five and unbranched, with about sixty joints: the stem is composed of 360 joints, smooth and very slender, and unusually flexible. The author also discusses the species of *Bathycrinus*, and makes a new name, *B. australis*, for one of them.

Clark also describes § *Phrynocrinus nudus* g. et sp. n. from the south coast of Nipon, Japan. The calyx is acorn-like, and quite different from that in any known Crinoid; there is a broad naked space between the small radials; no interradial plates could be made out; and in many features this new form is so peculiar that it requires a special family, Phrynocrinidæ. Another new form is *Bathyrinus pacificus*, from near the same locality, a representative of a genus hitherto known only from the Atlantic.

In a third paper ‖ the author describes *Eudiocrinus tuberculatus* sp. n., and records two other species of this Comatulid genus, all from Japanese waters.

New Holothurians.¶—W. K. Fisher describes 18 new species of Holothurians from the Hawaiian Islands, and a new genus *Opheodesoma*, represented by *O. spectabilis* and by three species included in Œstergren's *Euapta*. In this new type there are numerous madreporic canals, distributed around the ring canal. A cartilaginous ring is sometimes

* Journ. and Proc. Asiatic Soc. Bengal, iii. (1907) pp. 145–8.
† Bull. Mus. Comp. Zool. Harvard, li. (1907) pp. 165–230 (11 pls.).
‡ Proc. U.S. Nat. Museum, xxxii. (1907) pp. 551–4 (3 figs.).
§ Tom. cit., pp. 507–12 (4 figs.).
‖ Tom. cit., pp. 569–74.
¶ Tom. cit., pp. 637–744 (17 pls.).

present, when perforations are along the anterior border, not along the posterior border as in *Synaptula*. The two large lateral holes in the handle of the anchor plate are absent; the central hole is larger than *Euapta*, and rounded, not acute, on the outer edge. The plates are otherwise as in *Euapta*. The calcareous ring has conspicuous anterior projections. Tentacles and anchors are as in *Euapta*, and retractors are present.

Cœlentera.

New Fresh-water Medusoid from China.*—Asajiro Oka describes *Limnocodium kawaii* sp. n. from the Yang-tze-kiang, about 1000 nautical miles from its mouth. The umbrella is hemispherical; the velum projects inwards for about a quarter of the breadth of the sub-umbrellar diameter; there are over 256 tentacles of seven different sizes; the diameter was about 20 mm. The author compares this new form with *L. sowerbyi* (whose native habitat remains unknown), and with *Limnocnida* from Tanganyika, Victoria Nyanza and the Niger. Systematically the affinities of *Limnocodium* (the generic diagnosis of which is enlarged), are with the *Olindias* group, and the author is inclined to place it nearer to the Leptomedusæ than to the Trachomedusæ.

Hydroids of Madagascar and South-east Africa.†—A. Billard reports on a collection of 33 species, of which six are new, and the chief interest of his report is probably that at least eight of the species are characteristically Australian, while 18 are common to Australia and these South-east African regions.

Structure and Development of Turritopsis nutricula.‡—W. K. Brooks and S. Rittenhouse describe the structure of this Medusoid. It is compared with *Callitiara*, and with a new genus (*Modeeria* in part), for which the name Mccradia is proposed. The ova of *Turritopsis* arise in the ectoderm of the manubrium; they grow by the absorption of the primitive ovarian cells, and when mature are densely crowded with large yolk granules. Dehiscence takes place at a definite time, from 5 to 6 o'clock in the morning. The egg is spherical and membraneless. Maturation and fertilisation occur in the water after the eggs are deposited.

Cleavage is total and nearly equal, at first regular, afterwards very erratic. A solid morula results, whose cells form a syncytium. Parts of eggs divided during cleavage continue to develop normally in every respect except size. Cell-walls re-appear peripherally and establish the ectoderm, the mesoglœa appears, and the endoderm is late of being differentiated in the internal syncytium. There is some evidence of amitotic division in the late segmentation.

The planula becomes attached by nearly its entire side, and is transformed into a root. The first hydranth develops from a bud from about the middle of the root. The tentacles develop in indefinite whorls, each whorl with four tentacles.

* Annot. Zool. Japon, vi. (1907) pp. 219–27 (1 pl.).
† Arch. Zool. Expér., vii. (1907) pp. 335–96 (2 pls.).
‡ Proc. Boston Soc. Nat. Hist., xxxiii. (1907) pp. 429–60 (6 pls.).

Hydroids of Eastern Tropical Pacific.*—S. F. Clarke reports on the Hydroids collected by the 'Albatross' (1904–5). The collection is surprisingly small, including only 12 species. At 112 stations no Hydroids were obtained. The following are new—*Pennaria pacifica*, *Campanularia obliqua*, *Obelia striata*, *Campanulina denticulata*, and *Cladocarpus distomus*. It is interesting to find that two of the species, *Thiuaria tubuliformis* and *Zygophylax chuzalei*, were hitherto known only from the Atlantic side of the isthmus of Panama. The label in the bottle with *Campanulina denticulata* records a depth of 2845 fathoms, something unusual, but not unequalled for Hydroids. Allman records *Stylactis vermicola* and *Monocaulis imperator* from 2900 fathoms.

Hydroids from North Side of Bay of Biscay.†—E. T. Browne reports on a collection of 37 species, including two new species *Bimeria arborea* and *B. biscayana*, and several rare deep-sea forms.

Pelagic Larvæ of Actiniaria.‡—Angelo Senna reports on those collected on the voyage of the 'Liguria' in 1903–5, under command of the Duke of Abruzzi. In the family Cerianthidæ he describes four new forms of *Dactylactis*; in the Zoanthidæ, three larvæ of *Zoanthella* and several of *Zoanthina*. The structure of these forms is fully discussed.

In the same connection we may note the account given by O. Carlgren § of northern forms: *Arachnactis* and other larvæ of Cerianthidæ; the larvæ of *Peachia hastata* parasitic on Medusæ; and various pelagic forms, e.g. of *Sagartia viduata*, *Zoanthina* and *Zoanthella*.

Halcampella ostroumowi.‖—Th. Wyragévitch describes this new Actinian from the Black Sea. It is cylindrical, vermiform, delicate, semi-transparent, with 12 longitudinal striæ, with 24 tentacles. It changes its shape incessantly and rapidly. Eight mesenteries reach the œsophagus, but only four of these are fertile. The author found no acontia, no sphincter, and no septostomes. It seems likely. though not certain, that the young stages occur within the gastro-vascular system of *Aurelia aurita*, and some facts bearing on this question are recorded.

Recent Madreporaria of the Hawaiian Island and Laysan.¶—T. Wayland Vaughan deserves to be congratulated on his magnificent monograph of these Madreporarians. He discusses the classification, the species problem, the distribution and the factors determining it, the faunal affinities of the Hawaiian forms, and then proceeds to a systematic account with special attention to the morphology of the hard parts. The photographic plates are of great excellence.

Phellia murocincta.**—Chas. L. Walton found this beautiful little sea-anemone near St. Ives, under stones in a small dark cave, along with

* Mem. Mus. Comp. Zool. Harvard, xxxv. (1907) pp. 1–18 (15 pls.).
† Journ. Mar. Biol. Assoc., viii. (1907) pp. 15-36 (2 pls. and 1 fig.).
‡ Raccolte Planctoniche (R. Ist. Stud. Sup. Firenze), iii. (1907) pp. 81–198 (4 pls., 37 figs.).
§ Nordisches Plankton (Brandt and Apstein) lief v. (1906) pp. 65–89 (10 figs.).
‖ Bull. Acad. Imp. Sci. St. Pétersbourg, xxii. (1905, received 1907) pp. 85–98 (14 figs.). ¶ Bull. U.S. Museum, No. 59 (1907) pp. 1–222 (96 pls.).
** Journ. Mar. Biol. Assoc., viii. (1907) pp. 47–8.

young specimens of *Actinia equina*, *Cereus pedunculatus*, and a number of *Depastrum cyathiforme*. It was ½ in. in diameter when expanded; the "epidermis" was not dense (as in Gosse's description), but free and easily removed; the column was usually much flattened during the day, pillar-like at night; no acontia were emitted; there were 36 tentacles, much more active at night than during the daytime; the colouring harmonised very exactly with the surroundings.

Japanese Primnoidæ.*—K. Kinoshita gives a preliminary account of a number of interesting new species of Primnoidæ from Sagami and Kagoshima:—*Plumarella spinosa*, *Thouarella typica*, *Dicholaphis delicata* (g. n.), *Caligorgia granulosa*, *Primnoa pacifica*, *Stachyodes irregularis*, *S. trannulata*, and *Calyptrophora ijimai*. It will be very interesting to see the full descriptions of some of these, e.g. of *Primnoa pacifica*, for *P. lepadifera* or *reseda* has been hitherto the only known representative of the genus.

Alcyonaria, Antipatharia, and Madreporaria from the North Side of the Bay of Biscay.†—S. J. Hickson reports the occurrence of *Alcyonium coralloides* (= *Sympodium coralloides*), *Corallium maderense* (= *Pleurocorallium maderense*), *Isidella elongata*, *Acanella arbuscula*, *Acanthogorgia ridleyi*; *Stichopathes spiralis*, *Parantipathes larix*, *Schizopathes crassa*; *Caryophyllia clavus*, *Demophyllum cristagalli*, and *Lophohelia prolifera*. Of these records the most interesting is that of *Corallium maderense*. Only one other specimen of this species has hitherto been obtained, and no specimen of the family has hitherto been recorded from the Bay of Biscay.

Japanese Ctenophora.‡—Fanny Moser reports on a collection made by Doflein off the east coast of Japan, which included *Ocyroe maculata*, *Beroe cucumis*, *B. forskåli*, *B. hyalina* sp. n., *Hormiphora japonica* sp. n., *Pandora mitrata* sp. n., *Bolina mikado* sp. n. The distinctions of the genera *Neis*, *Pandora*, and *Beroe* are discussed. It is pointed out that in *B. cucumis* the gastral vessels are unbranched, and that the ramifications of the meridional vessels on the stomach-wall end blindly, whereas in *B. ovata* the gastral vessels are branched, and the ramifications of the meridional and gastral vessels on the stomach-wall form an anastomosing network. Agassiz's *Idya roseola* is identical with *B. cucumis*.

Porifera.

Amœbocytes of Spongillids.§—W. Weltner gives an account of the seasonal changes in *Ephydatia fluviatilis*, and devotes special attention to the amœbocytes. He maintains that in the growing sponge these elements form the mesoglœa, the skeleton, and the gemmules; that they are the agents in the new growth in spring and in the reparation of injuries. They are the most important elements in the sponge body, for they can replace all the others.

* Annot. Zool. Japon, vi. (1907) pp. 229–34.
† Journ. Mar. Biol. Assoc., viii., (1907) pp. 6–14.
‡ Zool. Anzeig., xxxii. (1907) pp. 449–54.
§ Archiv Natur., lxxiii. (1907) pp. 273–86 (2 figs.).

Degeneration and Regeneration in Sponges.*—H. V. Wilson notes that siliceous sponges in confinement give rise to small masses of undifferentiated tissue, which in their turn are able to grow and differentiate into perfect sponges. In a species of *Stylotella* the process as a whole has been worked out. The oscula and pores close, the canal system is in some degree suppressed, the sponge shrinks and becomes like *Spongilla* in its winter state. It may subdivide into numerous masses, which recover their differentiation in open water. In other cases a large part of the sponge dies, but living fragments remain, which can recover. Minute masses may occur over the general surface, or they may be scattered throughout the body. These small remnants behave like plasmodia; they are aggregations of syncytial protoplasm studded with nuclei. Wilson has shown that when suitably exposed in open water they can form perfect sponges. This production of regenerative tissue has been seen in *Microciona*, but only in *Stylotella* has the author directly proved the regenerative power. Maas has described in degenerating Sycons the formation of compact cords of cells showing amœboid phenomena. It may also be noted that in 1886 J. Arthur Thomson described and figured what he called "regenerative capsules" in *Spongelia pallescens*, without, however, following up their history.

Antarctic Monaxonellids.†—R. Kirkpatrick reports on the Monaxonellida brought home by the 'Discovery'—a collection of 43 species, of which 24 are new. The following new genera are established—*Sigmaxinyssa*, *Cercidochela*, and *Hoplakithara*.

New Fresh-water Sponges from Calcutta.‡—Nelson Annandale describes the following new species—*Spongilla proliferens*, *S. crassissima*, *Ephydatia indica*, *Trochospongilla latouchiana*, and *T. phillottiana*.

Protozoa.

Studies on Radiolarians.—V. Haecker § gives a detailed account of the structure and development of the skeleton in Cœlographidæ, with special reference to the highly differentiated condition seen in *Cœlographis antarctica*. Thus the central capsule is inclosed in an internal shell, which consists of two halves and is beset with small teeth on the aboral margin on both sides. Each of the shell-halves bears a high helmet-like galea elongated towards the oral side, and at the base of the galea is drawn out into a tube or rhinocanna extending towards the oral shell-margin. The Cœlographidæ are not separable from the Cœlodendridæ, and the sub-order Phæodendria is proposed. Within this there are five sub-families, characterised by their skeletons. The author deals with eight genera and seventeen species.

W. Mielck ‖ deals with Acanthometridæ from New Pomerania, and works out a notable simplification of the systematic relations.

* Science, xxv. (1907) pp. 912–15.
† Ann. Nat. Hist., xx. (1907) pp. 271–91.
‡ Journ. and Proc. Asiatic Soc. Bengal, iii. (1907) pp. 15–26 (7 figs.).
§ Arch. Protistenk., ix. (1907) pp. 139–69 (20 figs.).
‖ Wiss. Meer. Abt. Kiel, No. 10 (1907) pp. 41–105 (5 pls. and 20 figs.). See also Zool. Zentralbl., xiv. (1907) pp. 621–8.

Affinities of Blastulidium pædophtorum.*—E. Chatton has studied this parasite which Ch. Pérez found in the eggs and young parthenogenetic embryos of *Daphnia obtusa*. It was found on species of *Simocephalus*, *Chydorus*, and *Lynceus*, and Chatton has seen enough of it to enable him to say that it must be removed from among the Haplosporidia and placed among the Chytridineæ.

Structure and Movements of Condylostoma patens.†—John F. Bovard has studied this large Ciliate. He describes the thin, transparent, homogeneous, very elastic pellicula; the hyaline threads or myonemes which form the primary ridges marking the surface; the cilia which arise from furrows along the sides of the myonemes; the membranellæ which seem to arise from a fusion of rows of cilia; the broad, thin, transparent, undulating membrane which lies in the buccal groove and is attached at the base of the right oral lip; and so on.

The movements of the animal are directly dependent on the shape of the body. Normally the animal moves in a circle to the left when gliding. This is caused by the bend of the posterior end of the body towards the left. The spiral swimming is the result of the curvature of the body, and not wholly dependent on the oblique position of the cilia. The motor reaction is the same as for other Protozoa. It consists of a backward movement, a turning toward a structurally defined side, and then a movement forward. It is of the same type in cut pieces as in whole individuals, but is modified by the form of the pieces.

Trichocysts of Frontonia leucas.‡—A. Brodsky finds relatively large trichocysts in this Infusorian. Each shows three parts—head, neck, and body. After expulsion from the ectoplasm they increase ten or twelve times in length. They appear to arise in the deeper parts of the endoplasm near the nucleus. In contact with water the trichocyst becomes like a flattened sphere, and is the subject of violent agitation. A spiral line is seen in its interior, which uncoils with extreme rapidity into a long thread with the debris of the envelope as a minute body at one end.

Trichomastix serpentis.§—C. Clifford Dobell describes this new species of flagellate Infusorian from the rectum of a boa-constrictor. It is perhaps the same as Grassi's *Monocercomonas coronellæ*, Hammerschmidt's *Cercomonas colubrorum*, *Monocercomonas colubrorum*, and *Bodo colubrorum*. It is usually oval or pyriform in shape; it has three flagella at the anterior end directed forwards, and another longer flagellum directed backwards; there is a basal granule (like a Trypanosome's blepharoplast) at the origin of the flagellum; a flexible axial rod runs through the animal; there is a well-marked cytostome.

The creatures are very active. They divide longitudinally, and the details of the division are described. In the degenerative processes, leading on to death, giant forms twice the normal size were sometimes observed, and these divided abnormally, commonly giving rise to three or four daughter-cells.

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 34–6.
† California Univ. Publications, Zool., iii. (1907) pp. 343–68 (1 pl. and 21 figs.).
‡ Arch. Sci. Phys. Nat. (xxiv.) (1907) pp. 644–5.
§ Quart. Journ. Micr. Sci., li. (1907) pp. 449–58 (1 pl. and 2 figs.).

Leucocytozoon of Red Grouse.*—C. G. Seligmann and Louis W. Sambon publish a preliminary note on *Leucocytozoon lovati* sp. n. from the blood of *Lagopus scoticus*. Only the fully grown sexually differentiated sporonts have been observed, and these are briefly described. They are contained in oval or spindle-shaped elements, with the extremities usually drawn out into fine long threads not unlike flagella. These elements appear to be blood-cells greatly altered by the parasites they inclose. The infected bird was not considered to have suffered from "grouse disease."

New Sporozoon in Toad.†—Helen Dean King describes *Bertramia bufonis* sp. n. from Bidder's organ in the common American toad *Bufo lentiginosus*, and points out that the bodies Knappe described in 1886 as spermatozoa in this organ are probably stages in the life-cycle of *Bertramia*. Bidder's organ is undoubtedly a rudimentary ovary, and in the light of our present knowledge regarding the origin and development of germ-cells, it is inconceivable that functional spermatozoa could be formed in and from the cytoplasm of rudimentary ova that are destined to undergo degeneration.

Sporozoan Parasites of Fishes.‡—James Johnstone records a heavy infection of the skin of the sole with *Lymphocystis johnstoni*. The cysts are colourless, very opaque, and easily discernible to the naked eye, and of average diameter 0·32 mm. An account is also given of a Myxosporidian invasion of the cartilaginous layer of the sclerotic in *Gadus esmarkii*. H. M. Woodock has examined preparations of the cysts, and describes the spores; he concludes that there is here a new species of *Myxobolus*, distinguished by the size of the spores. It is the first Myxosporidian recorded for the Gadidæ. He proposes the name *Myxobolus esmarkii* sp. n.

Sarcosporidian in Parakeets.§—G. S. Graham-Smith describes the cysts and spores of a presumed Protozoon parasite from the heart, gizzard, and other muscles of young parakeets (*Psittacus undulatus*). Injection of cyst material into the abdominal cavity, and feeding experiments failed to infect adults, although naturally infected young forms died. The parasite, though differing in many respects, more closely resembles *Rhinosporidium kinealyi* than any other cyst-producing protozoon.

Sarcosporidial Infection in Mice.‖—L. Nègre has experimented on this subject. He finds that young mice are more easily infected than old; 45 days elapse between ingestion of spores and the appearance of the parasites in the muscles; 80 to 90 days elapse from the time of infection until the spores possess maximum infecting power. At the beginning of infection the parasites in the abdominal muscles are more developed than those elsewhere; when the infection is slight they are most numerous in the abdominal muscles. Inoculation by skin or

* Lancet, 1907, ii. pp. 829–30 (3 figs.)
† Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 273–8.
‡ Proc. and Trans. Liverpool Biol. Soc., xxi. (1907) pp. 295–8, 304–8 (1 pl. and 1 fig.).
§ Journ. Hygiene, vii. (1907) pp. 552–7 (2 pls.).
‖ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 374–5.

peritoneum cannot be effected, and if the spores are preserved in water for 3 or 4 days they become inert. Amongst mice living together the proportion infected is greater than amongst a similar number living apart. There is an intestinal stage of the parasite which is discharged with the excrement, and infection occurs by ingestion of such material, but this stage has not been isolated.

Culture of Treponema pallidum.*—C. Levaditi and J. McIntosh, by means of collodion sacs containing material from syphilitic lesions placed in the peritoneal cavity of the rabbit, successfully obtained cultures of this organism. As many as twelve passages were effected, and the organisms were more numerous at the end than at the beginning. It was proved that an exchange between the contents of the sac and the fluid of the peritoneal cavity is indispensable, and that the presence of anaerobic microbes favoured the culture. The *Treponema* of the cultures possesses a filiform prolongation at the extremity resembling the analogous formations described by Borrel in Schaudinn's *T. pallidum.* It multiplied by transverse fission. The cultures not being pure, the authors cannot affirm that all their forms are *T. pallidum*, but on morphological, biological, and staining reaction grounds, they consider that the two types are to be associated. A loss of pathogenic activity resulted, which is attributed to the new conditions of life of the organism and to the impurity of the cultures.

New Myxosporidian Family.†—L. Léger and E. Hesse describe a new Myxosporidian, a parasite of the gall-bladder of the sardine. It is extremely rare, and has always been found associated with *Ceratomyxa truncata* Thélohan. It possesses only one polar capsule, and is distinguished from *Myxobolus piriformis* by the form of the valves, the direction of the valve suture, the absence of vacuoles in the sporoplasm, monosporic pansporoblasts, and its free life in the biliary fluid. For this form, *Coccomyxa morovi*, the authors propose a new family Coccomyxidæ, intermediate between the Phænocystes and Cryptocystes.

Relation of Spirochæta pertenuis to Yaws.‡—A. Castellani has made out some definite points in connection with the relation of this *Spirochæta* to yaws. It is always present in eruption material obtained from persons suffering from the disease. When filtered off, the material is inert. Monkeys are infected by inoculation with such material, and may be also with blood from the general circulation and from the spleen. *Spirochæta pertenuis* is frequently present in the spleen and lymphatic glands. Yaws is generally conveyed by actual contact, but experiments have proved that it may be conveyed by flies, and possibly by other insects.

* Ann. Inst. Pasteur, xxi. (1907) pp. 784–95.
† Comptes Rendus, cxlv. (1907) pp. 85–7.
‡ Journ. Hygiene, vii. (1907) pp. 558–69.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Cytology of the Pollen of the Nymphæaceæ.*—W. Lubimenko and A. Maige have completed their researches upon the pollen-mother-cells of the Nymphæaceæ, with the following results. In the prosynapsis stage there is a simple nuclear network with chromatin granules; during synapsis the nuclear membrane bursts, while the network forms a spongy mass round the nucleolus, and the chromatin granules fuse to form corpuscles. During the spireme stage the chromatic thread fills the nuclear cavity, but there is no longitudinal splitting at this stage.

The chromosomes are formed by condensation of the chromatin at different points of the spireme. The first and second mitoses are normal, but in the telophase of both, a transitory granular plate appears at the equator of the spindle, which probably represents a remnant of one of the ancestral divisions of the pollen-mother-cells. Also in the telophase the mother-cell is simultaneously divided into four daughter-cells. In this respect, the two species studied resemble the Dicotyledons, while the simple nature of the prosynapsis and the early dissociation of the pollen-mother-cells brings them near the Dicotyledons. There appears to be a certain ratio between the masses of the nucleus and of the cell, both in the vegetative and reproductive tissues, and this ratio varies in a very definite way in the different cycles of development. The three pollen mitoses differ from a vegetative mitosis by bringing a larger mass of chromatin into play, and by the larger quantity of nuclear contents, which are very rich in chromatin. The third mitosis results in the formation of two nuclei, a large vegetative nucleus and a small generative one; this difference in volume may be attributed to an unequal division of the chromatin in this mitosis, which would thus play an important function in chromatic reduction.

Cell and Nuclear Division in Basidiobolus ranarum.†—Edgar W. Olive studied this fungus on material cultivated from the intestine of a frog. He found that the processes of division were the same in both beak and vegetative cells with some minor differences. Cell-division takes place by the gradual growth of a cell-plate from the wall inwards like the narrowing of an iris diaphragm. The mitotic figure consists of a broad barrel-shaped spindle; the chromatin plate in the centre consists of a mass of numerous minute chromosomes, and at each pole

* Rev. Gén. Bot., xix. (1907) pp. 474–501. See also this Journal, 1908, p. 60.
† Ann. Mycol., v. (1907) pp. 404–18.

there is a disk- or crescent-shaped mass—the pole-plate. Beyond each pole-plate there is a granular aggregation of archoplasm, from which towards the close of the karyokinetic process there extend radiations into the surrounding cytoplasm. In the late stages the daughter-nuclei move further and further apart as the fibres disappear.

Aleurone Grains of Grasses.*— A. Guilliermond contributes some remarks upon the aleurone grains of grasses. The grain is a spherical spongy mass, one of the interstices of which contains a very large globoid. During the earlier hours of germination, the proteid is partially dissolved, and the aleurone grain is transformed into a little vacuole occupied by one or two large granules which represent the insoluble part of the proteid, while near or upon the edge of this vacuole are numerous globoids. Subsequently the proteid entirely dissolves and nothing remains but the globoids, which also dissolve by the tenth day. The aleurone grains of grasses are analogous to those of the lupin, but have less proteid, which is nothing but a thin layer around the globoids, while the globoids themselves are of smaller size, also the proteid is insoluble in potash after fixation in alcohol. This type of aleurone grain is found in wheat, rye, oats, and barley ; maize is similar, but the globoids are larger and there is rarely more than one in each grain.

Structure and Development.

Reproductive.

Fertilization in Cypripedium.† — L. Pace has investigated the phenomenon of fertilization in *Cypripedium spectabile* and *parviflorum*, and less fully in *pubescens* and *candidum*. It appears that two cells are formed by the mother-cell, but no wall is formed in the second division, even when the nuclei of both "daughter-cells" divide, as may rarely occur. Two megaspore nuclei are used in the formation of the embryo-sac, and may be related to double fertilization. The completed embryo-sac has only four nuclei. Double fertilization is probably constant, and the primary endosperm nucleus results from the fusion of the polar nucleus, one synergid and one male nucleus.

Endosperm of four nuclei has been found. The presynaptic nucleus gives evidence of the pairing of threads, probably of paternal and maternal origin. The gametophyte has 11 chromosomes, the sporophyte has 22, while the endosperm probably has 33. An interesting comparison is made of the successive stages of development of the animal egg and of the eggs of *Lilium* and *Cypripedium* respectively. These two genera show only one more division from the mother-cell to the egg than in the maturation of the animal egg, and thus have the fewest divisions reported in the angiosperms.

Development of Saxifraga granulata.‡—H. O. Juel has investigated the development of *Saxifraga granulata*, with the following results. The nucleus of the embryo-sac-mother-cell contains a single homogeneous chromatin-thread during the synapsis and spireme stages, in the next

* Comptes Rendus, cxlv. (1907) pp. 768-770.
† Bot. Gazette, xliv. (1907) pp. 353–74 (4 pls., 1 fig.).
‡ Nov. Act. Reg. Soc. Sci. Upsala, i. (1907) pp. 1–39 (4 pls.).

stage this thread is drawn round so as to form a double thread, the two parts of which intertwine during the succeeding stage and give rise to a double chromosome. The reduced number of chromosomes is about thirty. The stigma and upper part of the style has an endotrophic conducting tissue, while the rest of the pistil has an ectotrophic conducting tissue, which is distributed over the placenta, but only forms a narrow band on the side near each carpel. The upper surface of the placenta is swollen between the points of insertion of the seeds; this arrangement, together with the conducting tissues, serves to direct the right course of the pollen-tube. While the nuclei are in the pollen-tube no special sheath could be seen surrounding them, but when they reach the embryo-sac a bladder-like sheath is visible, which soon disappears. The pollen-tube discharges its contents into the single synergid. After the division of the central nucleus the embryo-sac divides up into smaller cells round the antipodals, and these small cells fill up the remaining space. Two kinds of endosperm are formed: a basal portion which develops quickly, and a central portion which develops later at the expense of the basal portion. The nucellus-tissue is rich in starch and forms a perisperm during the development of the endosperm; it has quite disappeared, however, in the ripe seed. Fats and proteids are found in small quantities in the basal endosperm and in the embryo, but in larger quantities in the central endosperm. Starch is found in the embryo. While the seed is ripening, tubercles grow out from the bases of the funicles, which serve for seed-dispersal.

Physiology.

Nutrition and Growth.

Biological Chemistry.*—When Raulin published his study of the growth of a mould in an artificial solution he remarked on the advantage that seemed to accrue to the fungus from the admixture of certain chemical elements. Maurice Javillier has taken up the subject, and has again proved the favourable influence of infinitesimal quantities of zinc on the growth of *Sterigmatocystis nigra*. It acts as an antiseptic and prevents the development of foreign organisms that would damage the culture.

Irritability.

Sleep-movements of Leaves.†—W. Pfeffer has investigated the sleep-movements of plants, and finds that they are the result of light and heat reactions set up by daily changes in illumination and temperature. The sleep-movements disappear when the temperature and illumination are uniform, and never appear in plants raised under such conditions, although by establishing a daily change of light and temperature movements reappear in the one case and are induced in the other. Such movements can only be brought about by gradual and not by sudden change, and are the result of internal activities tending to the establishment of a position of equilibrium corresponding to the new

* Comptes Rendus, cxlv. (1907) pp. 1212–15.
† Abhandl. Math. Phys. Kl.k. Sächs. Ges. Wiss., xxxiii. (1907) pp. 259–472 (36 figs.).

conditions. As a rule the light-stimulus increases as the amount of light decreases. In uniform light and temperature the movements do not cease at once, but gradually, the rhythm being similar, but the amplitude decreasing. Some plants, e.g. *Mimosa* and *Albizzia*, have a very rapid time reaction, while others, e.g. *Phaseolus*, only respond after a considerable period. The two former genera are affected both by increase and decrease of light, while the latter is only affected by the increase of light in the morning. In plants like *Phaseolus*, which have a long reaction time, the process of stimulation continues for some time after the cause of the stimulus has ceased. Flowers which exhibit sleep-movements behave in the same way as foliage-leaves, e.g. the tulip and crocus behave like *Mimosa*, and flowers with slow time reactions behave like *Phaseolus*. In general, plants which respond to changes in temperature will also respond to changes in light, the same movements being produced by change in either condition.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Root-structure in Ceratopteris thalictroides.* — A posthumous paper by P. Lachmann has been published, on the origin and development of the roots and rootlets of *Ceratopteris thalictroides*. The subject is treated of fully under three heads: (1) Origin of the roots; (2) Development of the root; (3) Origin and Development of the rootlets; and a résumé is given at the conclusion of each part. The author finds that the first ten or twelve roots of *Ceratopteris* emanate from the stem, while the later ones proceed from the leaves, where they occupy the basal region of the petiole. As regards the development of the root, the mother-cell produces groups of elements, usually composed of one rootcap-segment and of three series of cortico-stelic segments. These are all described in detail. The centre of the stele is occupied by large cells or potential vessels which, in most ferns having a binary root, are differentiated into large scalariform vessels and consequently do not form a pith. The formation of the tissues composing the central cylinder is clearly centrifugal, while their differentiation is centripetal.

A study of the rootlets of *Ceratopteris* shows that they are disposed in two rows diametrically opposite and produced by two series of sextants, predestinated for their formation and for that of the ligneous bundles. The division of each of these sextants is described. The apex of the rootlet frees itself by piercing the piliferous layer of the root-mother. The author has never seen the intra-lacunary rootlets described by Poirault. From the very base the rootlet possesses its piliferous layer and two quite distinct cortical zones: consequently, there is no epistele. The connection of its conducting tissue with that of the root is established across the pericycle of the latter, without the production of a "pédicule péricyclique" analogous to that described by Van Tieghem and Douliot for other species. The paper is illustrated by thirty-seven figures.

* Rév. Gen. Bot., xix. (1907) pp. 523–56 (figs. in text).

Christensen's Index Filicum.*—H. Christ publishes some remarks upon the "Index Filicum" of Carl Christensen, which has been in the hands of the public for a little more than a year. The "Index" is a great advance in systematic pteridology, achieving its emancipation from the two cardinal errors of the old Hookerian school, viz. a blind insistence upon the importance of the indusium and sorus as characters for the formation of genera; and secondly, the forcible inclusion of the less well-marked species as varieties and forms under arbitrarily created species-types. Christensen has revived many genera and species created by Presl, Fée and Mettenius, which for years have been treated with suspicion or neglect in the "Species Filicum" and "Synopsis Filicum," Christensen being able to recognise the validity of a genus or species without prejudice to the particular part of the plant in which the proper character is situated. Hence Christensen's system of classification is a natural and not an artificial one. Christ's criticisms embrace questions of geographical distribution, nomenclature, synonymy, the genera of Diel's system, and so on.

Abnormal Production of Spores in Platycerium.†—H. Poisson describes and figures a plant of *Platycerium biforme* which in the warm fern-house of the Paris Museum produced spores on the upper surface of one of its sterile fronds. He endeavours to account for this abnormal occurrence.

Development of Lygodium.‡—R. Binford has studied the development of *Lygodium circinnatum* with a view to testing its value as an intermediate type in the line of evolution from Marattiaceæ to Polypodiaceæ. *Lygodium* is chosen as representing Schizæaceæ. The author describes his results under the headings: Arrangement and order of sporangia; the stalk; the tapetum; the wall; the sporogenous mass; sterile sporangia; relationships. He finds that the family to which *Lygodium* belongs has some characteristics which cannot be considered as intermediate in the line of evolution mentioned above, but belong to this family only. The sporangium has a marginal initial cell with early divisions of the dolabrate (zwei-schneidig) type, and this is not reported for any other ferns. The single sporangium in each sorus, the large sporangium and spores, and the indusium, which in cross-section shows the tissue regions of the foliage leaf, are characteristics which in nature or degree of development belong only to this special group of ferns. Notwithstanding the fact that the Schizæaceæ form a clear link in the chain of evolution of the annulus, the author considers that the peculiarities mentioned above are so striking and apparently so well established, and the relations of *Lygodium* are so ancient, that we can hardly consider it to be very close to the evolutionary line that leads to the Polypodiaceæ. It seems rather to have appeared very early in the evolution of leptosporangiate ferns and to have progressed in a line somewhat divergent from the main line leading to the Polypodiaceæ.

* Hedwigia, xlvii. (1908) pp. 145–55.
† Bull. Soc. Bot. France, liv. (1907) pp. 108–10 (figs.).
‡ Bot. Gazette, xliv. (1907) pp. 214–24 (37 figs.).

Sporangial Development in Equisetum hyemale.*—L. A. Hawkins gives an account of the development of the sporangium of *Equisetum hyemale*, and claims that the plant "is of the eusporangiate type; the sporogenous tissue comes from a single cell; the first wall is periclinal, the inner cell being sterile, while the sporogenous tissue comes entirely from the outer cell; the tapetum comes from the cells surrounding the sporogenous mass; there are two types of sporangia differing in development and governed by the direction of the second division; many of the sporocytes are disintegrated during the formation of tetrads."

Inner Roots of Lycopodium pithyoides.†—A. G. Stokey describes the structure and development of the roots of *Lycopodium pithyoides*, an epiphytic Pteridophyte transplanted from Mexico to Chicago. It resembles a young *Pinus sylvestris*; and practically every leaf is a sporophyll. But more striking than the general habit is the appearance of the stem in transverse section. The stele is small, and not remarkable, but is conspicuously surrounded by numerous smaller heavily sheathed steles. These are the "inner roots" described by Strasburger as existing in certain species of *Lycopodium*. They arise in acropetal succession at any point of the stele, and, instead of penetrating the cortex at once, and emerging as aerial roots, they turn downwards, and, boring through the cortex, emerge finally at or near the base. This habit is associated with erect forms of *Lycopodium*, both terrestrial and epiphytic. Stokey describes the development and structure of these roots in *L. pithyoides*, giving some comparative notes on other species.

New Palæozoic Lycopod.‡—M. Benson describes shortly a new palæozoic Lycopod with a seed-like structure. The vegetative organs of this plant, *Miadesmia membranacea*, were discovered by Bertrand in 1894, in sections of a calcite nodule from the Gannister beds of Hough Hill. From an examination of much new material, further details are known as to the vegetative organs, as well as a fairly complete account of the reproductive organs. *Miadesmia* was very minute, with a slender stem and without any trace of skeletal tissue. It is the first palæozoic Lycopod of herbaceous character known structurally. The megasporophylls were identified by D. H. Scott in 1901, and they show a more advanced type of seed habit than has hitherto been met with in Cryptogams. The megasporangium gives rise to but one thin-walled spore, which in development and structure resembles an embryo-sac and germinates in situ. An integument surrounds the sporangium, leaving but a small orifice as micropyle. This is surrounded by numerous long processes of the integument, which formed a collecting and incubating apparatus for the microspores. There is no trace of an envelope about the microsporangium. The carpellary leaf was shed at maturity, and resembles a winged seed. Apart from structural modifications of the megasporophyll, *Miadesmia* is most closely allied to

* Ohio Naturalist, vii. (1907) pp. 122–8 (2 pls.). See also Bot. Gazette, xliv. (1907) p. 78.
† Bot. Gazette, xliv. (1907) pp. 57–63 (2 pls.).
‡ Proc. Roy. Soc., Series B, lxxix. (1907) No. B 534, p. 473.

non-specialised species of *Selaginella*, such as *S. selaginoides*, but the foliage leaves show the archaic leaf base comparable with that of Lepidodendreæ.

Lycopodium complanatum subsp. moniliforme.*—C. A. M. Lindman describes and figures a new subspecies of *L. complanatum* found in Södermanland, Sweden, in great quantities in 1895, at a station which the author has failed to rediscover.

Fossil Osmundaceæ.†—R. Kidston and D. T. Gwynne-Vaughan describe and figure two new species of *Osmundites*, *O. Dunlopi*, and *O. Gibbiana*, both obtained from Jurassic rocks near Gore, Otago district, New Zealand. They give a detailed account of the minute structure of the stem, leaf base, and roots; and compare the structure of *O. Dowkeri* Carr. and *O. skidegatensis* Penhallow, adding a chapter on theoretical considerations and the ancestry of the Osmundaceæ.

Anatomy of Palæostachya vera.‡—G. Hickling has made a careful re-investigation of the anatomy of *Palæostachya*, and describes the general features of the fossil cone, the structure of its axis, its cortex and medulla, the vascular system, vascular supply of the appendages, sporangiophore bundles, bracts, sporangiophores, sporangia, spores. He thereby brings to light certain new features and corrects some errors of observation made by Williamson. He discusses the affinities of the cone, and holds that *Palæostachya vera* is a Calamarian fructification characterised by axillary sporangiophores.

Structure of Syringodendron.§—K. H. Coward describes the structure of a portion of a fossil plant from the Lower Coal Measures of Shore sent to the Manchester Museum by Lomax of Bolton. They were tangential sections of bark, and at A. C. Seward's suggestion were compared with *Syringodendron*, and found to agree. *Syringodendron* is the bark of *Sigillaria*. The pairs of scars in rows exhibited by the specimens are interpreted as having been caused by the parichnos strands which have undergone subsequent growth. There is evidence that the parichnos strands acted as respiratory organs.

Parichnos in the Lepidodendraceæ.‖—F. E. Weiss gives a résumé of all that has been published upon the parichnos in these fossil plants, the structure of the organ and the nature of its function. He gives the results of his own study of a series of slides in the Manchester Museum, figures a re-construction of the leaf-cushion *Lepidodendron*, and shows how the ærenchyma of the parichnos of the leaf, communicating with that of the middle cortex of the stem and with that of the roots, constituted a respiratory system for those parts of *Lepidodendron* and *Sigillaria* which were imbedded in a water-logged soil.

* Hedwigia, xlvii. (1908) pp. 131–2 (figs.).
† Trans. Roy. Soc. Edinburgh, xlv. (1907) pp. 759–80 (6 pls.).
‡ Ann. of Bot., xxi. (1907) pp. 369–86 (2 pls.).
§ Mem. Proc. Manchester Lit. and Phil. Soc., li. part 2 (1907) No. 7, 6 pp., 1 pl. and figs.
‖ Tom cit., No. 8, 22 pp., 1 pl. and figs.

Bryophyta.

(By A. Gepp.)

British Muscineæ.—A. R. Horwood* treats of the extinction of numerous species of lichens, hepatics and mosses in Charnwood Forest during the past 70 years, as a consequence of the disafforestation, drainage, increasing smoke and gases from collieries and brick and pipe works, and dust from quarries and cement works. The same thing is going on to a less extent in many parts of England, and the author urges that a competent investigation of the local cryptogamic floras should be made before it is too late. A. Ley † gives a list of 62 mosses in his additions to the flora of Herefordshire. They are rarer species and varieties, and are either new to the county or recorded from new stations. H. Whitehead ‡ records the luxuriant occurrence of *Ricciella fluitans* in a pond on Golding's Hill during the autumn of 1906. The author adds a few general remarks upon the habit and structure of the members of Ricciaceæ.

New and Rare Scottish Mosses.§—J. Stirton gives an account of some new and some rare mosses collected mostly at or near Arisaig in the West of Scotland. The following 11 species and a variety are described as new to science:—*Dicranum leiophyllum*, *Trichostomum episemum*, *Barbula limosella*, *Schistidium nodulosum*, *Grimmia polita*, *Rhacomitrium consocians*, *R. divergens*, *Bartramia subvirella*, *Pohlia tenerrima*, *Oligotrichum exiguum*, *O. hercynicum* var. *fastigiatum*, *Hypnum teichophyllum*. All but the *Hypnum* and *Dicranum* are barren plants. Among the rarities mentioned are fruiting specimens of *Ulota phyllantha* and *U. scotica*; of the former probably not more than a dozen capsules had been previously found. It is remarkable that capsules of *U. phyllantha* have never been found save when the plant grows intermingled with *U. Bruchii* in a fertile state. Other rare species are *Barbula limosa*, *B. exiguella*, *B. icmadophila*, *Hypnum corrugatulum*, *H. canariense*.

Irish Muscineæ.—D. McArdle‖ publishes lists of 71 species and varieties of mosses and 20 hepatics, collected on the island of Lambay, which lies off Howth in Co. Dublin. These records are part of the results obtained during 1905–6 from an organised attempt to determine the natural history of the island. The rocky coast yielded an abundance of material of a few genera; the caves of the north shore were found to be monopolised by a few appropriate species; in the inland and marshes were several species of *Hypnum*. A new variety of *H. splendens* is plentiful in a rocky pasture. A great difference is revealed between the hepatic flora of the island and that of the Hill of Howth. The same author ¶ gives a list of 68 mosses and 43 hepatics of Co. Mayo, collected in a remote mountain district near Lough Corrib, the Finny River, etc.

* Journ. of Bot., xlv. (1907) pp. 334–9.
† Tom. cit., pp. 317–29.
‡ Essex Naturalist, xiv. (1907) p. 276.
§ Ann. Scot. Nat. Hist., No. 63 (1907) pp. 171–80.
‖ Irish Naturalist, xvi. (1907) pp. 99–104.
¶ Tom. cit., pp. 332–7.

In the limestone of Cong is the Pigeon Hole cave; here *Lejeunea Mackaii* grows plentifully; here also are found *Eurhynchium pumilum*, *E. Teesdalei* and *E. tenellum*. At Curranamona a small quantity of *Andreæa crassinervia* was collected. The moss flora is often poorly developed in the district. H. W. Lett* points out that *Polytrichum attenuatum* is not rare in Ireland, as D. McArdle has stated, but is abundant in Co. Down, and has been found in eleven other Irish counties.

North American Muscineæ.—C. C. Haynes† concludes her account of the species of *Lophozia* of the United States, selected from the writings of A. W. Evans, but illustrated by herself. G. E. Nichols‡ gives a list with synonymy of the five species of *Amblystegiella* found in the United States, and supplies an account of the history of the genus. J. M. Holzinger§ explains the series of errors which have been made by authors over the moss now designated *Homalotheciella subcapillata* Card., and shows why the name *Burnettia* has to be dropped. A. Lorenz‖ publishes some illustrated notes on *Radula tenax* Lindb., which has never previously been figured. It occurs in New Hampshire, Massachusetts, and Connecticut.

Parisian Species of Philonotis.¶—G. Dismier has revised the species of *Philonotis* found in the environs of Paris, and shows that, whereas three species only of this difficult genus, *P. fontana*, *P. calcarea*, and *P. marchica*, have been recorded as occurring there, in reality two other species, *P. cæspitosa* and *P. capillaris*, also occur. Further, *P. marchica* really does grow in the district, though all previous records of it are shown to be false. This species has often been confounded with others, especially with *P. fontana* and *P. cæspitosa*. It differs in having its leaves shaped like an elongated isosceles triangle with curvilinear sides, concave at base, not plicate, carinate, with margins flat, and bearing sharp teeth along the whole length, with cells always papillate on their upper angles, with tissue translucent, and nerve thin throughout. He says that *P. cæspitosa* does not seem to have become sufficiently well known hitherto; its principal distinguishing characters are that the tufts are but little radicelliferous, the stems are slender, the leaves relatively large, homotropous (a rarely absent character), falcate, flat (not plicate), with tissue translucent, and often composed of square or rather long rectangular cells. The lower leaves of sterile plants should always be examined, since the upper leaves and those of male stems are nearly always misleading; hence the bad naming of many specimens.

New Species of Sphagnum.**—C. Warnstorf begins a paper on new European and extra European Sphagna, in which he gives descriptions of 27 species of *Sphagnum*, belonging to the *cymbifolium*, *subsecundum*, *mucronatum*, *acutifolium*, and *cuspidatum* groups. The descriptions are detailed and are in some species supplemented by figures.

* Irish Naturalist, xvi. (1907) p. 348.
† Bryologist, xi. (1908) pp. 1–3 (1 pl.).
‡ Tom. cit., pp. 4–5.
§ Tom. cit., p. 7.
‖ Tom. cit., p. 9.
¶ Bull. Soc. Bot. France, liv. (1907) pp. 196–200.
** Hedwigia, xlvii. (1907–8) pp. 76–124.

Trichostomum mutabile Br. and its Allies.*—Th. Herzog has made a thorough study of the variable species *T. mutabile* and all the supposed allied species and varieties. He has had more than 250 specimens through his hands, and he is therefore able to form a broad and just view of the mutability of the species. As a result, he sinks *T. litorale* Mitt., *T. cuspidatum* Schimp., and *T. lutescens* (Lindb.), and disposes of many varieties, taking as the name for this collective species *T. mutabile* Br. Unfortunately, the forms are so numerous that the author finds it impossible to point out a really fixed type to serve as a true variety of *T. mutabile*, in the ordinary sense; and he has, therefore, set up what he calls "ideal types" as indicating the main lines of divergence. These are founded on forms more or less easily diagnosed and distinct from each other: *densum*, *litorale*, *mutabile*, and *cuspidatum*. The intermediate forms are designated by a special system of nomenclature, explained by the author. He then treats of difference in growth, the foliage-characters, leaf-form, and anatomy, form of the capsule, size and variety of structure of the peristome. Finally, the author describes fully the types and sub-types, giving full geographical distribution of each, followed by a chapter on phylogenetic conclusions and a diagram of form-affinities.

Muscineæ of Crete.†—W. E. Nicholson publishes a list of 91 mosses and 13 hepaticæ collected by him during a fortnight's stay in the island of Crete. The sun was already beginning to dry up the vegetation, which added to the difficulty of the collector. The region examined was in the neighbourhood of Kandia, in which the most productive locality was the bed of the Kairatos and the adjacent ravines close to the recent excavations of Knossos. The author also crossed the island, and was thus enabled to gain a fairly good general idea of the moss flora. He finds the mosses of the subalpine zone, which are so rich in Central Europe, to be poorly represented in Crete. There was no species of *Dicranum*, *Rhacomitrium* or *Hylocomium*, and the genus *Hypnum* was represented by *H. cupressiforme* only. A cave on Mount Ida, at a height of 5000 ft., was thickly hung with mosses, among which *Neckera turgida* predominated. The author points out that many localities remain unexplored, which offer an interesting field for work.

New Greenhouse Fissidens.‡—A. A. Elenkin describes and figures *Fissidens Waldheimii*, a new species of moss which grows abundantly on the trunks of *Dicksonia antarctica* in the glasshouses of the Imperial Botanic Garden of St. Petersburg. It was associated with *Pterygophyllum hepaticæfolium* and *Rhacopilum convolutaceum*. This *Fissidens* fruits in winter, and much resembles *F. adiantoides*, but the leaves lack the hyaline margin of that species, the spores are verruculose, and the stems are rufescent below with radicles almost to the apex.

Hybrids of Physcomitrella.§—I. Györffy has investigated the comparative anatomy of *Physcomitrella patens*, *P. Hampei*, *Physcomitrium*

* Nova Acta Acad. Cæs. Leop.-Carol., lxxiii. (1907) pp. 451–81 (7 pls.).
† Rev. Bryolog., xxxiv. (1907) pp. 81–6.
‡ Bull. Jard. Imp. Bot. St. Pétersbourg, vii. (1907) pp. 1–8 (2 pls.).
§ Hedwigia, xlvii. (1907) pp. 1–59 (figs.).

pyriforme, and *P. sphæricum*, and gives a detailed account of his results. He states that just as *Funaria hybrida*, *Ditrichum Breidleri*, *D. astomoides* are hybrid mosses of known parentage, so also is *Physcomitrella Hampei*, the mother of which is always *P. patens*, but the father may be either *Physcomitrium sphæricum* or *P. pyriforme* or *P. eurystomum*. The author very carefully describes the structure of the respective parents and of the resulting hybrids. He finds that the hybrids in their vegetative parts (oophyte) correspond with the mother species, *P. patens*; but in the asexual generation (sporophyte) they inherit the characters of the father species.

Parallel Forms and Variability of Cell-length in Mosses.*—L. Loeske has been studying the parallelism of forms in various species under the influence of similar external conditions. In this sort of work the study of herbarium specimens is of very little help; the plants must be observed in their natural habitats. He discovered a new variety, *Hygrohypnum subsphæricarpum* var. *cataractarum*, in a cascade in Algäu, a form remarkable for the long and even excurrent costa in its leaves (the costa of the type being but three-quarters of the length of the leaf). He thereupon turned his attention to *Amblystegium fallax* and its var. *spinifolium*, which Roth and others claim to be a distinct species; and he has come to the conclusion that *A. fallax* is a flowing-water form of *A. filicinum*, that *A. fallax* var. *spinifolium* is a parallel form of *A. irriguum*, and *A. noterophiloides* a parallel form of *A. fluviatile*. Warnstorf indeed combined the two latter into one species. *Cratoneuron irrigatum* is, Loeske thinks, a mixture of parallel forms of *C. commutatum* and *C. falcatum* growing in mountain streams. The rest of Loeske's paper treats of the increase in length of the prosenchymatous cells of the leaf in species of *Cratoneuron* and *Hygroamblystegium*, this lengthening being proportional to the increased length of the leaf under the influence of running water; this is associated with a strengthening of the midrib. Loeske recounts some observations made by him of change of form in mosses under change of environment.

Ramification in Muscineæ.†—M. Servit has been incited by the researches of Velenovsky to examine the mode of branching in Muscineæ. On the whole he confirms the results of that author, but he also publishes fresh observations and adds to those already made. In liverworts two modes of ramification are recognised: (1) the terminal branching in which the branches arise exogenously; (2) the intercalary endogenous formation of shoots. Leitgeb distinguishes two modifications of the former method. This division is based on the behaviour of the shoot in an early stage, but the present author shows that the fully developed plant does not always correspond with the young stages. Velenovsky describes certain so-called angular leaves (angular blätter) for the vascular cryptogams only, but Servit here describes and figures similar growths for liverworts, notably *Mastigobryum trilobatum*, where this axillary bract is inserted on two branches. He discusses monopodial and dichotomous branching as it occurs in the hepatics, in which group the former mode of branching characterises the erect growing species,

* Allgem. Bot. Zeitschr., xiii. (1907) pp. 119–22.
† Beih. Bot. Centralbl., xxii., Abt. 1 (1907) pp. 287–93 (figs.).

and the dichotomous the closely creeping species. The mosses branch monopodially. The sphagna are so peculiar in their ramifications as to confirm the view that they form an isolated moss type.

Androgynous Inflorescences in Dumortiera.*—A. Ernst has made a special study of two Javan species of *Dumortiera*, *D. trichocephala* N. ab E., and *D. velutina* Schiffn., and compares his results with the work done in other species of the genus by Leitgeb and Goebel. He describes the habit and place of growth of the two species under consideration, and then gives a short description of their male and female receptacles. Besides these, he finds in *D. trichocephala* frequently, and more rarely in *D. velutina*, inflorescences of mixed sex, that is, shoots which have come to bear sexual organs, the rays of which do not all bear organs of similar sex. These are by no means exceptional growths, as in *Preissia commutata*, but quite common in *D. trichocephala* on plants collected from many localities in Java. This species differs, therefore, from the generality of Marchantioideæ Compositæ in being monœcious, not diœcious, inasmuch as it possesses male, female, and mixed inflorescences, on different branches of the same plant. Statistics are given as to the occurrence of mixed inflorescences in both *D. trichocephala* and *D. velutina.*

Comparison between Muscineæ and Vascular Cryptogams.†—G. Bonnier reviews the theories put forward from time to time by various authors as to an analogy between the respective parts of plants in these two groups, but he condemns them all as being untenable, and pronounces the Muscineæ to be a group by itself, occupying a special position in the vegetable kingdom. He then proceeds to examine possible intermediates between Muscineæ and Vascular Cryptogams on the one hand and Muscineæ and Thallophytes on the other, the former of these considerations being the subject of the present paper. This he does, after a few preliminary remarks, under the following headings: (1) Comparison of the Gametophyte in Muscineæ and Vascular Cryptogams; (2) Comparison of the Sporophyte; and (3) Comparison of the mode of multiplication. In conclusion, he points out that notwithstanding comparisons and homologies, the Muscineæ present great differences from other plants. Though *Anthoceros* resembles Vascular Cryptogams in its gametophyte, it differs profoundly in its sporophyte; and though an alga of the Florideæ in protonema, sporogonium and thallus may have a general development very comparable with that of a moss, it differs profoundly in the origin of the spore mother-cells, the archegonium and antheridium.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Staining of Algæ.‡—F. Brand has made interesting experiments, proving that the use of various reagents is not only a convenient means

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 455-64 (1 pl.).
† Rev. Gén. Bot., xix. (1907) pp. 513-21 (figs. in text).
‡ Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 497-506.

of determining their identity, but that it also leads to certain scientific deductions. He finds that a given reagent has the same effect on all parts of the same species, be they vegetative or rhizoidal, zoospores, or germinating plantlets. This fact is of great importance in the discrimination of forms belonging to polymorphic species, and would, for instance, prevent confusion between the young stages of *Cladophora*, which resemble *Gongrosira*, and the true *Gongrosira* which reacts to a different stain. Instances are given of the effect of various stains on certain genera of algæ, which have been soaked for 24 hours in water containing a percentage of acetic acid ; all the material employed, except where specially stated, was from dried plants.

The author then describes a new species of *Gongrosira*, *G. lacustris*, which he discovered during his staining experiments. A new form of *Coleochæte scutata*, f. *lobata*, is also described, which the author considers as representing merely a biological form of typical *C. scutata*. There is no sign on it of reproductive organs, and it has not reappeared in the year of writing.

Coleochæte nitellarum.*—I. F. Lewis remarks on the structure of *C. nitellarum*, and compared specimens collected at Long Island with the original German plants described by Jost in 1895. † Lewis notes two peculiarities of structure—the thin, delicate cell-walls, and the broad, flat shape of the cells, and explains both these phenomena by the endophytic habit of the species. He points out that his Long Island plants are strictly monœcious, the antheridia being usually produced in the immediate vicinity of the oogonia. The mode of origin of antheridia and oogonia is described, and an account given of fertilisation as observed in stained preparations. The nucleus of the oogonium is central in the cell, and somewhat larger than the vegetative nuclei. The nucleus from the spermatozoid, at first small, increases in size as it approaches the oogonial nucleus, until two nuclei of approximately the same size lie side by side in the centre of the oogonium. The nuclei fuse while the chromatin is in the resting condition. Immediately after fusion, neighbouring vegetative cells send up branches over the oogonium to form the characteristic cortex of the oospore. Formation of the zoospores is described, and the author shows that there is here an indication of the formation of a multilocular sporangium similar to that in certain Phæophyceæ. Division of the nucleus is indirect, and does not take place until the single pyrenoid and chromatophore have first divided. The only exception to this rule is in the case of the antheridia, where the chromatophore and pyrenoid remain undivided in the mother-cell.

Algæ of Mark Brandenburg.‡—E. Lemmermann publishes the second part of his work on the algæ of Brandenburg. He completes the systematic treatment from *Phormidium* to *Rivularia* and the genera of Camptotrichiaceæ ; and then proceeds to deal with the class Flagellatæ from a general point of view. His remarks cover the structure of

* Johns Hopkins Univ. Calendar, Notes Biol. Lab., March 1907, pp. 29–30.
† Ber. Deutsch. Bot. Gesell. xiii.
‡ Kryptogamen-Flora Mark Brandenburg, iii. part 2 (1907) pp. 129–304.

the cell, movement, nutrition, multiplication, formation of colonies, phenomena of attraction, occurrence, seasonal dimorphism, parasites, and symbiosis. A list of literature on the subject is given, and the opening lines of the systematic treatment of the group are included in this part.

Contributions to the Algal Flora of Nordhausen.* — F. Quelle gives a list of 31 species new to the district collected by himself. Among these is *Surirella anceps* Lewis, which up to the present time has only been recorded once, and that was from the Notch Valley in the White Mountains, United States, in 1860. The conditions in which this species is found living in the Hartz Mountains are much the same as those of the original habitat. The author describes some of the characteristic features of the species. Names are given of certain Cyanophyceæ which constitute "water-bloom" at two localities.

French Algæ collected in the English Channel.†—J. Bessil gives an account of an algological excursion lasting three days to the environs of Saint-Vaast-la-Hougue, and of Barfleur in the English Channel, the objects being to observe marine algæ in situ, to study them alive in their habitats, to obtain an idea of the marine flora in its diverse facies, to learn how to collect, determine, and study algæ, to become familiar with their forms and names. He recounts what was done each day, and gives lists of the algæ found.

Marine Algæ of Lambay.‡—The late E. A. L. Batters made a list of about 200 species of algæ collected at Lambay, an island off the coast of Co. Dublin, during a week in April 1906, during the combined attempt of zoologists, botanists, etc., to investigate the natural history of the island. Twenty of the species have never previously been recorded from the coasts of the island, and only one species has been recorded previously from Lambay. Many of the common species were absent at the time of the investigation. The algal flora of the island on the whole resembles most nearly that of the Isle of Man and the Clyde sea area.

Caulerpas of the Danish West Indies.§—F. Börgesen writes an ecological and systematic account of the Caulerpas of the Danish West Indies, and divides his remarks into two sections, a General and a Systematic part. In the General part he deals first with the external conditions under which the Caulerpas live in the Danish West Indies, describing the three localities as "somewhat exposed," "sheltered," and in "deeper water." On much exposed shores he has never found any of these plants. Under "the rhizome and root of the Caulerpas and their variations under different external conditions," the author describes (1) epiphytic or mud-collecting Caulerpas ; (2) sand and mud Caulerpas ; and (3) rock and coral-reef Caulerpas. In the sand-Caulerpas the roots "first grow vigorously without division some cms. down into the bottom, and then suddenly become divided into numerous

* Mitth. Thüring. Bot. Ver., 1907, pp. 36–9.
† Bull. Soc. Bot. France, liv. (1907) pp. 269–80.
‡ Irish Naturalist, xvi. (1907) pp. 107–10.
§ Mem. Acad. Roy. Sci. Lett. Danemark, ser. 7, iv. (1907) pp. 339–92 (figs. in text).

rhizoids, whereas the roots of the rock and coral *Caulerpa*, on the contrary, are commonly directly divided into several branches, which by degrees are divided into a great multitude of thin rhizoids." The form of the rhizoids may vary in the same species according to the substratum on which it grows. Under the heading of "The different types of assimilation-shoots in *Caulerpa*, and their ecological adaptation to the surrounding external conditions," the author criticises the published views of Reinke as to their uniformity of external conditions, and maintains that among Caulerpas there is sufficient variation in this respect to account for much of the variety of form in the genus being caused by adaptation. He divides the genus into species which have (1) leaf-like, bilateral assimilation-shoots, and (2) radial species, and he finds that Caulerpas must be regarded, to a great extent, as ecologisms which are highly variable and adapted to particular growing places. There are, of course, certain variations which are not ecological, but the whole subject must be treated by means of experiments, and more knowledge is required before the variability of the species can be satisfactorily explained. Nine species are recorded from the Danish West Indies, on each of which the author gives critical notes and adds illustrations.

Plankton of the Yang-tze-kiang.*—E. Lemmermann publishes the first records of the plankton of Chinese rivers. He took six samples between Chingkiang and Kiukiang, and he enumerates the species found therein, which included 10 Schizophyceæ, 8 Chlorophyceæ, 5 Conjugatæ, 1 Flagellate, 54 Bacillariæ; he makes remarks on some of the species and describes several novelties. Finally, he states that the plankton of the Yang-tze differs from that of previously examined rivers by the predominance of *Lysigonium varians* De Toni, *Synedra ulna* Ehrenb., *S. longissima* var. *subcapitata* Lemm., *Surirella calcarata* Pfitz., and *Diaptomus*, the presence of *Pediastrum clathratum* Lemm. and *Surirella elongata* Lemm., and the absence of certain typical forms.

Phytoplankton of Ceylon.†—E. Lemmermann publishes the first records of phytoplankton from Ceylon. The material was collected by Borgert and Willey, partly in Gregory Lake near Nuwara Eliya, and partly in Colombo Lake. From Gregory Lake are recorded 4 Schizophyceæ, 6 Chlorophyceæ, 4 Conjugatæ, 2 Flagellatæ, 1 Peridiniale and 10 Bacillariales. Remarks are made on the species of *Melosira* and *Pediastrum*, which occur there; a new species, *Lyngbya Borgerti*, is described, as well as a new variety, *ceylanica*, of *Dinobryon cylindricum*. In Colombo Lake were found 6 Schizophyceæ, 9 Chlorophyceæ, 3 Conjugatæ, 1 Flagellate, 3 Bacillariales. The phytoplankton of this lake is poor, and the species, with three exceptions, are not well represented. All except two are found in European waters.

Swarm-spores of Fresh-water Algæ.‡—A. Pascher publishes an account of his experiments, extending over four years, on certain Chloro-

* Archiv Hydrobiol. u. Planktonkunde, ii. (1907) pp. 534–44 (1 pl.).

† Zool. Jahrb. Abt. Systematik. xxv. (1907) pp. 263–8. See also Hedwigia, xlvii. (1908) Beibl., p. 69.

‡ Stuttgart: Luerssen, Bibliotheca Botanica, xiv. heft 67 (1907) 116 pp. (8 pls.).

phyceæ, arranged under the following headings:—1. Variation of zoospores of certain Chlorophyceæ, notably *Ulothrix zonata*, *Stigeoclonium* (4 species), *Draparnaudia glomerata*, *Tribonema* and *Oedogonium*. 2. Development of zoospores, with special regard to intermediate forms of swarm-spores. 3. Systematic treatment of Ulotrichales, divided into Tetrakontæ and Dikontæ. The paper is illustrated with 8 plates, representing the variations by mathematical curves.

Pathological Growth-phenomenon in Spirogyra and Mougeotia.*—Z. Woycicki has investigated further the effect of coal-gas on plants, and adds to our knowledge on the subject. He finds that the quantity of this gas which is present in laboratories exercises a strong influence on the cells of *Spirogyra* when kept there. Various experiments were carried out on species of *Spirogyra* and *Mougeotia*, short accounts of which are given in the present preliminary note, and further details are promised shortly. The results are a further confirmation of the views of Richter.

Processes of Division, Cell-rejuvenation and Sporulation in Biddulphia.†—P. Bergon gives the results of five years of careful study of the biology of *Biddulphia mobiliensis* Bailey. Despite prolonged observation he has failed to determine the fate of the motile microspores after their escape from the sporangium. He describes in detail the process of cell-division, the disposition of the nucleus and endochrome in the resting state, the orientation and symmetry of the cell. As regards the formation of auxospores, he finds that in *B. mobiliensis* they do not arise from the most diminutive cells, but from cells only slightly less than medium size. He therefore prefers to regard this phenomenon as a rejuvenation of the cell, rather than as a method of re-establishing its size. He gives a long and minute description of the details of sporulation, which he finds to occur at a fairly constant season in the year, depending, however, rather on the weather. At Arcachon sporulation occurs between the extreme end of December and the end of February; that is, in the time of greatest vegetative intensity. Fine cold weather is particularly favourable to the process. He thinks that there is a correlation between rejuvenation and sporulation, since he has found the two processes going on side by side in great abundance. He gives a series of measurements of the cell in repose, in rejuvenation, and in sporulation.

Species of Ceratium in the Gulf of Lyons.‡—J. Pavillard publishes notes upon all the species of *Ceratium* found in the Gulf of Lyons. These are 27 in number, and one of them is new to science. His system is to regard as a species every form that is sharply defined by constant characters, rather than to group them as varieties of a specific type, or as forms of the same variety. In this he follows Schrœder. For some of the species he gives dimensions, which as a rule are invariable.

Avrainvillea and Halimeda.§—M. A. Howe publishes the third part of his Phycological Studies, and in it he deals almost entirely with the

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 527–9.
† Bull. Soc. Bot. France, liv. (1907) pp. 327–58 (4 pls.).
‡ Tom. cit., pp. 148–54, 225–31 (1 fig.).
§ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 491–516.

two genera above mentioned. His first section is devoted to remarks on the sporangia of *Halimeda tridens* (under which name he refers to what we commonly call *H. incrassata*) and of *H. Tuna*. The sporangia of *H. tridens* have not been hitherto recorded, and they are here compared with those of *H. Tuna*. They are uniformly yellowish-brown or burnt-umber colour, and the sporangiophores are most densely clustered along the upper margins of the segments, especially at the apices of the lobes; they may, however, emerge from any part of the segment and sometimes completely cover its surface. The author then presents his views on the American species of the *H. Tuna* group, in which he recognises three distinct species—*H. Tuna*, *H. discoidea*, and *H. scabra*. He attributes a certain amount of importance to the degree of calcification, as well as to the size and shape of the peripheral and subperipheral utricles. The next section is devoted to a treatment of the American species of the *H. tridens* group, in which the author describes a new species *H. simulans*, and recognises three other species. One of these is the *H. monile* Lam., generally regarded as being a form of *H. incrassata*. A key of the four species of this group is given. An important fact is recorded in this paper, namely, the finding for the first time of the sporangia of *Avrainvillea*, which the author has discovered in the species *A. nigricans* Decne. They consist of clavate and fusiform to pyriform and subglobose bodies, borne on filaments raised above the surface of the thallus. Sometimes the sporangium only contains a single spore, but the usual number is three, four or five, rarely six, seven or eight. The author regards them as aplanospores. The final section of the paper deals with the American species of *Avrainvillea*, of which the author describes four with synonymy and key. He adds finally a note on *U. tomentosa* Murray and *U. luteofusca* Murray.

Some Critical Green Algæ.* —G. S. West publishes notes on six members of the Chlorophyceæ, about which nothing or little is known. Three of these are new species, and one is transferred to another genus. The first alga dealt with is *Polychætophora simplex*, the discovery of which adds a second species to that genus. The author describes it in detail, and points out the differences between it and *Glœochæte Wittrockiana* Lagerh. *P. simplex* is a member of the Chlorophyceæ, and its cells, which are not enveloped in mucilage, are each furnished with two to four simple bristles. *G. Wittrockiana*, on the other hand, is one of the Myxophyceæ, with its cells enveloped in a copious mucilage, and its bristles frequently possess short spur-like branches. *Brachiomonas submarina* Bohlin is next described, belonging to a genus only observed hitherto from Norway and Sweden. *Phyllobium sphagnicola* is another new species, and constitutes the first recorded instance of a *Phyllobium* occurring on the leaves of a *Sphagnum*. *Kirchneriella subsolitaria*, the third new species, differs from the three previously known members of that genus in the subsolitary habit and the entire absence of mucus. *Tetraëdron platyisthmum* has been known as *Cosmarium platyisthmum* Archer, who recorded it from Ireland. West now finds it in collections of algæ from the boggy hollows in the Lewisian gneiss of West

* Journ. Linn. Soc. (Bot.) xxxviii. (1908) pp. 279–89 (2 pls.).

Sutherland, and is able to give a fuller description of the plant, showing that it is not a Desmid. Finally, the author records *Chodatella quadriseta* Lemmermann, from Studley Park, Warwickshire.

Diatoms of the Pacific.*—A. Mann reports on the Diatoms collected by the 'Albatross' in the Pacific Ocean during the years 1888–1904. He first describes the methods employed for examining the samples to see if they contained diatoms, as well as the way of mounting the specimens. Many of the samples were destitute of diatoms, but some, even as deep as 987 and 1744 fathoms, were particularly rich in them. The importance of the study of diatoms is pointed out as an aid in determining the extent and direction of ocean currents and the origin of the materials composing the sea bottoms. This is partly owing to the indestructibility of their siliceous remains, those which were formed centuries ago being as well preserved as those of this year's product; and partly to their extreme minuteness, which allows them to be readily transported by even quite slow ocean currents or surface drifts from their places of origin to remote points and finally sifted down upon the sea bottom. Another point is the enormous number of known species, over 4000, some of which are peculiar to certain localities, there being a tropical, temperate, and frigid flora. The author then goes on to show that certain species were found in certain areas, one instance being that of *Biddulphia favus*, which forms a practically unbroken chain from California to the Hawaiian Islands. Other important facts concerning the geographical distribution of diatoms are given. The main part of this report consists of an annotated catalogue of genera and species, in which a certain number of new species are described. Synonymy, references to literature, and critical notes follow each record. A list of data of the stations at which diatoms were collected by the 'Albatross,' and a full bibliography complete the work, which is illustrated by 11 plates.

Distribution of Fucaceæ on the Coast of Greenland.†—H. Deichmann and L. K. Rosenvinge write a criticism of a publication by K. J. V. Steenstrup on the question whether the upper limit of the Fucaceæ zone can be regarded as indicating variations of sea-level. A short résumé is given of the views of this author, and then the views of the present writers are set forth. They deal principally with the "Isfod" or coating of ice which is formed during the winter on the rocks at the edge of the sea, and stretches from a point above high-water mark to a point more or less below it. Deichmann has made a careful study of this Isfod and describes the manner and time of its growth and the effect it has on the algæ. He maintains that it is not harmful to the littoral flora as has been supposed, but that the bare zone lying between high-water mark and the lowest limit of terrestrial vegetation is the result of other causes. The zone is too much splashed by sea-water to allow of the successful growth of land plants, while marine algæ cannot easily exist where there is an insufficient supply of water.

The distribution of the Isfod varies in different parts of the region

* Contrib. U.S. National Herbarium, x. (1907) pp. 215–422 (11 pls.).
† Bot. Tiddsk., xxviii. (1907) pp. 171–84 (photos.). (French résumé.)

examined, but the authors show that its presence is not destructive to marine algæ.

Sphæranthera lichenoides.*—F. Heydrich discusses this plant, which was figured so long ago as 1786 by Ellis and Solander †; indeed, their figures are pronounced to be far the best existing to this day. He criticises adversely the views held by Foslie on the limits of the species and its forms, which views have been incorporated in De Toni's Sylloge Algarum. Heydrich considers that of the material he has examined, two large groups can be made; the first, consisting exclusively of plants which grow on *Corallina*, and are found more often on the North-European coasts; the second, all those which do not occur on *Corallina*, but on stones, large algæ and rhizomes of *Posidonia*, and inhabit the Mediterranean. The first form he calls *pusilla*, the second *depressa*. The figure of Ellis and Solander ‡ represents Heydrich's f. *pusilla*, but f. *depressa* has never been figured. A third form, growing on *Rytiphlæa pinastroides* in Jersey is called f. *densa* and forms a link between *S. lichenoides* and *S. Philippi*. The manner of attachment to the substratum is discussed and the differences are considered by the author to be of value in the determination of the species. The structure of the procarp is considered in detail, and both antheridia and tetrasporangia are described.

Fucus Living on Sand and on Mud.§—C. Sauvageau has found two species of *Fucus*—*F. spiralis* and *F. vesiculosus*—growing at Arcachon on clayey sand. The plants of *F. spiralis* measure only a few centimetres, rarely a decimetre. The older plants throw out at their base new fronds on a very short perennial stipe, but these shoots never become transformed into stolons. Propagation takes place exclusively by the germination of oogonia. The plants are attached to the sand by means of rhizoids, which are the prolongation of the intertwined hyphæ or fibres of the stipe; these become generally welded together to form the disk of attachment in plants of *Fucus* which have passed their first youth. Thus it is seen that *F. spiralis* adapts itself to a life on sand by preserving the characters of its early stages. Living side by side with *F. spiralis* is found *F. vesiculosus*, similarly affixed to the sand by a bouquet of rhizoids. It attains, however, a greater height, namely, 10–15 cm., and it grows more rapidly. The large fronds are usually without vesicles, and the few vesiculiferous individuals observed were not fertile; indeed, the fructification, almost constant in *F. spiralis*, is on the contrary rare in *F. vesiculosus* growing on sand, while large plants of this species fixed on a solid base are abundantly fertile.

The author records also *F. lutarius*, growing on stretches of mud at a tide level intermediate between that of *F. vesiculosus* and *F. platycarpus* var. *spiralis* (*F. spiralis*), forming scattered tufts which are weighed down at low water. Their base, more and more enveloped in mud, is never fixed to any solid substratum, and new fronds arise from the midrib of the enveloped portion. Thus the plants multiply by vegetative

* Beih. Bot. Centralbl., xxii. Abt. 2 (1907) pp. 222–30 (1 pl.).
† Zoophytes (London, 1786) p. 131, tab. xxiii. (figs. 10–12).
‡ Loc. cit. § C.R. Soc. Biol. Bordeaux, lxii. (1907) pp. 699–703.

means, which accounts for the absence of reproductive organs. By its habitat, its sterility, and its mode of multiplication, *F. lutarius* appears to the author sufficiently distinct from *F. vesiculosus* and *F. axillaris*. He considers it is probably an adaptation of one of these two species to a particular habit of life. This opinion is strengthened by the variation in the distribution of the cryptostomata, which is not yet of a definite character.

Colpomenia sinuosa.*—L. Corbière publishes a note upon *Colpomenia sinuosa*, recording its presence at numerous stations on the coast of Cherbourg as well as 20 kilometres to the west. He has no doubt that millions of plants of it exist in the English Channel to the north of Cotentin, though at the time of writing it had not been observed on the oyster beds of St. Vaast. Specimens were collected at Les Flamands, near Cherbourg, so long ago as March 1906.

L. Mangin shortly discusses points of interest in connection with this alga, and states that he has found it at St. Vaast among rocks to the north and east of the Isle of Tatihou. It has also been found in water of varying degrees of salinity, and the author hopes to give shortly more information on the degrees of salinity and of brackish water in which the plant can live. He points out that in certain states *C. sinuosa* may be confused with *Leathesia difformis*; but the former has a dense cortex, composed of polyhedral cells closely adpressed, while *L. difformis* has a filamentous external cortex, composed of cells easily separated. The confusion can only take place in autumn, since *Colpomenia* appears in autumn and winter, while *Leathesia* is a summer plant, appearing in June.

Lithothamnia of the 'Sealark' Expedition.†—M. Foslie has worked out the collection of *Lithothamnia* made by J. Stanley Gardiner in the Chagos Archipelago, Saya de Malha Banks, Seychelles, and other of the surrounding reefs and islands. He opens his paper with remarks on the different species which occur in the different localities, and makes interesting comparisons with the coral-reef building flora of other parts of the world. He finds a close correspondence between the area in question and the Maldives, the only region of the Indian Ocean which has been well worked hitherto. It appears that three or four species are the important reef-builders in the littoral region and in the uppermost part of the sublittoral region. These are *Lithophyllum onkodes*, *L. craspedium* and *Goniolithon frutescens*; while *L. Kaiseri* (*pallescens*) also contributes to the formation of reefs, and in depths of about 60 fathoms *Lithothamnion indicum* and *L. australe* play their part. The author finds also that where *Lithothamnia* occur in great abundance, covering entire atolls, the number of species is small, but the number of individuals is enormous. This is the case at Chagos, Coetivy, certain places in the Maldives, at the Ellice Islands (Funafuti), and at the Gilbert Islands in the Pacific. In places where *Lithothamnia* do not appear in such large quantities the number of species is much larger. There seems to be a considerable correspondence between the *Lithothamnia* in the Indian Ocean and those in large areas of the Pacific

* Bull. Soc. Bot. France, liv. (1907) pp. 280–4.
† Trans. Linn. Soc. (Bot.) ser. 2, vii. (1907) pp. 93–108 (2 pls.).

Ocean within the tropics; and this concerns several of the species themselves as well as their mode of occurrence, particularly such as determine the general aspect of the vegetation. The author describes 13 species collected on the 'Sealark' Expedition, one of which is new.

Okamura, K.—**Icones of Japanese Algæ.** Tokyo: (1907) i. Nos. 1–3.

Fungi.

(By A. Lorrain Smith, F.L.S.)

Experiments with Sclerospora graminicola.*—G. B. Traverso published some time ago an account of a *Sclerospora* found on plants of *Setaria italica*, which varied somewhat from the typical form *Scl. graminicola*. Further gatherings of the fungus have enabled him to examine it more carefully. He finds that the conidial forms of the two are identical, but all attempts to infect plants other than *S. italica* have failed, and he has also found the fungus richly infesting *S. italica* in a field, and leaving untouched the plants of *S. viridis* that grew there also in abundance. Traverso considers that he is dealing with a new biological form, var. *Setariæ-italicæ*.

Studies in North American Peronosporales. II.†—G. West Wilson discusses in this paper the two tribes Phytophthoreæ and Rysotheceæ, which normally germinate by means of zoospores. The latter includes the genera *Basidiophora*, *Sclerospora*, *Rhysotheca*, and *Pseudoperonospora*. *Rhysotheca*, a new genus, includes the greater number of species usually referred to *Plasmopara*, the type species being *Plasmopara viticola*. Two species are assigned to *Pseudoperonospora*: *P. cubensis* and *P. Celtidis*. The former causes a somewhat widespread and serious disease on Cucurbitaceæ. *P. Celtidis* is the only member of the order which affects a tree—it grows on *Celtis occidentalis*, and is somewhat rare.

Mycotheca of the School of Pharmacy of Paris. XXI.‡—G. Bainier gives a further series of interesting studies of various fungi. Two additional species of *Syncephalastrum* were cultivated and are now described and figured; they differ from the previously known species in having stolons. *Piptocephalis Freseniana* was also grown and the development watched; zygospores were produced on the mycelium cultivated with *Mucor fragilis* on a crust of bread moistened with water.

A new species of *Trichurus* is described; it resembles somewhat a *Stysanus*, but the fructification is beset with long bristles. A new genus and species of Hyphomycetes (Dematieeæ) *Chlamydomyces diffusus* is described and compared with *Trichocladium asperum* and *Acremoniella atra*. All three are closely related.

Cytology of Humaria rutilans.§—H. C. L. Fraser has made a careful study of this Discomycete with a view to ascertaining the

* Nuovo Giorn. Bot. Ital., xiv. (1907) pp. 575–8.
† Bull. Torrey Bot. Club, xxxiv. (1907) pp. 387–416.
‡ Bull. Soc. Mycol. France, xxiii. (1907) pp. 218–41 (4 pls.).
§ Ann. of Bot., xxii. (1908) pp. 35-53 (2 pls.).

development of the ascogonium, spores, etc. She finds that the ascocarp originates as a tangle of septate hyphæ, each cell containing one or a few nuclei of two sizes, the smaller fusing in pairs and so producing the larger, thus constituting a process of reduced fertilisation or apogamy. The cells containing these nuclei form ascogenous hyphæ ; as they develop, their nuclei increase in size ; the two terminal nuclei undergo simultaneous karyokinetic division, showing sixteen chromosomes. The further formation of the ascus and the various phases of nuclear division are followed in detail. The spores are outlined by radiations passing from the centrosome ; near the base of the spore vacuoles may take part in the process.

Biology of Ergot.*—Rob. Stäger publishes a continuation of his studies on *Claviceps purpurea*. He finds that, though the sclerotia lie 4 to 6 months in the soil without germination, growth can be hastened by more favourable conditions of moisture and warmth. From the ascospores produced on sclerotia collected from *Festuca arundinacea*, he infected *Anthoxanthum odoratum* and *Melica nutans* successfully, the latter especially so. Later the infection experiments were extended to *Poa alpina* and *Bromus erectus*, in both these cases unsuccessfully. Other grasses were also infected, and Stäger finally established that he was dealing with typical *Claviceps purpurea*. He next experimented with *Claviceps* taken from *Poa annua*, and as a result proved that he was dealing with a biological species of *C. purpurea*. Further experiments are to be undertaken.

Gooseberry Mildew in Russia.†—R. Regel communicates the history of the first appearance of the American mildew in central Russia. It was seen first at Winnitzy, in Podolia, in 1895, in the garden of a man who was keenly interested in American fruit trees, which he had imported in considerable numbers. Along with the fruit trees he had also brought over the disease.

Mycological Notes from South America and Spain.‡—F. W. Neger records two species of Chytridiaceæ found by him in Chili : *Synchytrium Taraxaci*, in which the sporangia are rather larger than in the European forms, and *Syn. aureum*, on a species of *Plantago*. From Patagonia he records *Urophlyctis major*, on *Rumex maritimus*, hitherto found only sparsely in Germany. Two species of Erysiphaceæ, also from Patagonia, were diagnosed, one, *Sphærotheca spiralis*, new to science. Notes are added on several fungi from southern Spain, notably *Antennaria ericophila*, which, at a slight elevation, forms little pustules on the leaf, which, as a rule, contain perithecia as well as the conidial form. At a higher elevation, the vegetative mycelium grows so luxuriantly that balls are formed the size of a hen's egg or larger. These are either formed of sterile mycelium or with conidiophores only. Perithecia never occur at the higher altitude. Changed conditions of temperature and humidity account for the wide differences in the development of the

* Centralbl. Bakt., xx. (1908) pp. 272–9.
† Gartenflora, lvi. (1907) pp. 357–8.
‡ Centralbl. Bakt. xx. (1907) pp. 92–5.

fungus. It is always superficial, but damages the host-plant by excluding air and light.

Morphology of Aspergillus herbariorum.*—H. C. L. Fraser and H. S. Chambers have made a cytological study of the development of this fungus. All the cells are multinucleate as well as the ascospores and conidia; the latter contain about four nuclei at maturity. The archicarp arises as a narrow branch from the mycelium; it is at first aseptate, but cell-walls soon appear and cut off a septate stalk, a unicellular trichogyne and a unicellular ascogonium. The antheridium arises separately, and consists of a long stalk, at the apex of which is a small antheridial cell. It either fuses with the tip of the trichogyne or degenerates before reaching this stage. It seems probable that such fusion sometimes takes place; at other times it is replaced by the fusion of ascogonial nuclei in pairs. The ascogonium then becomes septate, and each cell produces ascogenous hyphæ, from which arise the asci in which eight spores are formed. The authors suggest several new terms to explain the different forms of nuclear fusion other than the normal syngamy: viz. homoiogamy—a fusion of two sexual nuclei of the same kind; hylogamy—fusion of one sexual with one vegetative nucleus; and pseudogamy—fusion of two vegetative nuclei. In *Aspergillus* either normal syngamy or homoiogamy takes place. A comparison is made between *Aspergillus* and other Ascomycetes, and the relationship of the group to the Uredineæ and the red algæ is indicated. *Aspergillus* is regarded as a primitive ascomycetous type, from which most others can be derived.

Conidial Development of Xylaria Hypoxylon.†—F. Guéguen kept this fungus in a moist chamber, and made observations on the formation of conidia, etc. He found that the stromata were positively phototropic; the elongation of the clubs and the production of conidia took place only under the influence of light. The basidia produce at their tips a large number of conidia, which do not germinate until they have attained complete maturity.

The region of growth of the "club" is subterminal a few millimetres below the tip; the basidia that bear the conidia rise from medullary hyphæ.

Remarkable Fungus Forms.—H. and P. Sydow ‡ describe a new species, *Xylaria obesa*, 15 cm. high and 10 cm. thick, which grew on wood in Eastern Africa. The stroma is at first smooth and with a yellow covering, the fruiting portion being distinguished by wrinkles and folds.

T. Petch § publishes an account of a *Sclerotium* found in termite nests, which had already been seen and described by Berkley as *Sclerotium stipitatum*. Petch was able to develop from these the ascus form of *Xylaria nigripes*. When a comb from the nests is kept under a bell-jar, it produces a conidial *Xylaria*. T. Petch concludes that this fungus was continually kept in check by the ants as a weed. When the nest is deserted in wet weather, *Xylaria* grows from the comb; if

* Ann. Mycol., v. (1907) pp. 419–31 (2 pls.).
† Bull. Soc. Mycol. France, xxiii. (1907) pp. 186–217 (2 pls.).
‡ Ann. Mycol., v. (1907) p. 400. § Tom. cit., pp. 401–3.

in dry weather, a *Sclerotium* is formed, *Sc. stipitatum*. Large sclerotia give rise to a perithecial *Xylaria*; the smaller sclerotia produce only conidial forms.

Study of Penicillium.*—Carl Weidemann sums up the work of various writers on this genus, and gives a sketch of the species examined and established by them. He lays special stress on the necessity of always recording the substratum on which the fungus has been growing, and also in culture experiments he considers it advisable to test the development on a variety of substances. He has followed this plan in his examination of seven species, *P. olivaceum*, *P. italicum*, *P. camemberti*, *P. roqueforti*, *P. Juglandis*, *P. Muscæ*, and *P. kiliense*. The last three are new species discovered by him on various substances; several of the others, as the names indicate, grew on cheese. He gives in each case a microscopic description of the species and adds the observations made on the cultures on gelatin, rice, sugar, milk, tannin, etc. The species are all illustrated. No ascomycetous fruit was found for any of the species.

Hyphomycetes.†—The fascicle just issued by G. Lindau deals with some of the largest genera of Hyphomycetes, *Helminthosporium*, *Brachysporium*, and *Cercospora*. The latter is parasitic on leaves, stalks, etc., and is often the cause of considerable damage to cultivated plants. A large number of species are described, and the genera are illustrated, sometimes by drawings of several species.

Development of Endophyllum Euphorbiæ-silvaticæ.‡—W. Müller describes this fungus, which lives in the stems and leaves of *Euphorbia amygdaloides*, and which takes two years for its full development. The rhizome buds become infected by the spores, the fungus remains dormant during the winter and grows in spring with the growth of the host-plant. In April and May pycnidia and sometimes æcidia are formed. After a second winter the mycelium attacks the meristem of the plant and causes the characteristic deformations. Pycnidia are again formed and teleutospores in cup-like sori on the under side of the leaves. The growth of the plant is seriously retarded, and flowering is hindered or entirely prevented.

Uredineæ.—Ed. Fischer § reports on *Gymnosporangium* in Switzerland. He distinguishes two classes; those in which the teleutospores grow on *Juniperus Sabina*, and those with teleutospores on *J. communis*. Five species have been distinguished, but Fischer thinks there are probably more than that number included in the group. His inoculation experiments proved this in more than one instance.

F. Urech ‖ reported a case of *Puccinia Caricis* having been found growing on a nettle stalk, forming a sorus, about 10 cm. in length, and causing a bending of the stalk. Though diligent search was made, no second instance of its occurrence was found.

* Centralbl. Bakt., xix. (1907) pp. 675–90, 755–69 (8 figs.).
† Rabenhorst's Kryptogamen Flora, i. abt. 9, lief 106 (Leipzig, 1907) pp. 49–112.
‡ Centralbl. Bakt., xx. (1908) pp. 333–41.
§ Arch. Sci. Phys. Nat., xxiv. (1897) pp. 494–6.
‖ Tom. cit., pp. 497–8.

Eriksson * writes on the significance of the Barberry in the propagation of wheat rust. There are seven different biological forms of *Puccinia graminis* in which the æcidium is to be found on the Barberry, but the æcidiospores will only reinfect the grass from which it originated in the first instance—all other crops are safe from that particular rust. Eriksson notes also that æcidiospores from the Barberry do not germinate easily, and he concludes from his study of the subject that it is quite safe to cultivate the Barberry, as it plays a comparatively small part in rust propagation.

J. C. Arthur † publishes the results of his series of culture experiments for 1907. In the first 17 recorded, no results were obtained. A second list of 22 includes those species which had been already experimented with, but in which additional knowledge was gained as to germination, etc. He records further 8 species of Uredineæ that were successfully cultivated for the first time.

W. Müller ‡ has undertaken an exhaustive study of *Melampsora* on Euphorbiaceæ. He has established 7 biological species in *M. helioscopiæ*. There is one that grows on *Euphorbia helioscopia* alone, the other forms are confined to different species of *Euphorbia*. The author has also made observations on the time of teleutospore germination, the duration of the period of incubation, etc.

Walther Krieg § publishes the results of an extended series of similar experiments with the *Uromyces* that form their æcidia on species of *Ranunculus*. He has established some new biological species, and fixed the limits of growth of the many forms dealt with.

Sphaceolotheca on Polygonum.‖—De Bary separated this genus from *Ustilago* because the hyphæ were not entirely converted into spores as in the latter genus. Four species are now known : *Sph. Hydropiperis* on *Polygonum Hydropiper* ; *Sph. borealis* on *P. Bistortæ* ; and *Sph. Polygoni-vivipari*, which were included by De Bary under the first-mentioned. H. C. Schellenberg in the paper before us describes the appearance and development of all of these, and gives the reasons for separating them. The fourth species, *Sph. alpina* sp. n., on *P. alpinum*, is also carefully described ; in it, the spore layer is found between the leaf-sheaths and the flower-stalks, and infection probably takes place during the development of the flower. The so-called columella of this fungus is composed of sterile hyphæ that surround the vascular bundle of the host ; similar hyphæ clothe the wall of the attached capsules.

Growth of Woody Fungi.¶—L. Mangin has made observations on the growth of some of the larger Polyporeæ. He calculated that a large fructification of *Ungulina fomentaria* measuring 3·50 m. in circumference and 20 cm. thick, had grown entirely in not more than 11 months. Similar observations had been made on *U. betulina*, of which the growth is similarly rapid ; a few months only are necessary for the growth of woody fungi 40 cm. and more in width.

* Illustr. Landw. Zeit., No. 41 (1907). See also Centralbl. Bakt., xx. (1907) pp. 188–9. † Journ. Mycol. xiv. (1908) pp. 7–26.

‡ Centralbl. Bakt., xix. (1907) pp. 441–60.

§ Tom. cit., pp. 697–714 and 771–88.

‖ Ann. Mycol., v. (1907) pp. 385–95 (1 pl.).

¶ Bull. Soc. Mycol. France, xxiii. (1907) pp. 155–6 (1 pl.).

Wood-destroying Fungi.*—Richard Falck has made a biological study of those fungi that are destructive to living trees, to felled trees, or to worked wood. He enumerates the different fungi of these groups, each showing a different type of mycelium. In all of these, there is an internal mycelium. In a fourth series, which embraces *Merulius* (dry rot), some Polyporeæ, etc., a surface mycelium is formed. These are compared and the rate of growth of the different hyphæ noted and tabulated. It is constant for each species, and depends on the dimensions of the mycelium, a purely physical consideration.

Polyporaceæ.† — The North American flora is gradually being published, and W. A. Murrill has charge of the Polyporaceæ. He treats these according to his own rearrangements of genera and species. He recognises 4 tribes : Porieæ, with 8 genera ; Polyporeæ, with 47 genera ; Fomiteæ, with 10 genera ; and Dædaleæ with 5 genera. The new genera are *Fuscoporia*, *Fuscoporella*, *Fomitiporia*, *Fomitiporella*, *Tinctoporia*, *Melanoporella*, and *Melanoporia*. A very large number of the species described are new to science.

New Localities for Amanita cæsarea.‡—This edible agaric is very common in Italy and southern France, but less frequently met with further north. M. W. Russell publishes a list of places where it has been gathered : Fontainebleau, Versailles, etc., with some new localities also in the north. The fungus is usually found on sandy soils.

Diseases of Plants. §—F. D. Kern gives an account of the occurrence of *Sclerotinia* in the State of Indiana. The fungus in the conidial stage is known as *Monilia fructigena*, and causes rotting of certain stone fruits. Peaches or plums finally shrivel up and become mummified —on these dried fruits the ascospore-form *Sclerotinia fructigena* is produced. It is rarely found, as it takes two years to develop, and occurs on fruits that have been covered over by humus for some time.

The same author ‖ gives a list of diseases that have been identified in the State of Indiana for some years past. These are classified under root-diseases, affecting absorption of food materials ; stem-diseases, affecting ascent of sap and transpiration ; those on wood, interfering with absorption and transfer of water ; those on bark, affecting transpiration only ; and on leaf, affecting transpiration and assimilation.

T. Petch ¶ describes a disease of the tea-plants in Ceylon, caused by the fungus *Massaria theicola* sp. n. It attacks the stem.

E. J. Butler ** also describes diseases from the East Indies. On *Areca Catechu*, a species of *Phytophthora* attacks and destroys the upper parts of the tree. Another fungus, probably a Basidiomycete, destroys the roots ; and on other palms he found a *Pythium*, which lived on and destroyed the sheathing leaves of the crown.

* Hausschwammforschungen, Jena (1907) pp. 53–154. See also Centralbl. Bakt., xx. (1908) pp. 348–51.

† North American Flora, ix. pt. 1 (1907) 72 pp. New York Bot. Gard.

‡ Bull. Soc. Bot. France, liv. (1907) pp. 25–6.

§ Proc. Ind. Acad. Sci. (1906) pp. 134–6.

‖ Tom. cit., pp. 129–33 (1 fig.).

¶ Circ. and Agric. Journ. Roy. Bot. Gard. Ceylon, iv. (1907) pp. 21–30 (1 fig.). See also Ann. Mycol. v. (1907) p. 445.

** Agric. Journ. India, i. (1906) 12 pp. (2 pls.). See also Ann. Mycol., v. (1907) pp. 450–1.

The same writer, along with H. M. Lefroy, * undertook experiments with *Mucor exitiosus* on insects of the locust tribe, to see if the fungus would attack these and so aid in reducing their numbers. The experiments all proved the futility of the attempt. The fungus did no harm even when introduced as a wound-parasite into the bodies of the locusts.

W. Harris † has published a paper on vine culture, and adds an account of the fungoid diseases which attack it. These are *Sphaceloma ampelinum*, *Læstadia Bidwelli*, *Peronospora viticola*, *Uncinula spiralis*, *Oidium Tuckeri*, and *Glœosporium fructigenum*. Various remedies are suggested for these diseases.

P. Hariot ‡ describes an *Oidium* of the genus *Microsphæra* that infested an oak. Its development coincided with a prolonged time of wind from the north-east.

A. Maublanc § gives a study of the fungi that infest Conifers, with a more detailed description of *Fusicoccum abietinum*, which attacks the branches and kills the tips, or sometimes fastens on branches several years old with equally serious results. The diseased portion is easily recognised by the coloration of the affected part, which becomes a blackish-brown.

Economic Mycology.‖—An account of various fungous diseases of fruit trees which have done serious damage in the Kent orchards has been published by E. S. Salmon. These are chiefly cherry leaf scorch (*Gnomonia erythrostoma*) and apple scab or black-spot (*Fusicladium dendriticum*). Both of these have done great harm. Salmon recommends spraying with Bordeaux mixture as an effective and proved remedy. He notes also the first appearance in England of *Urophlyctis Alfalfæ* on lucerne plants. It forms galls on the crown of the plant, and completely destroys it. He also redescribes the American gooseberry mildew (*Sphærotheca mors-uvæ*), confined so far to a few localities in the Midlands, but quite certain to spread rapidly if measures are not adopted to stamp it out. In a second paper ¶ he describes a serious disease of potatoes that has appeared in England within the last ten years, and forms black scabs on the tubers. It is due to a chytridiaceous fungus, *Chrysophlyctis endobiotica*, which, as Salmon points out, has erroneously been described by several writers as *Œdomyces leproides*, a totally different fungus. Growers are specially warned against diseased seed. The fungus has appeared so far chiefly in Scotland and the north of England, where whole crops have been rendered useless.

Pathogenic Spotting of Vine-shoots.**—Emil Molz has examined the spots on the young stems of the vine, and finds they are due to a

* Agric. Res. Inst. Pusa, Bull. No. 5 (1907) 5 pp. See also Ann. Mycol., v. (1907) p. 451.

† Bull. Jamaica Dept. Agric., v. (1907) pp. 1–26. See also Bot. Centralbl., cv. (1907) pp. 670–1.

‡ Bull. Soc. Mycol. France, xxiii. (1907) pp. 157–9.

§ Tom. cit., pp. 160–73 (6 figs.).

‖ Report S.E. Agric. Coll. Wye., 1907, 58 pp. (26 pls.).

¶ Leaflet, Black-scab or Warty Disease of Potatoes, S.E. Agric. Coll. Wye., 6 pp. (6 pls.).

** Centralbl. Bakt., xx. (1908) pp. 261-72 (2 pls. and 13 figs.).

variety of causes. Often they resemble lenticels, but in section they may be distinguished by the absence of the loose cells that fill the cavity of the lenticel. Instead of these there is a massing of dead brown cells cut off by a cork-layer, which mark the position of old lenticels that have lost their function. Other spots mark the place of glands that have now become brown and withered. The fungus, *Uncinula necator*, causes spots to form round the place where its haustoria have pierced the epidermis. Fungicides, such as Bordeaux mixture, and hail, also cause damage to the young shoots, and the fungus *Sphaceloma ampelinum* gives rise to extended black patches.

Parasitic Fungi from Java.*—S. H. Koorders gives the results of prolonged and careful culture experiments with *Glœosporium elasticæ*, *Colletotrichum Ficus*, and their ascomycetous form, *Neozimmermannia elasticæ* sp. n. They all grow on *Ficus elastica*, causing sometimes considerable damage, though never entirely destroying the host. In addition to these two forms of fungi imperfecti, various other growth-forms were identified belonging to the same life-cycle, mostly conidial forms that were produced in the cultures, or that grew saprophytically on decaying vegetation. All the different stages are described and figured. The author has studied another series of fungi on the same host, a number of them being new species, and the following genera also new : *Neohenningsia* (Aspergillaceæ), *Wentiomyces* (Perisporiaceæ), *Lindauomyces* (Stilbaceæ), *Wiesneriomyces*, and *Acrotheciella* (Tuberculariaceæ).

Colour Reactions in Russula and Lactarius.†—I. Arnould and A. Goris, following the example of lichenologists and of Boudier for the Ascomycetes, have employed a chemical solution as a means of distinguishing between different species. The substance *sulfovanilique* (water 2 parts, sulphuric acid 2 parts, vanilin $\frac{1}{4}$ gramme) had been used by Ronceray to test certain lichens for the presence of orcin. On the application of the reagent the tissues of most of the larger fungi tinge rose of varying shades. In certain species of *Lactarius* and *Russula*, the tissue turns rose, and the cystidia and laticiferous cells blue. *Russulæ* that are very acrid turn rose and blue. *Russula rosea* becomes entirely rose-coloured, and *R. vesca* and *R. lilacea* give the same reaction ; in *R. lepida* the hymenial layer becomes rose-violet. *R. delica* has numerous cystidia and laticiferous cells, which colour blue, while in *R. cyanoxantha* only the tips of the cystidia take the blue colour. Similar variations of colour are noted in *Lactarii*. Further tests will be made in a future season.

Assimilation of Free Nitrogen by Fungi.‡—Hermann Froehlich selected four Hyphomycetes for experiment, *Macrosporium commune*, *Alternaria tenuis*, *Cladosporium herbarum*, and *Hormodendron cladosporioides*. Incidentally, he established the autonomy of the last two species. All of these are saprophytes, and live on plant remains. They

* Verh. k. Akad. Wet. Amsterdam, xiii. No. 4 (1907) iv. and 264 pp. (12 pls. and 61 figs.)

† Bull. Soc. Mycol. France, xxiii. (1907) pp. 174–8. See also Comptes Rendus, cxlv. (1907) pp. 1199–1200.

‡ Jahrb. Wiss. Bot., xlv. (1907) pp. 256–302 (3 figs.).

are all aerobic and require oxygen for their development; no fermentation was produced in any of the cultures. Froehlich established the assimilation of free nitrogen in all of these fungi: it was highest in *Macrosporium commune*, lowest in *Hormodendron*. The combined nitrogen is thus made available for the use of chlorophyll plants. He also proved in a series of cultures what has been long surmised, that *Penicillium glaucum* and *Aspergillus niger* also assimilate free nitrogen from the atmosphere.

Chalk-disease of Bread.*—A sample of bread that had been left wrapped in parchment for some time was found to have developed a growth of a white chalky fungus. P. Lindner examined it and found it to be a new species, *Endomyces fibuliger*. It has the power of forming hat-shaped spores and can ferment various sugars, thus resembling *Willia* yeasts; but it does not give a yeast generation free from mycelia in fermenting liquids.

Fermentation Fungi.†—G. Ritter has proved that a spherical yeast may be imitated by cultivating *Mucor racemosus* in a nutrient solution; if the yeast-cells are placed in solution that contains no acid, mycelia are again formed.

Fungus-culture of Wood-boring Beetles.‡—F. W. Neger has carried on an investigation, begun by H. G. Hubbard, as to the fungus-food and fungus-culture of certain ambrosia beetles. In the passages formed in the wood by the beetles the fungus growth called ambrosia is constantly found. Neger tried to grow these fungoid bodies, but they invariably died off without further development. He established, however, that the fungus was brought into the passages by the beetles, and that the ambrosia fungus is one that infects pine-needles, probably a *Ceratostomella*. He found, further, that very frequently *Graphium*—the conidial form of *Ceratostomella*—grew abundantly in the passages. The beetles do not purposely carry in fungus spores, as do the ants, but the conidia cling to their bodies and are carried with them to any new wood that is attacked by them.

Bergamesco, G.—**Clitocybe Pelletieri.**
[A new species of Agaric from Italy.]
Nuovo. Giorn. Bot. Ital., xiv. (1907) pp. 527–8.

Bubak, Fr.—**Adatok Magyarország gombaflórájahoz.** (Contribution to the fungus flora of Hungary.)
[A number of new species have been found and described, especially among the Sphæropsideæ.] *Novenytani Közlemények* (1907) 42 pp.
See also *Ann. Mycol.*, v. (1907) pp. 439–40.

Henneberg, W.—**Ein Beitrag zur Bedeutung von Gips, Kohlensaurem Kalk und Soda für die Hefe.** (The significance of gypsum, carbonate of lime and soda, in the culture of yeast.)
[Yeast-cells die off where there is a lack of alkali.]
Centralbl. Bakt., xx. (1908) pp. 225–9.

* Wochensch. Brau., xxiv. (1907) pp. 469–74. See also Journ. Inst. Brewing, xiii. (1907) pp. 735–6.

† Ber. Deutsch. Bot. Gesell., xxv. (1907) p. 25. See also Journ. Inst. Brewing, vii. (1907) p. 733.

‡ Centralbl. Bakt., xx. (1908) pp. 279–82.

HÖHNEL, FR. VON—**Mykologisches.**
[Notes on various species of fungi, *Leptosphæria modesta* and *Cladosterigma fusisporum*, the latter one of the Dacryomycetineæ.]
Oesterr. Bot. Zeitschr., lvii. (1907) pp. 321–4.
See also *Ann. Mycol.*, v. (1907) p. 440–1.

JAAP, O.—**Weitere Beiträge zur Pilzflora der nordfriesischen Inseln.** (Further contributions to the fungus flora of the North Friesian Islands.)
[Several new species are described, and a large number listed.]
Schrift. Nat. Ver. Schlesw.-Holst. xiv. (1907) pp. 15–33.
See also *Ann. Mycol.*, v. (1907) p. 44.

KELLERMAN, W. A.—**Rehm's First Report on Guatemalan Ascomycetæ.**
[A few species are new, the others are determined.]
Journ. Mycol., xiv. (1908) pp. 3–7.

KUSANO, S.—**A New Species of Taphrina on Acer.**
[Four species are already known: the author describes a fifth, *T. nikkoensis*.]
Bot. Mag. Tokio, xxi. (1907) pp. 65–7 (1 fig.).
See also *Ann. Mycol.*, v. (1907) p. 441.

MIEHE, H.—**Thermoïdium sulfureum g. et. sp. n.**
[A new heat-fungus, isolated from self-heating plant remains; sulphur coloured; spores produced from cells of the hyphæ.]
Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 510–15 (6 figs.).

MORGAN, A. P.—**North American Species of Agaricaceæ, the Melanosporæ.**
[Seventeen species are described.] *Journ. Mycol.*, xiv. (1908) pp. 27–32.

OERTEL, G.—**Phoma Kuhniana sp. n.**
[The fungus was found on runners of cultivated *Viola odorata*; it has minute perithecia and minute spores.] *Ann. Mycol.*, v. (1907) p. 431.

PECK, C. H.—**New Species of Fungi.**
[Six species of Basidiomycetes.] *Journ. Mycol.*, xiv. (1908) pp. 1–3.

PETCH, T.—**Note on Ustilago Treubii Solms.**
[The writer notes the frequent occurrence of this gall-forming *Ustilago* in Ceylon. He adds measurements to the original diagnosis.]
Ann. Mycol., v. (1907) p. 403.

RYTZ, W.—**Beiträge zur Kenntnis der Pilzflora des Kienthales.** (Contributions to the fungus flora of the Kien Valley (Bernese Oberland).
[A special study was made of Chytridiaceæ and Uredineæ, and a number of new forms were determined.] *Mitth. Nat. Ges. Bern* (1907) p. 168.
See also *Bot. Centralbl.*, cv. (1907) p. 602.

SARTORY & DEMANCHE—**Etude d'une levure (Cryptococcus Rogerii sp. n.).**
[Study of a pathogenic yeast.]
Bull. Soc. Mycol. France, xxiii. (1907) pp. 179–85.

STRASZER, P. PIUS—**Vierter Nachtrag zur Pilzflora des Sonntagberges.** (Fourth contribution to the fungus flora of the Sonntagberg, N. Austria.)
[This completes the list of 1348 species.]
Verh. k.k. Zool. Bot. Ges. Wien, lvii. (1907) pp. 299–340.

SYDOW—**Mycotheca Germanica, Fasc. xii.–xiii. (Nos. 551–650).**
[Several new species are included in the list, and diagnoses are given of these and of several others, with explanatory notes.]
Ann. Mycol., v. (1907) pp. 395–99.

VILL, A.—**Fungi bavarici exsiccati.** (Bavarian fungi, 8th cent.)
[This is a continuation of Allescher and Schnabl's Exsiccati, chiefly microforms.] Gerolshofen (1904).
See also *Bot. Centralbl.*, cv. (1907) pp. 664–5.

Lichens.

(By A. Lorrain Smith, F.L.S.)

Text-book of Lichens.* —A. Zahlbrückner has just issued the last fascicle dealing with lichens in the *Pflanzenfamilien*. It concludes the Ascolichenes, and gives an account of the Hymenolichenes. The latter include only the three genera *Cora*, *Corella* and *Dictyonema*, all of these containing only tropical or subtropical species in which the symbiont is a cyanophyceous alga, and the fructification that of a Basidiomycete. An index of the genera completes the volume.

Noteworthy Lichens.†—E. Senft has examined a peculiar growth found by A. Zahlbrückner on the thallus of *Physma dalmaticum*. It arose either intercalary on hyphæ of the thallus or terminal on these hyphæ. There was no cellulose reaction, and the author considered it to be probably a change in the hyphæ due to an enzyme, whereby they were rendered mucilaginous.

Dispersal of Lichens.‡—P. Beckman has considered the case of those crustaceous rock lichens that have neither soredia nor hymenial gonidia, such as *Gasparrinia murorum*, *Lecanora sordida*, *Hæmatomma ventosum*, etc. The spores must be chief agents in the spread of these forms, but the mode of growth of the thallus must also play a part; the areolæ into which they are divided tend to become further apart, and in time, by weather-action, to become loosened from the substratum and carried about by the wind. All these scattered areolæ represent one individual plant. In the case of several species of *Rhizocarpon* with a creeping and spreading hypothallus, the spores start new individuals at different centres which tend to meet each other, thus presenting a decussated thallus. The thallus of these forms is also often cracked, but the cracking serves probably only for aeration and not for dispersal.

Lichen Constituents.§—O. Hesse has examined the chemical constituents of a large series of lichens, a continuation of previous work in the same field. He found a new acid in *Usnea articulata*, which he designates articulat-acid, and two in *Ramalina armorica*, armorica-acid and armor-acid. He found also new substances in the brightly-coloured *Tornabenia* (*Physcia*) *chrysophthalma* and *T. flavicans*. Other lichens yielded various acids already known.

Brown Parmeliæ.‖—F. Rosendahl has brought his anatomical study of the group to bear on their systematic position, and at the end of his

* Engler and Prantl's Nat. Pflanzenfamilien, Leipzig: W. Engelmann, i. Abt. 1, lief. 230 (1907) pp. 193–249 (24 figs.).

† SB. k. Akad. Wiss. Wien Math.-Nat. Kl., cxvi., Abt. 1 (1907) pp. 429–38 (1 pl.). See also Bot. Centralbl., cv. (1907) p. 630.

‡ Engler, Bot. Jahrb., xxxviii. (1907) Beibl., pp. 1–72 (10 figs.). See also Ann. Mycol., v. (1907) pp. 459-60.

§ Journ. prakt. Chemie, Neue Folge, lxxvi. (1907) pp. 1–57. See also Bot. Centralbl., cv. (1907) pp. 628–9.

‖ Nova Acta Abh. k. Leop.-Car. Deutsch. Akad. Nat., lxxxvii. (1907) pp. 403–59 (4 pls.).

paper he draws up three different tables of arrangement, each embodying the results of his observations and discoveries. He divides the series of the lichens broadly into two classes: those with a many-layered cortex, and those with a narrow cortex of about two cells. In the many-layered cortex he distinguishes an inner layer of living cells and an outer of crushed and dead cells. In each species he has given details of the structure, the presence or absence of isidia, soredia, trichomes, fat-cells, and rhizoids, and he describes the developments of the ascogonia and spermogonia. Calcium hypochlorite has been found useful in differentiating species; some tinge red when it is applied, others show no change of colour. The red coloration is usually due to the presence of lecanor-acid. The paper is illustrated by microscopic drawings and by photographic reproductions of nearly all the species discussed.

HUE, A.—**Trois Lichens Nouveaux.** (Three new lichens.)
[Two species of *Stereocaulon* and one *Solorina* from the East (Japan and Java).]
Bull. Soc. Bot. France, liv. (1907) pp. 414–21 (2 figs.).

,, **Heppiearum ultimæ e familia Collemacearum tribubus nonnullas species morphologice et anatomice elaboravit.** (Morphological and anatomical study of some species of *Heppia*, a "tribe" of Collemaceæ.)
[A description of the genus *Heppia*, with which the author unites several other genera.]
Mem. Sc. Nation. Sci. Nat. Math., xxxvi. (1907), 44 pp.
See also *Ann. Mycol.* v. (1907) pp. 460–1.

JATTA, ANTONIO.—**I Licheni dell' Erbario Tornabene.** (The lichens of the Tornabene herbarium.)
[A list of 86 species or varieties collected in Sicily.]
Nuovo Giorn. Bot. Ital. xiv. (1907) pp. 529–38.

LESDAIN, BOULY DE.—**Notes Lichenologiques.** (Lichenological notes.)
[A number of new varieties are diagnosed, and notes published on various species.] *Bull. Soc. Bot. France*, liv. (1907) pp. 442–6.

NILSON, BERGER.—**Die Flechten vegetation des Sarekgebirges.** (Lichen flora of the Sarek Mountains.)
[288 species were determined, 5 of them new to science. The author makes a new genus *Parmularia* for the section *Placodium* of the genus *Lecanora*.] *Nat.-Wiss. Unters-Sarekgebirg. in Schwedisch-Lappland* iii. *Botanik* (1907) pp. 1–70.
See also *Ann. Mycol.*, v. (1907) p. 461.

STEINER, J.—**Lichenes Austro-africani.** (Lichens of Southern Africa.)
[Lichens collected by H. A. Junod and Dultre. Several new species are determined and diagnosed.]
Bull. Herb. Boiss., ser. 2, vii. (1907), pp, 637–46.
See also *Ann. Mycol.*, v. (1907) p. 462.

,, ,, **Ueber Buellia saxorum und verwandte Flechtenarten.** (On *Buellia saxorum* and allied lichen species.)
Verh. k.k. Zool. Bot. Ges. Wien., lvii. (1907) pp. 340–71.

Mycetozoa.

(By A. LORRAIN SMITH, F.L.S.)

Influence of Bacteria on the Culture of Myxomycetes.*—Ernest Pinoy concludes his paper on this subject. The action of bacteria on

* Ann. Inst. Pasteur, xxi. (1907) pp. 686–700.

the Acrasieæ has been already recorded. He now studies them in connection with the development of true Mycetozoa, *Didymium difforme* and *Didymium diffusum*. In nature the sporangia of these Myxomycetes always contain numerous impurities, including a large series of Bacteria. He proved by his cultures that the spores would not develop without the accompanying bacterium, *Bacillus luteus* Flügge. The author draws attention to the formation of cysts in the sporangium; they are larger than the spores and without ornamentation on the surface. These can persist for several years; a sclerotium is but an assemblage of cysts. He verified the observation that from the spores of *D. effusum* and *Spumaria alba* zoospores are only formed in liquid media; on a solid substratum the spores give rise to myxamœbæ.

Further experiments were made with *Plasmodiophora Brassicæ*. Pinoy describes his methods of preparing and obtaining pure cultures. He finds that bacteria always accompany the spores. Their role in the host-plant seems to be to destroy the tissue and secure the escape of the *Plasmodiophora*, but they exercise also some extracellular influence, as cultures that contained no bacteria showed no signs of growth. It is evident that the bacteria are introduced into the roots by the *Plasmodiophora*, and then follows a true symbiosis between the two organisms.

STURGIS, W. C.—**The Myxomycetes of Colorado.**
[About 100 species have been published, with descriptive notes; one new species and two varieties are included.]
Colorado Coll. Publ. Gen. Ser. 30, Sci. Ser. xii. (1907) No. 1, pp. 1–43.
See also *Ann. Mycol.*, v. (1907) p. 445.

Schizophyta.

Schizomycetes.

Sporulation of the Bacillus Rheumaticus.*—G. Rosenthal, from observations on two varieties of the bacillus of Achalme, viz. *B. perfringens* and *B. rheumaticus*, finds that when subcultures of these two organisms in albumen water are plunged into boiling water for two minutes they all give a positive growth on incubation, but if exposed for four minutes the cultures of *B. rheumaticus* are apparently killed, whereas those of *B. perfringens* give a late but abundant growth with irregular forms; the same results were obtained when the cultures were boiled for half a minute, showing that the two varieties have unequal resistance to heat. Cover-slip preparations showed, in the case of the *perfringens* cultures, typical sporulation; but with *B. rheumaticus*, besides some bacilli, there were a number of bodies about the size of *Staphylococcus aureus*, that stained by Gram's method, resisted badly the decoloration by acids when stained by Ziehl's method, and when unstained were slightly refringent.

Bacteriology of Tropical Abscess of the Liver.†—A. Gilbert and A. Lipmann have examined pus from two cases of tropical abscess of the liver. In the first case the pus was slightly odorous and of a brown colour, and cover-slip preparations showed a number of cocci and rods

* C.R. Soc. Biol. Paris, lxiii. (1907) p. 577. † Tom. cit., p. 565.

that stained, and a few bacilli that did not stain by Gram's method; aerobic cultures gave only *Staphylococcus aureus* having no pathogenic action on rabbits, but from cultures in the depth of agar were isolated *B. perfringens*, *Enterococcus*, *B. ramosus* and *B. fragilis*. In the second case the pus was also slightly odorous and brown in colour, and cover-slip preparations showed a few cocci and a number of bacillary forms, none of which were stained by Gram's method. Ordinary broth and agar cultures gave no growth, but anaerobic cultures showed a small growth of *Enterococcus* and a large development of *B. funduliformis*, which probably masked the development of other germs. The authors consider that with more complete bacteriological examinations the number of non-microbial cases of hepatic abscess would be diminished.

Coli Group of Bacteria.*—A. Buck concludes from the results of his researches on this group of organisms that in the same bowel there may occur at the same time many varieties of *B. coli*. About 25 p.c. of all these bacteria were agglutinated by the serum of the same individual, or by other sera, in dilutions of 1 in 30. Strains of *B. coli* that are culturally alike may be separated by their serum reactions. A readily agglutinating strain will agglutinate at a higher dilution with a strange serum than with that of its own host. The agglutination of *B. coli* is not interfered with if the strange serum is from a typhoid patient.

Multiplying of Relapsing Spirochætes in the Body of the Bug.†
N. N. Klodnitzky has observed the development of Spirochætes of relapsing fever in the tissues of the bug. Using Giemsa's stain the author examined the morphology of the contents of normal and of infected insects. During the first 3 to 5 days after infection the preparations showed individuals with well marked spirals, but in later specimens there was an unusual development of threads felted together or arranged in skeins, or like twisted hair. These threads were usually stretched, and rarely wavy; they were also observed in hanging drops. Later specimens obtained about the 30th day after infection showed that these threads had broken up into rods of various forms and lengths.

Plant Tumour of Bacterial Origin.‡—E. F. Smith and C. O. Townsend have isolated a motile bacillus from a tumour or gall found on a cultivated daisy. The organism is aerobic, and grows on ordinary nutrient agar and potato, and also in broth, which becomes slightly clouded, and has a tenacious fibrous pellicle; it produces no gas within 12 days on sugar or alcoholic media; casein is separated from litmus milk, with the production of an alkaline reaction; it does not liquefy gelatin; a temperature of 25° C. is most favourable to the growth on agar or in broth; the bacillus has 1–3 polar flagella. Inoculation of roots, and young shoots and stems of healthy daisies, tobacco plants, tomatoes, potato, sugar beet, and peach trees, caused the formation of galls.

Flagella and Capsule of B. Anthracis.§—A. Hinterberger was never able to observe that *B. anthracis* possessed true flagella, but, by

* Centralbl. Bakt., 1te Abt. Orig., xiv. (1907) p. 577.
† Op. cit., xlv. (1907) p. 126. ‡ Op. cit., 2te Abt., xx. (1907) p. 89.
§ Op. cit., 1te Abt. Orig., xlv. (1907) p. 108.

treating with ammonia and staining with silver colloid, the author appears to have established the areas surrounding the bacilli as true capsules.

Micrococcus Esterificans.*—Beck describes this organism as resembling *Staphylococcus pyogenes aureus*, and producing a characteristic fruity aroma. The aromatic substance is insoluble in alcohol, but dissolves in ether, chloroform, and sulphide of carbon. Butter treated with broth cultures of the coccus, keeps fresh for about five days longer than ordinary butter made from the same cream. It is suggested that this organism might be useful in the manufacture of butter, by improving its taste and keeping property.

Bacillus Aterrinus Tschitensis.†—W. N. Klimenko has isolated from the air of his clinical laboratory, at Tschita, a bacillus that produces a brown pigment; it is an actively motile rod with rounded ends, resembling *B. mesentericus vulgaris*; it occurs most often singly, rarely in pairs, and sometimes forms threads: it has a single centrally-placed oval spore; it stains by ordinary analin dyes and by Gram's method, but is not acid-fast; it is a potential aerobe; the optimum temperature is 36°–40° C.

On agar the colonies appear after 16 to 20 hours, and by reflected light both superficial and deep colonies have a white colour with a lustreless wrinkled surface; but after 48 hours the deep colonies by transmitted light, and the superficial colonies by reflected light, have a dark brown colour; after the fourth day a production of brown pigment commences to diffuse into the medium around the superficial colonies. Pigment is also formed by colonies grown on gelatin, and the medium commences to liquefy after the third day, and on the surface of the liquefied gelatin there floats a pellicle which develops a brown-black pigment; growth on agar containing sugar or glycerin shows no formation of gas; pepton-broth is clouded, a pellicle being formed which develops a brown-black pigment; on potato the growth is at first dry and wrinkled, but later is thick and greasy, having the colour of café-au-lait, the colour of the potato itself being unaltered; milk is clotted, the coagulum being subsequently dissolved. The organism is not pathogenic. It closely resembles *B. mesentericus niger* and *B. lactis* Gorini.

Purple Bacteria.‡—H. Molisch has classified these organisms into two groups, viz. those that deposit sulphur granules in their bodies and those that do not. Each of these is again subdivided into two sub-groups or families, according as the cells are free or are associated, and these families comprise separate sub-families, depending on the form of the cell division, the property of swarming, and on the morphology of the cells. The author finds that the susceptibility of those bacteria to light extends to all the visible and invisible ultra red rays. On examining the giving off of oxygen under the influence of light, it was found that carbonic acid was not assimilated, so that the colouring matter of these organisms is not analogous to chlorophyll.

* Centralbl. Bakt., 2te Abt., xix. (1907) p. 594.
† Op. cit., 2te Abt., xx. (1907) p. 1. ‡ Op. cit., 2te Abt., xx. (1908) p. 289.

By extracting cultures with alcohol the author obtained a green colouring matter, "bacteriochlorin," which was quite distinct from chlorophyll, and gave an entirely different spectrum. By extracting the bacteria thus freed from bacteriochlorin with carbon disulphide, "bacteriopurpurin" was obtained. The combined spectra of these two colouring matters corresponded with the spectrum of the living bacteria.

Bacterium Mariense.*—W. N. Klimenko has isolated this bacillus from the spleen and blood of an apparently healthy guinea-pig. The round-ended rods, which are actively motile, and possess 8 to 12 peritrichal flagella, are usually single, sometimes in pairs, rarely forming threads; they stain by the ordinary dyes, but not by Gram's method, and are not acid-fast; metachromatic granules may occasionally be demonstrated. The organism is a potential anaerobe, but the best growth is obtained under aerobic conditions at 37° C. The colonies on gelatin resembles those of *B. coli* and *B. typhosus*, and the medium is not liquefied; on Conradi-Drigalski and on Endo's media, development resembles that of *B. typhosus*. In milk no change is apparent for the first six days, but it then becomes transparent and of a yellow-brown colour, with a deposit at the bottom of the tube, the reaction becoming more and more alkaline. Growth on potato is similar, but less vigorous than that of *B. coli*. This bacillus has no denitrifying properties, it produces no indol, and its growth on all media containing carbohydrates causes an alkaline reaction. It is pathogenic for white rats, white mice, rabbits, guinea pigs, and pigeons.

Nitrogen-fixing Bacteria.†—F. Löhnis and N. K. Pillar have examined the soil from rice fields on the Malabar coasts, near Trawankur, for the presence of nitrogen-fixing bacteria.

Tubes of soil extract + 0·5 p.c. K_2HPO_4 received respectively 1 p.c. mannite, 1 p.c. glucose, 1 p.c. tartaric acid, and were neutralised with soda; to one set of these tubes was added 1–2 p.c. of $C_a CO_3$, a controle set being free from chalk. All the tubes were then inoculated with the soil. The amount of nitrogen being measured before and twenty days after inoculation. In the mannite tubes with chalk the increase of nitrogen was 4·1 mg. per 100 cm., which was 0·86 mg. more than in the mannite tube without chalk. In the glucose tubes the nitrogen increase was 3·38 mg. and 0·56 mg. more than in the tubes containing chalk. In the tartaric solution tubes the increase of nitrogen was only 1·7 mg., and this was 0·14 mg. less than in the chalk containing tubes.

Microscopically Azotobacter was not observed, but besides several strains of *B. pneumoniæ*, *B. radiobacter*, *B. subtilis*, *B. oxalaticus*, *Micrococcus sulphureus*, *B. turcosum*, *B. chrisoglæa*, *B. lipsiense*, the author isolated two new species, *B. malabarensis* and *B. tartaricum*. *B. malabarensis* is a strong nitrogen fixer, especially in mannite solutions; it occurs as large, stout rods, with numerous flagella; it is

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) p. 481.
† Op. cit., 2te Abt., xix. (1907) p. 87.

slightly motile, stains by Gram's method, and forms spores; when grown on gelatin it liquefies the medium.

B. tartaricum is not a marked nitrogen fixer; it occurs as short rods, which are not motile, do not stain by Gram's method, do not form spores, and do not liquefy gelatin.

Cultural Differentiation of Capsulated Bacilli.*—V. K. Russ examined a number of capsulated bacilli belonging to the four groups of (1) *B. lactis aerogenes*, (2) *B. pneumoniæ*, (3) *B. mucosus ozœnæ*, (4) *B. scleromatis*, in respect to their production of acid and alkaline with carbohydrate media, and their reactions to coloured media of Endo's fuchsin, and Loeffler's green solution.

The carbohydrates used were dextrose, galactose, lævulose, lactose, maltose, saccharose, starch, arabinose, dextrin, mannite, dulcite, and erythrite. The tests showed that only *B. scleromatis* produced alkali, or had no action with lactose; only *B. ozœnæ* produced acid with erythrite; that *B. aerogenes* and *B. ozœnæ* both formed acid, whilst *B. friedländeri* and *B. scleromatis* both gave alkaline reaction, or had no effect with dulcite.

On Endo's lactose fuchsin agar, the *aerogenes* group behaved as the *coli* group, producing a deep red colour; the *B. friedländeri* and *B. scleromatis* behaved as *B. typhosus*, or had no effect, and with *B. ozœnæ* the medium was coloured pink.

The author gives a table of the results obtained with four solutions of Loeffler's green, and finds that though *B. lactis aerogenes* has very marked characters with these solutions, the test is not of practical use in differentiating the other three groups. The author also refers to other capsulated organisms not included in the above four groups, and shows in what way they are allied biologically according to the above tests. It appears that *B. capsulatus* of Pfeiffer, and *B. mucosus capsulatus* of Fasching, are both indentical with *B. lactis aerogenes*.

* Centralbl. Bakt., 1te Abt. Orig., xliv. (1907) p. 289.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

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

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

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

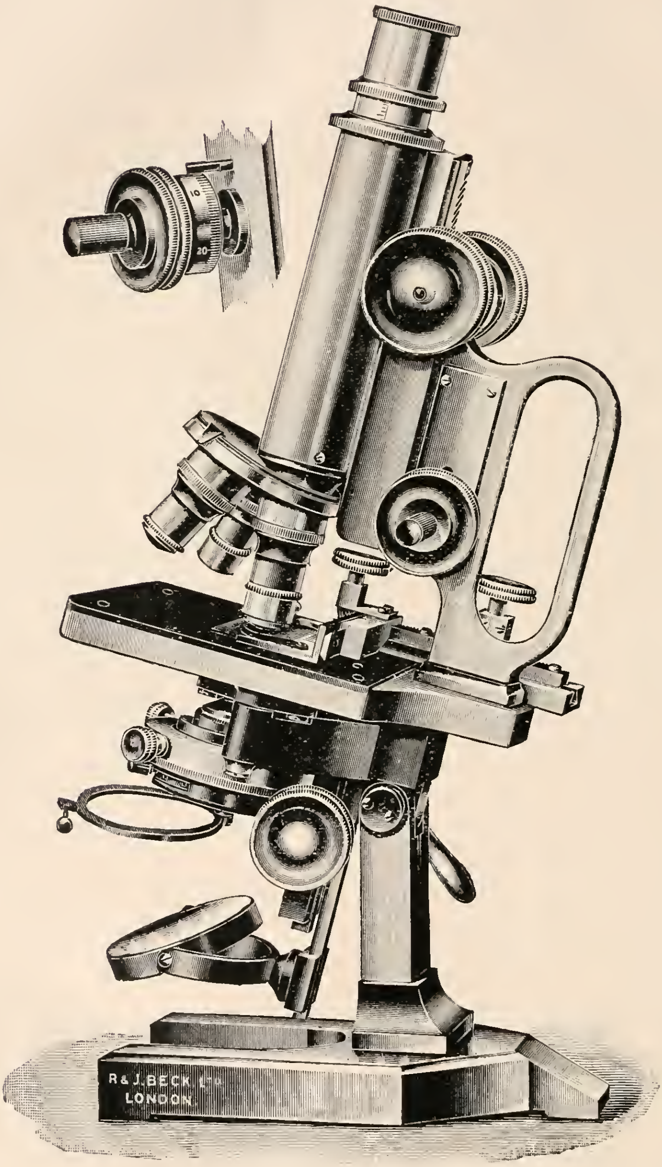


Fig. 33.

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

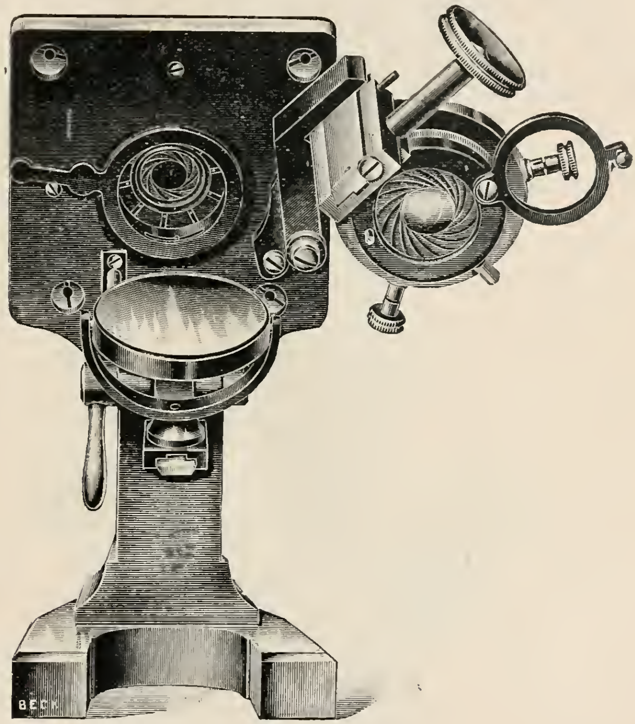


Fig. 34.

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

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

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

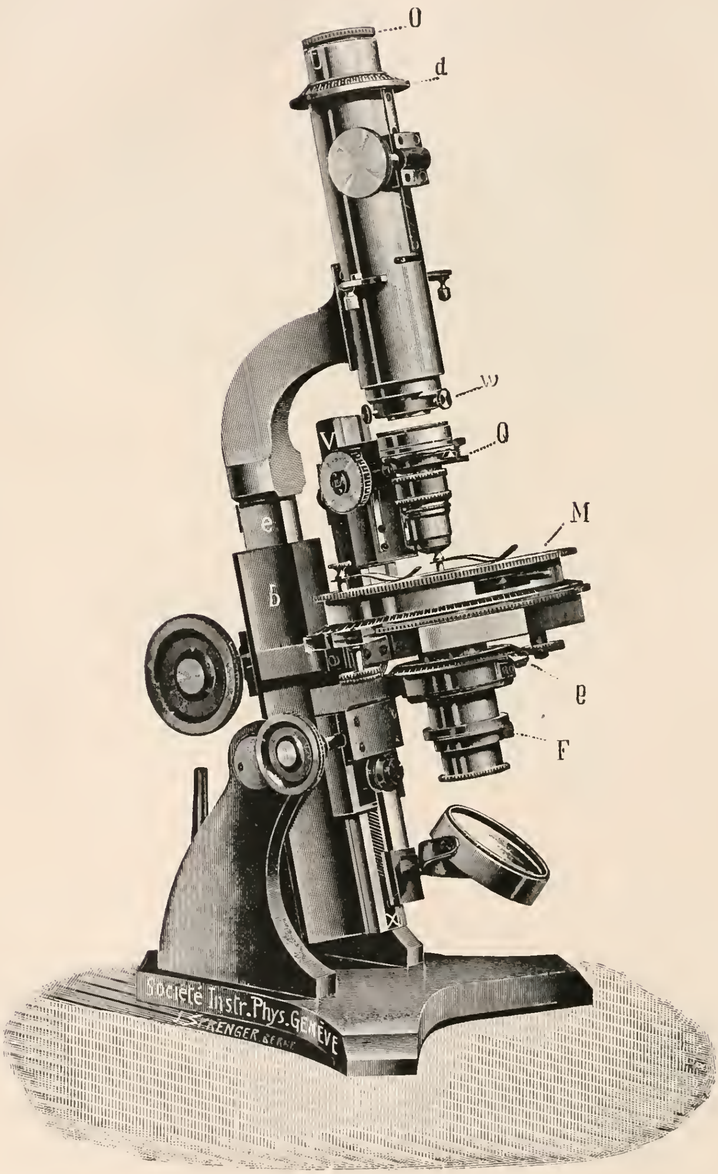


Fig. 35.

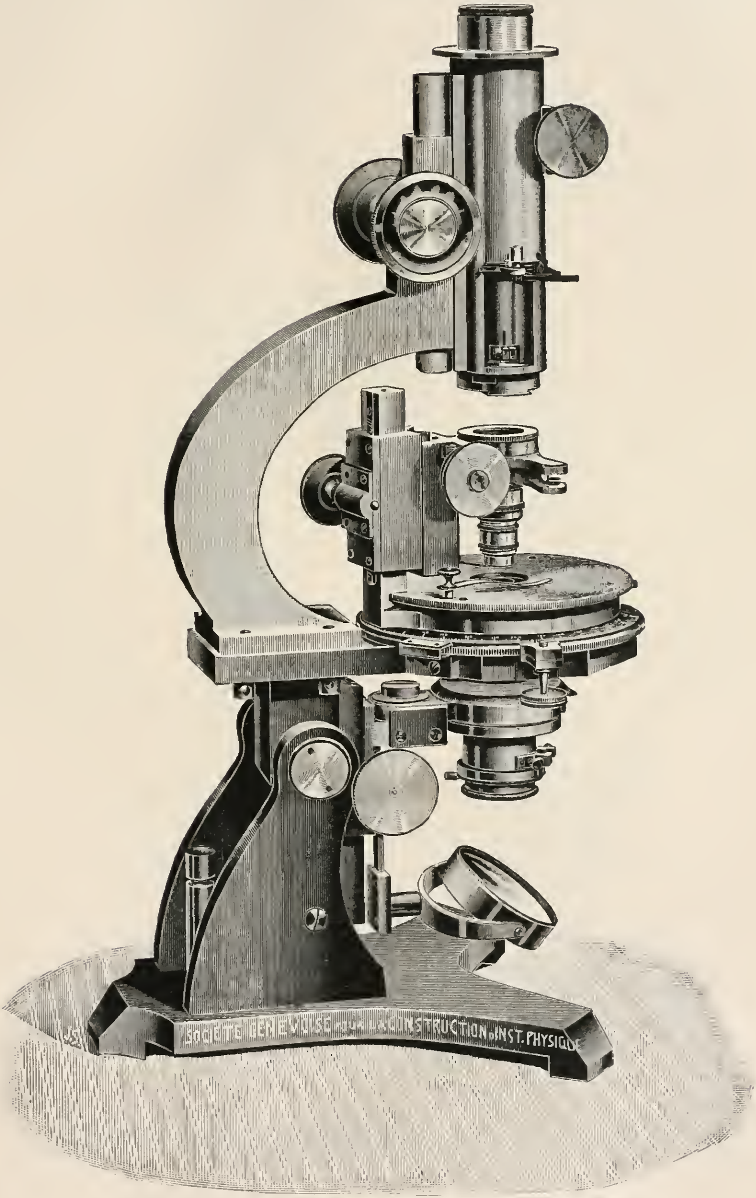


Fig. 36.

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

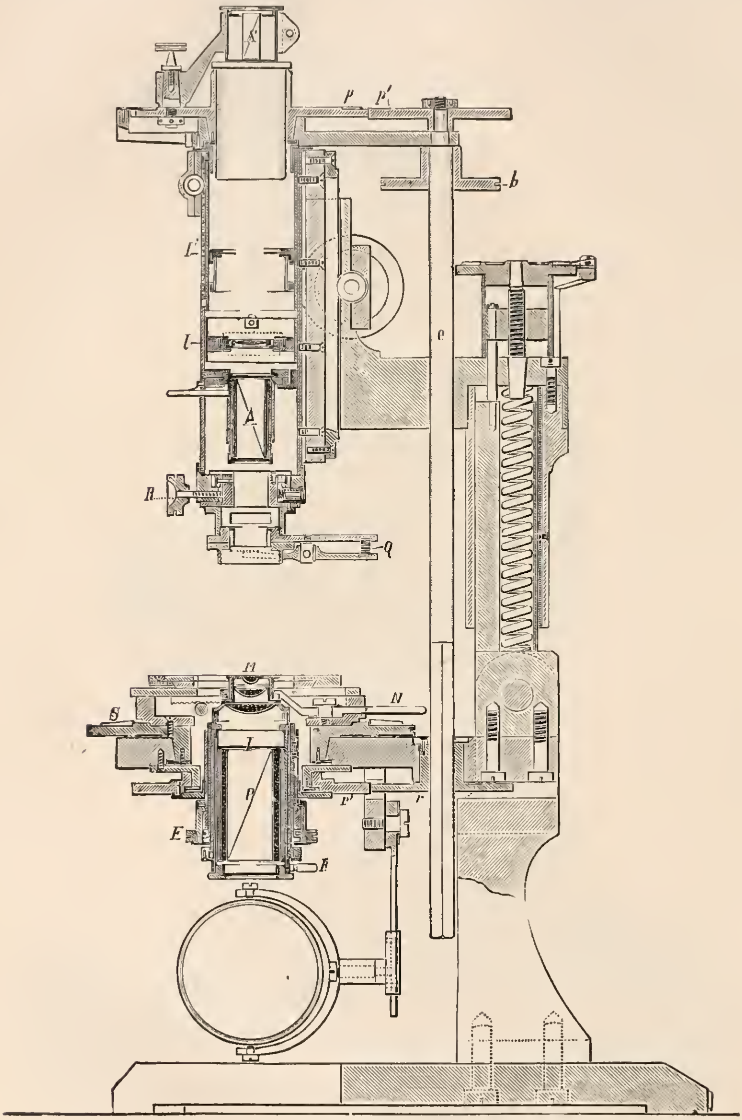


FIG. 37.

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

Fig. 37 shows model No. 2431 in section. Here the nicols rotate while the stage is fixed, and this arrangement gives a means of suppressing all decentring of the microscopic stage in relation to the optical axis of the Microscope. The rotation of the nicol is obtained by means of a pillar, parallel to the Microscope, and bearing two pinions engaging in two small stages supporting the polarisers and analysers. The polariser is fitted with a quick-movement screw for raising or lowering. The object-stage can be rotated, as desired, independently of the nicol ; it carries a pivoting condenser.*

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

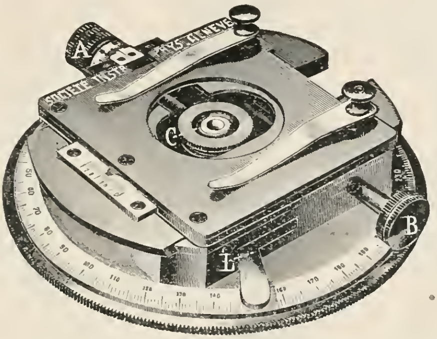


Fig 38.

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

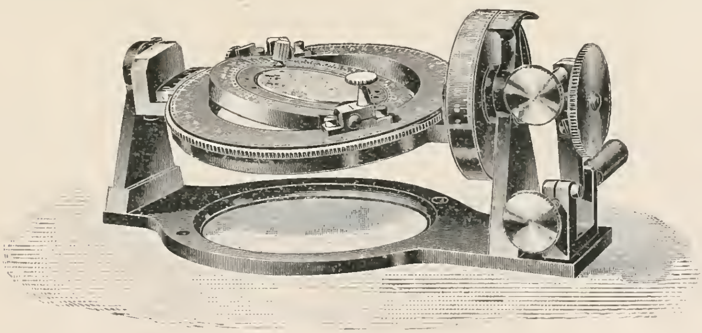


Fig. 39.

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

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

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

‡ Op. cit., Catalogue No. 2492.

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

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

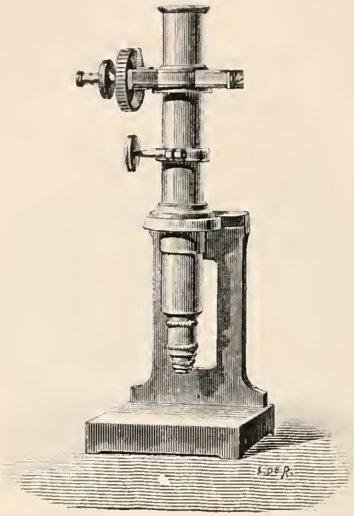


Fig. 40.

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

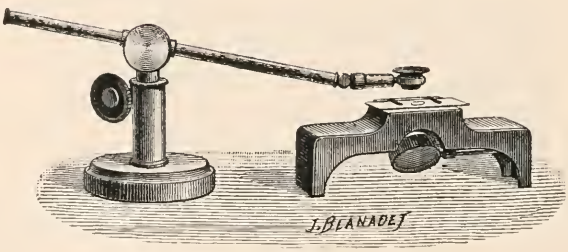


Fig. 41.

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

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

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

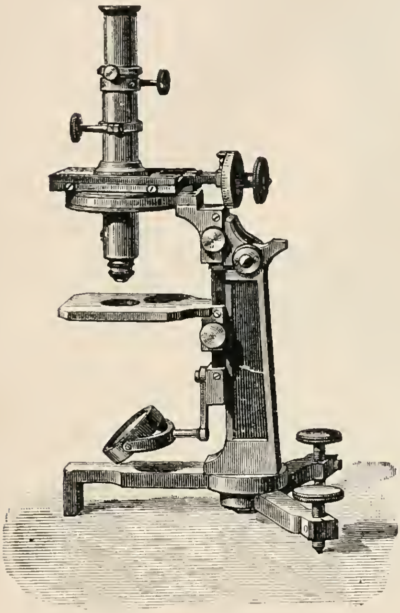


FIG. 42.

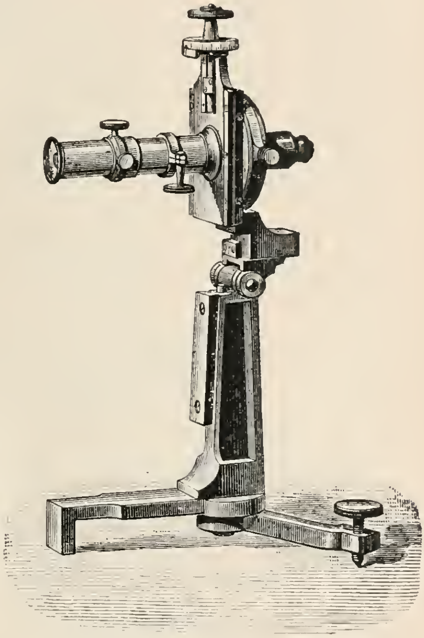


FIG. 43.

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

(2) Eye-pieces and Objectives.

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

* List Phys. and Mech. Instr. Soc. genevoise, 1907, pp. 36–7 (2 figs.).
† Catalogue (1907) of the Soc. genevoise pour la construction d'instruments de physique et de mécanique, p. 12.

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

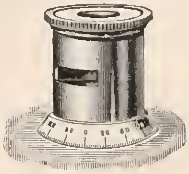


Fig. 44.

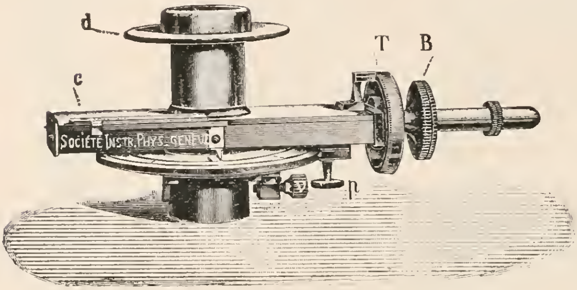


Fig. 45.

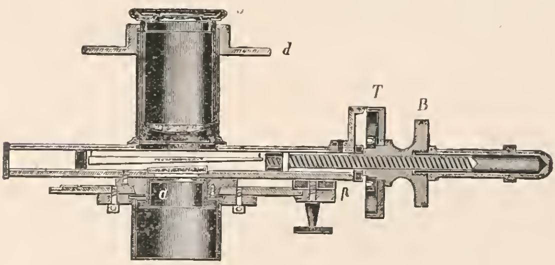


Fig. 46.

(3) Illuminating and other Apparatus.

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

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

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

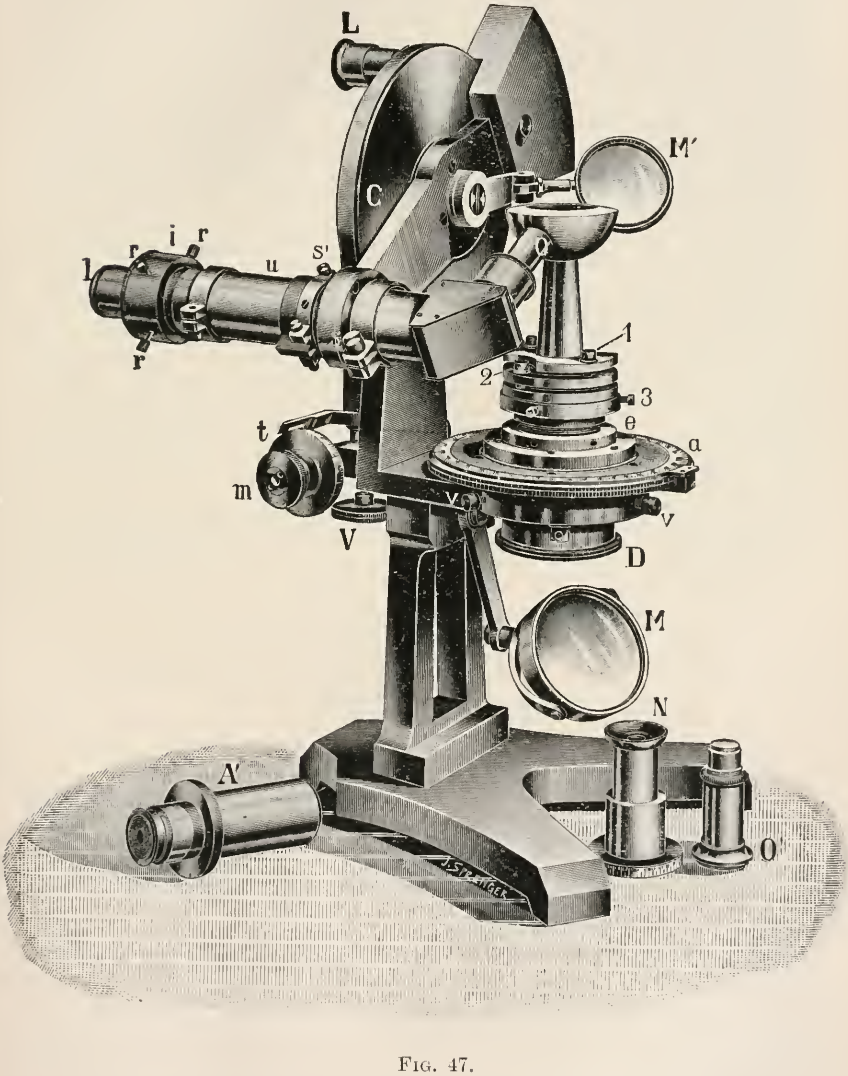


Fig. 47.

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

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

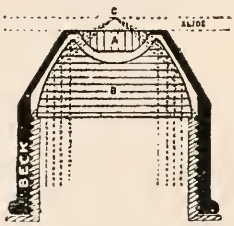


Fig. 48.

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

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

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

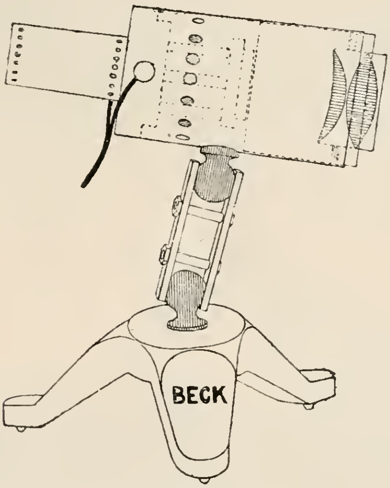


FIG. 49.

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

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

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

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

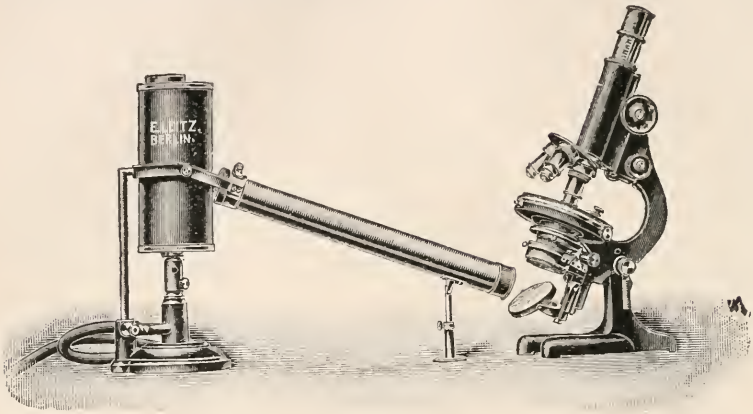


Fig. 50.

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

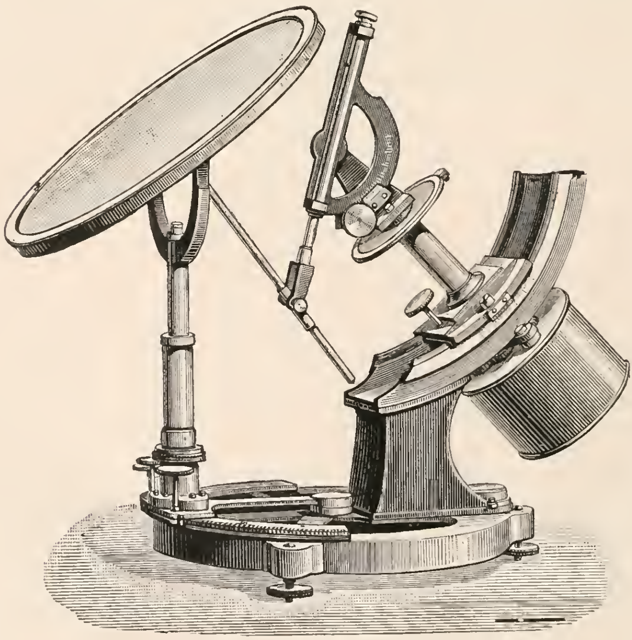


Fig. 51.

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

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

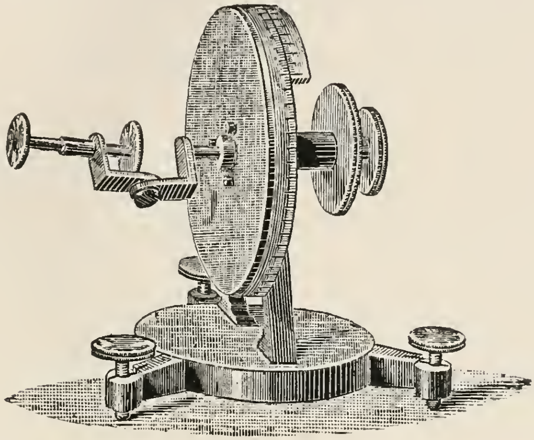


FIG. 52.

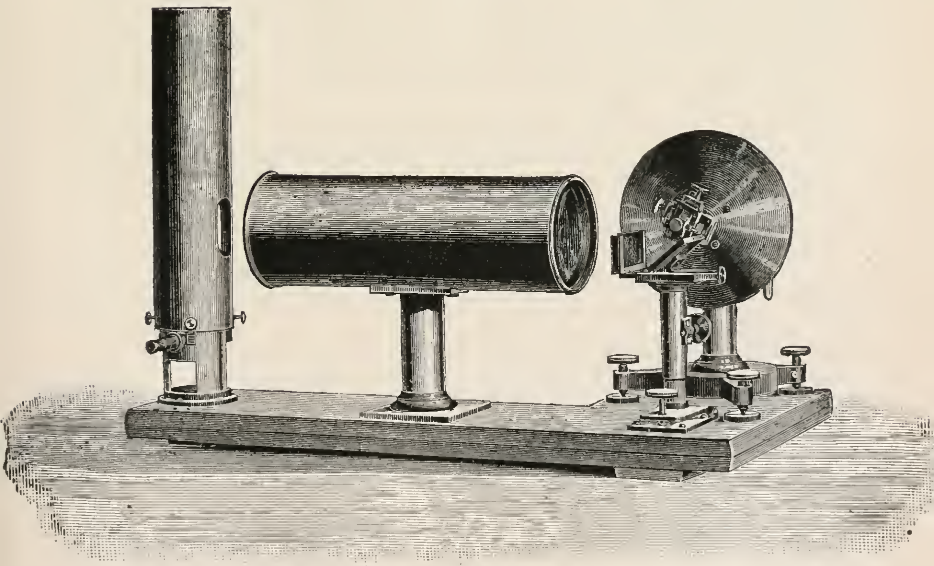


FIG. 53.

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

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

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

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

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

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

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

(4) Photomicrography.

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

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

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

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

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

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

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

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

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

(5) Microscopical Optics and Manipulation.

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

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

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

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

(6) Miscellaneous.

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

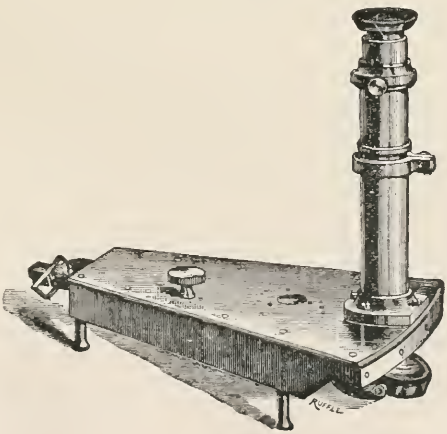


FIG. 54.

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

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

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

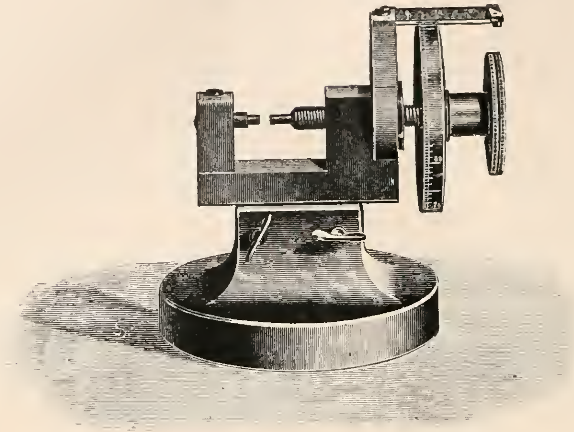


FIG. 55.

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

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

B. Technique.*

(1) Collecting Objects, including Culture Processes.

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

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

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

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

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

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

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

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

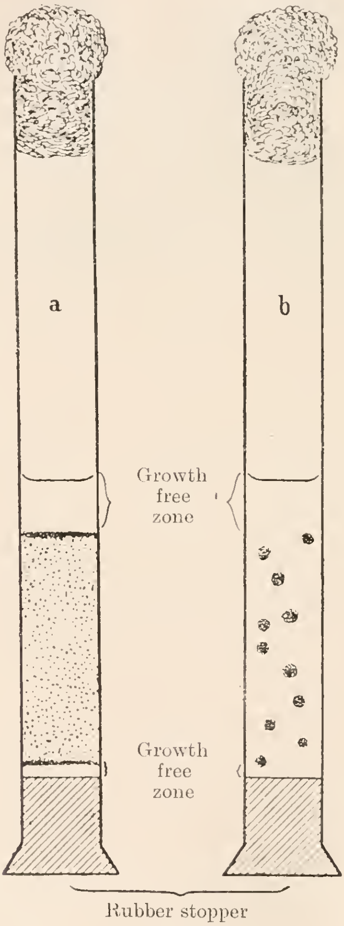


Fig. 56.

plug sodium pyrogallate solution is dropped, and the tube is at once closed with a rubber cork. A refinement of this method was devised by Burri, who flamed the wool plug before it was pushed into the tube, and after it had been pushed down a second wool plug was introduced, and this was soaked with the pyrogallate solution, the tube being then closed with a rubber cork, thus avoiding much risk of contaminating the medium (fig. 57).

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

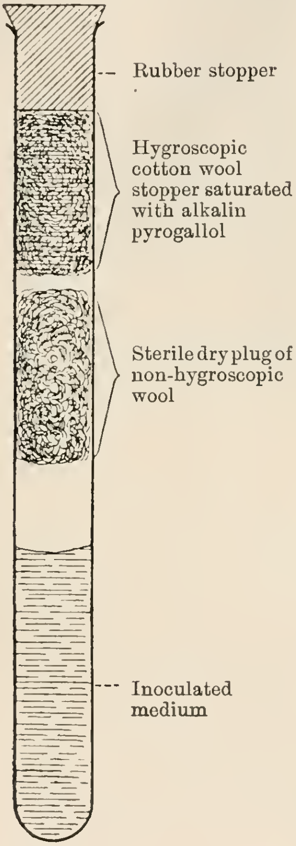


Fig. 57.

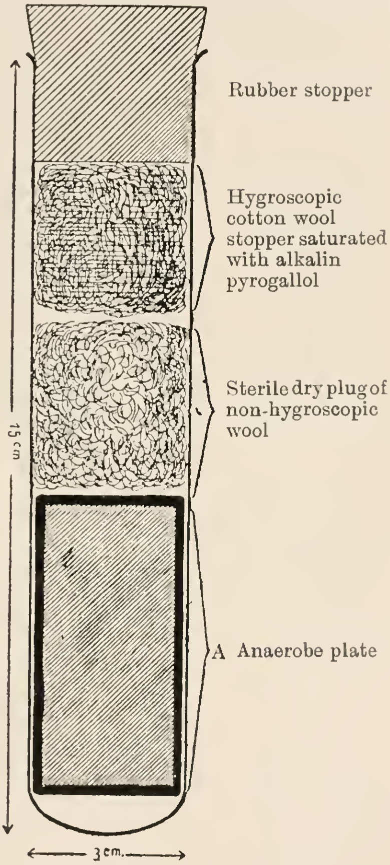


Fig. 58.

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

The author also describes a method for cultivations under conditions completely free from oxygen. The apparatus is shown in fig. 59 ; it consists of a long tube holding sterile broth, and communicating at the middle with a short tube, in which is the inoculating material, and both tubes are corked, like the modified Wright's tube (fig. 57) ; after standing at 37° C. for five days, the long tube is inoculated, and after 18 hours the broth is clouded. The absence of oxygen is demonstrated by control tubes, the long arm containing a clear solution of pyrogallic acid, the shorter tube a solution of caustic potash, the tube being corked as before; after 10 days at 37° C. the contents of the tubes are mixed, and no sign of brown coloration occurs.

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

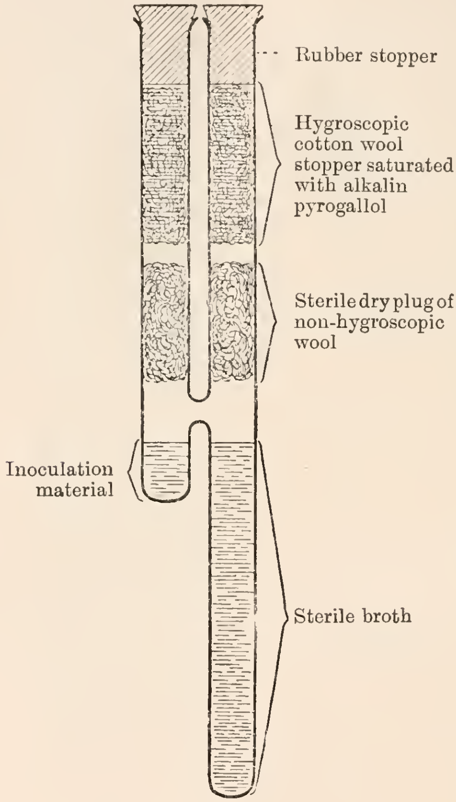


Fig. 59.

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

The author next considers the method of effecting a number of sub-cultures in continuous oxygen-free condition. The apparatus (fig. 60) is a development of the double culture tube (fig. 59), and consists of 4 to 16 tubes, joined at the middle, the level of communication between succeeding tubes being higher than between those immediately preceding: the series of tubes contains fluid medium; the right amount of liquid necessary to allow succeeding tubes to be filled from the preceding by tilting the whole apparatus, is previously tested and the levels marked. The tubes are sterilised and inoculated with *B. mesentericus*,

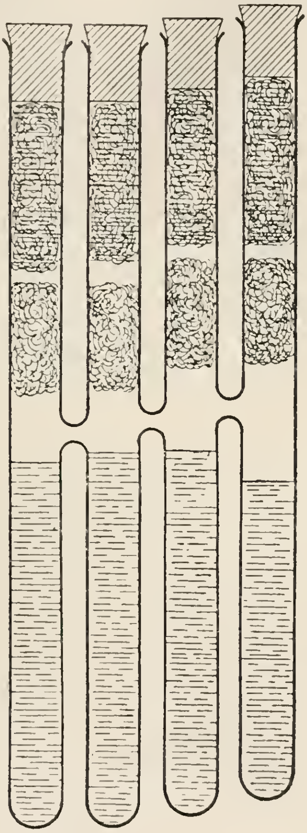


Fig. 60.

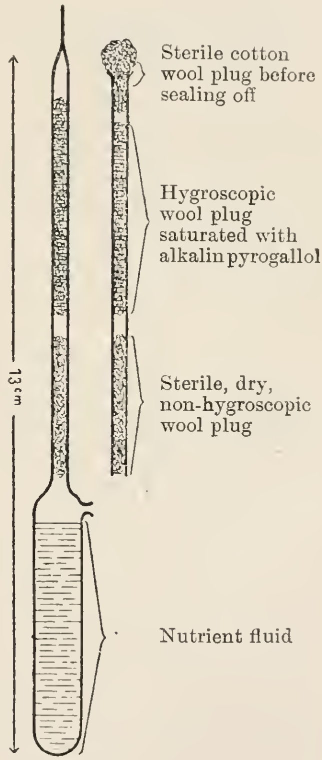


Fig. 61.

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

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

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

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

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

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

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

* Centralbl. Bakt., 2te Abt. xix. (1907) p. 264.
† Ann. Inst. Pasteur, xxi. (1907) pp. 1005–8 (2 figs.).

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

FIG. 62.

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

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

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

(2) Preparing Objects.

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

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

* Zeitschr. wiss. Mikrosk., xxiv. (1907) p. 133.
† Quart. Journ. Micr. Sci., lii. (1908) pp. 1–73 (3 pls. and 11 figs. in text).

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

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

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

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

(3) Cutting, including Imbedding and Microtomes.

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

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

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

(4) Staining and Injecting.

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

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

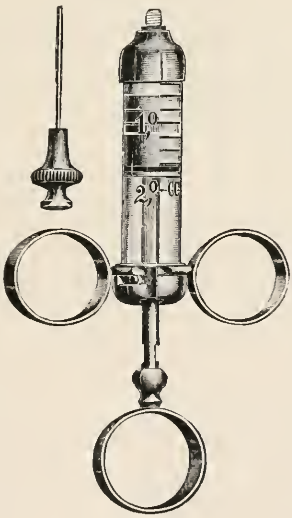


FIG. 63.

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

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

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

(6) Miscellaneous.

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

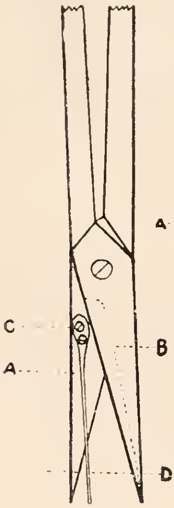


Fig. 64.

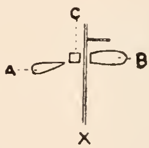


Fig. 65

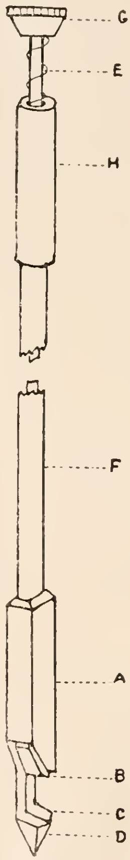


Fig. 66.

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

* See this Journal, 1907, pp. 760–1.

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

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

Metallography, etc.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

* Zeitschr. Anorg. Chem., lvii. (1908) pp. 185–219 (8 figs.).
† Stahl und Eisen, xxvii. (1907) pp. 1797–1809, 1833–9 (19 figs.). (Report of committee appointed by the German Association for Testing Materials to investigate this method of testing.)
‡ Comptes Rendus, cxlvi. (1908) pp. 74–5.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 19TH OF FEBRUARY, 1908, AT 20 HANOVER SQUARE, W.
A. N. DISNEY, ESQ., M.A., B.SC., IN THE CHAIR.

The Minutes of the Meeting of the 15th of January, 1908—being the Anniversary Meeting of the Society—were read and confirmed, and were signed by the Chairman.

The List of Donations to the Society (exclusive of exchanges and reprints) received since the last Meeting, was read, and the thanks of the Society were voted to the donors.

	From
J. M. Hulth, Bibliographia Linnæana. Partie I., Livraison 1. (8vo, Upsala, 1907)	*Kungl. Vetenskaps Societeten i Upsala*
Conrad Beck, Cantor Lectures on The Theory of the Microscope. Delivered at the Society of Arts, Nov. and Dec. 1907. (8vo, London, 1908)	*The Author.*
Slide, *Alveolina boscii*	*Mr. F. Chapman.*

Mr. J. E. Barnard exhibited and described an improved type of mercury vapour lamp. The lamp exhibited on a former occasion had been improved on, and the one now shown was made with a thicker and shorter tube. This gave a sufficiently large source of light to enable critical illumination to be obtained with a well filled field, when using medium powers. The effect of using this new form of lamp was shown under two Microscopes in the room, one with a screen, giving absolutely monochromatic green light, the other without a screen, the soft blueish light in which was very pleasant to work with, and, owing to the entire absence of red rays, constituted an excellent illuminant for visual microscopic work.

Mr. J. W. Gordon inquired if Mr. Barnard had satisfied himself as to the absence of any short-length waves of light, which might prove injurious to the user. The danger which lurked in that sort of thing had been brought home to them lately by the fact that Dr. Hall Edwards had lost his arm through incautious operating with X-rays, at a time when the risks of damage from that source were unknown and unsuspected.

Mr. Barnard said this risk was really nil, owing to the incandescent mercury vapour being inclosed in a glass tube, which of course absorbed practically all the ultra-violet rays. A further safeguard in the case of glass tubes which were transparent to ultra-violet rays, was to use a screen of a solution of sulphate of quinine between the light and the Microscope, which completely absorbed all these rays.

Mr. C. L. Curties exhibited a number of slides under Microscopes in the room, illustrative of the stages in the life-history of the Culicidæ; the labels attached to each were, he thought, sufficiently explicit to render it unnecessary for him to further describe them.

Votes of thanks to Mr. Barnard and to Mr. Curties for their exhibits were unanimously passed.

Attention was called to some excellent stereo-photographs sent for exhibition by Mr. Dollman, and placed upon the table, with stereoscopes, for the inspection of the Fellows present.

Mr. E. M. Nelson's paper on "Eye-pieces for the Microscope" was taken as read, the greater part of it consisting of numerical tables which, though of considerable value, it was thought would prove uninteresting reading. The paper would, however, be printed in the Journal.

The thanks of the Society were voted to Mr. Nelson for his paper.

The **Rev. Eustace Tozer** read a paper on "The Life-history of a new Protophyte," which he illustrated by six lantern slides, and by living and mounted specimens under Microscopes, showing the various methods of reproduction. He also exhibited micro-slides of Rotifers, stained and mounted in Canada balsam by a new process.

The thanks of the Meeting were voted to the author.

Mr. F. Chapman's paper, "On Dimorphism in the Recent Foraminifer, *Alveolina boscii*," was read by Dr. Hebb, specimens in illustration being exhibited under the Microscope.

Mr. Earland said that he had examined Mr. Chapman's specimens, and was under the impression that he had observed similar ones on several occasions, when examining dredgings in which *Alveolina boscii* was plentiful. It had never occurred to him, however, that the variation might be due to dimorphism, he had always regarded it as an abnormal variation. Such questions could only be answered, in the majority of species, by the cutting of thin sections through the median line, a process requiring the greatest skill and delicacy of touch. He had often tried, but very rarely succeeded in the operation. Mr. Chapman was well known for his skill in these matters, and he was to be congratulated on the interesting discovery resulting from his work.

A vote of thanks to Mr. Chapman for his paper was unanimously passed.

Mr. Nelson's paper, on "*Biddulphia Mobiliensis*," was read by Dr. Hebb—the concluding portion dealing with the comparative values of long and short-tube Microscopes in the examination of minute structures.

Mr. C. L. Curties exhibited on the screen a number of lantern slides of various microscopic objects, for which the thanks of the Meeting were unanimously voted.

A description of a micro-object locater, devised by Mr. S. E. Dowdy, and exhibited applied to a Microscope in the room, was read by Dr. Hebb.

It was announced that at the next Meeting of the Society the President hoped to be able to give his address, "On Seeds, with Special Reference to those of British Plants."

New Fellow.—The following was balloted for and duly elected an *Ordinary* Fellow of the Society :—Mr. Eric Graham Saunders.

The following Objects, Instruments, etc., were exhibited :—

The Society :—The following Stereo-photomicrographs, by Mr. Dollman : Blow-fly's tongue × 300 ; Medusa of *Opercularella* × 20 ; Medusa of *Schyzohydra tergemma* × 30 ; *Plumatella* × 16 ; *Tubularia crocea* × 8 ; *Volvox globator* × 50 ; an Object-locater, sent for exhibition by Mr. S. E. Dowdy ; Slide of *Alveolina boscii*, in illustration of Mr. Chapman's paper.

Mr. J. E. Barnard :—An Improved Mercury Vapour Lamp.

Mr. C. L. Curties :—Eight Slides, illustrating the life-history of some Diptera : *Culex*, pupa, larva, male, female ; *Tanypus*, pupa, larva, male, female ; and Lantern Slides of various microscopic objects.

Mr. J. I. Pigg :—Scale of Dogfish, stained with hæmatoxylin.

Rev. Eustace Tozer :—Drawings, and six Lantern Slides, and the following Slides under Microscopes in illustration of his paper, A New Protophyte : (1) Living forms ; (2) Direct reproduction of parent-form, small ; (3) Canada balsam mount, showing flagella ; (4 and 5) Bud-cysts ; (6) Zoospores from bud-cysts ; Micro-slides of Rotifers, stained, and mounted in Canada balsam by a new process.

MEETING

Held on the 18th of March, 1908, at 20 Hanover Square, W. The Right Hon. Lord Avebury, F.R.S., etc., President, in the Chair.

The Minutes of the Meeting of the 19th of February, 1908, were read and confirmed.

The following Donation to the Society was announced, and the thanks of the Meeting were voted to the donor.

	From
Woodward, Horace B., History of the Geological Society of London (8vo, London, 1907)	*The Council of the Geological Society of London.*

Mr. J. Ciceri Smith read a description of a direct-reading micrometer gauge, which he exhibited in the room; the mechanism of the instrument being further illustrated by diagrams.

Mr. Smith said this micrometer would be found very convenient for microscopists. It was an improved cover-glass gauge, with an automatic calculating index, upon which the thickness of the glass in decimal fractions of an inch was seen at a glance, and upon the divided-thimble half divisions ($= \frac{1}{2000}$ in.) could be read off. A full description of the instrument, with illustrations, will be published in next issue.

The thanks of the Society were unanimously voted to Mr. Smith for his exhibition and explanation.

Mr. C. F. Rousselet gave the following account of a series of mounted specimens of the rarer species of fresh-water Polyzoa, which were exhibited under Microscopes in the room.

The fresh-water Polyzoa received a good deal of attention from zoologists about the middle of last century, but Professor Allman, by the publication in 1856 of his monograph of this group, appears to have almost exhausted the subject as far as Great Britain is concerned, for during fifty years afterwards no new species were discovered in England, with the single exception of the remarkable *Victorella pavida*, found by Saville Kent in 1868.

Naturalists abroad, in America, Germany, India, Japan, etc., have been more active, and have brought to light about a dozen new species of great interest, and it is these rarer and mostly foreign forms which my exhibit this evening is intended to illustrate.

The well-known and common species, such as *Lophopus*, *Cristatella*, *Plumatella*, *Fredericella sultana*, and *Paludicella*, have often been exhibited, and are not here this evening. The forms represented are the following :—

1. *Victorella pavida* Saville Kent was first found at one of the earliest excursions of the Quekett Microscopical Club, on September 12, 1868, in the Victoria Docks. Some years afterwards, in 1885, it was found again by Dr. Bousfield, in the Surrey Canal, and in March 1906, guided

by this gentleman, I obtained it once more at the same spot, after an interval of 21 years. Lastly, I found it in the Surrey Commercial Docks, at a Quekett Club excursion on October 5 of last year.

This species is also known from Germany. It is always found attached to the stems of the hydroid *Cordylophora lacustris*, with which it seems to have entered into a symbiotic arrangement for mutual support and food supply.

I cannot enter into any description, beyond saying that it is a very small species of a marine type, with a circular lophophore of only eight tentacles. The specimen under the Microscope is the first ever prepared with tentacles fully extended.

2. *Victorella symbiotica*. Last year * I described a second species of this genus, which was brought by Dr. Cunnington from Lake Tanganyika. It was found completely imbedded in a sponge, the long narrow tubes penetrating through its substance, to enable the creature to expand its tentacles above the surface of the sponge.

This species also seems to possess sufficient intelligence to see the advantage of entering into a similar symbiotic arrangement with a sponge for protection and food supply.

3. *Pottsiella erecta*.—In 1884 Mr. Edw. Potts, of America, published a very short account, without figure, of a new Polyzoan under the name of *Paludicella erecta*, which he had found attached to submerged stones in the Pennsylvania Canal in his neighbourhood. In 1887 Professor Kraepelin, of Hamburg, having obtained some specimens from Mr. Potts, changed the generic name into *Pottsiella* in his monograph of the German Fresh-water Bryozoa, having recognised that its affinities are quite different from those of *Paludicella*.

Last August, at my request, Mr. Potts was good enough to send me some living specimens to Boston, where I was able to prepare a few fully expanded, and the specimen under the Microscope is the first one so obtained. Later in the year, after the cold weather had set in, Mr. Potts sent me some stones with the died-down tubes of this species, and from the creeping stolons of some of these, new tubes have been formed in my aquarium, and for the first time in England I have seen the living *Pottsiella* expand its circular lophophore of about twenty-two tentacles.

4. *Urnatella gracilis* is another rare American species which was discovered and described by Leidy in 1851, in the Schuylkill River.

The same stones lately received from America to which *Pottsiella* is attached, have also a number of *Urnatella*, and here again I revived in my aquarium the first living specimens ever seen in this country.

Urnatella is a fresh-water representative of another marine type—*Pedicellina*.

5. *Arachnoidia Ray-Lankesteri*.—In 1903 Mr. Moore brought this remarkable Polyzoan from Lake Tanganyika, where it was subsequently found again by Dr. Cunnington, and the slide exhibited here is from this expedition of 1905. It is also of a marine type with rounded flat cells, closely adhering to shells and stones, with a tall erect tube at one end, from which the animal protrudes its circular lophophore of sixteen tentacles.

* Proc. Zool. Soc. London (1907) pp. 250–257 (2 pls.).

6. *Hislopia lacustris* is a peculiar species found by Carter in 1858 in Central India. Lately it has again been found by Dr. Annandale, of the Calcutta Museum, and also by Captain Walton, who sent me the specimen exhibited here from Bulandshahr, Northern India.

7. *Membranipora monostachys* var. *fossaria* Hincks, is a brackish-water species which has evidently wandered from the sea, and occurs in tide pools, which, after heavy rains, contain very little salt water. The present specimen was sent to me by Mr. Hurrell, who found it near Great Yarmouth in a pool about a mile from the sea, encrusting the submerged stems of an herbaceous plant.

8. *Pectinatella magnifica* is a remarkable American species made known in 1851 by Leidy. It has also been found in the Elbe at Hamburg, the statoblasts having no doubt been introduced from America, and in the Havel, near Berlin. The colonies form solid, rounded, gelatinous masses of the size of a child's head, and the animals are arranged in rosette-shaped groups on the surface. I saw a number of these colonies at the Government Biological Station at Wood's Hole, in America, and Mr. Potts, having procured a living specimen when staying at Philadelphia, I prepared the group under the Microscope with the horseshoe-shaped lophophore of every individual fully expanded. The statoblasts are very large, rounded, and have 12–17 long, anchor-shaped hooks round the periphery. I brought back some living statoblasts, which are now hatching in my aquarium, and have also introduced some in various canals and ponds, so I hope it will be possible in future to study this interesting species in this country.

9. *Pectinatella gelatinosa.*—This species comes from Japan, and was discovered in 1890 at Tokio by Dr. Oka, who was good enough to send me the specimens here exhibited. The large statoblasts have the shape of a cardinal's hat, and have very minute hooklets round the edge.

10. *Lophopodella Thomasi.*—This species I described in 1904 * from a specimen received from Mr. Thomas, who had found it four years earlier in a pool formed by the Hunyani River in Rhodesia. The specimen was killed and preserved in a fully contracted state, so only the peculiar and characteristic statoblasts can be shown.

11. *Plumatella tanganyikae* is another African species brought back by Dr. Cunnington, who found it in Lake Tanganyika, encrusting shells, stones, and submerged plants.

12. *Fredericella Cunningtoni* is yet another new species from the same Tanganyika Expedition ; the tubes of this *Fredericella* are formed of coarse sand-grains, creeping, closely adherent, interlacing on shells and stones. The circular lophophore has sixteen tentacles.

The President said that Professor Allman's work on the Polyzoa, to which reference had been made, was one of the most excellent monographs produced in this country, and it was a remarkable thing that so long a period should have elapsed before any additions were made to the species which he described. The Society was much indebted to Mr. Rousselet for his interesting communication and for the exhibition of the specimens described.

The thanks of the Meeting were unanimously voted to Mr. Rousselet for his exhibit.

* Journ. Quekett Micr. Club., ser. 2, ix. (1904) pp. 45–56 (1 pl.)

The President, on rising to give his annual address to the Society, said that when the Society did him the honour of asking him to accept the office of President, he had some hesitation as to acceding to their request; in the first place because he was not now so much in London as formerly, and in the second place because the state of his eyes did not permit him to do much microscopic work. Hence he felt rather doubtful if he ought to occupy such a position. However, the Council persisted in their request that he would do so, and he had given way to their appeal, as he so highly appreciated the honour which they proposed to confer upon him that he felt he could not decline. The responsibility of the position was, however, borne upon him again when he had to consider the subject for the annual address. His distinguished predecessor in that chair had taken the subject of the Seeds of Fossil Plants. and following this precedent, he decided to address them on the subject of the seeds and fruits of modern British Plants (confining his attention on the present occasion to those of the Dicotyledons), and, if the subject proved acceptable, to take the seeds and fruits of the Conifers and Monocotyledons as the topic of his address of next year. He then proceeded to read an extremely interesting paper on the seeds of the various orders of flowering plants and trees, with special reference to the methods by which they were distributed—remarking at the close that he feared the subject might have been wearisome to some persons, although if he had failed to interest them he was sure it was not the fault of the seeds themselves.

Mr. Disney said he had very great pleasure in proposing a very hearty vote of thanks to the President for the interesting and suggestive address to which they had just had the pleasure of listening. The subject was somewhat novel as regarded that Society, but he felt sure that it had been none the less welcome on that account, and that all would look forward with expectation to the continuation which the President had promised. He also wished—in addition to showing their appreciation of the address—to express their indebtedness to Lord Avebury for accepting the office of President of their Society.

Mr. Wynne E. Baxter, in seconding the vote of thanks, reminded the Fellows of the Society that this was not the first time they had been indebted to the President for an address, for when in 1877 the Council decided to establish a "Quekett Lecture," the first one was delivered by their present President, "On the Anatomy of the Ant." They were not only under great obligation to him for the address given to them that evening, but also for having consented to become their President for another year.

Mr. Disney then put the proposal to the Meeting, when it was carried unanimously by acclamation.

The President said he felt greatly indebted to the mover and seconder of the vote of thanks for the kind way in which they had spoken, and to the Fellows present for the way in which it had been received. He desired also to thank them for the constant support which he had received during the year of his Presidency, and which he felt sure would be further extended to him during the year on which they had entered.

The Secretary said they had received a letter from Mr. Stephenson, intimating his wish to dispose of a number of the Journals of the Society, which he offered for 4*l*. 10*s*.

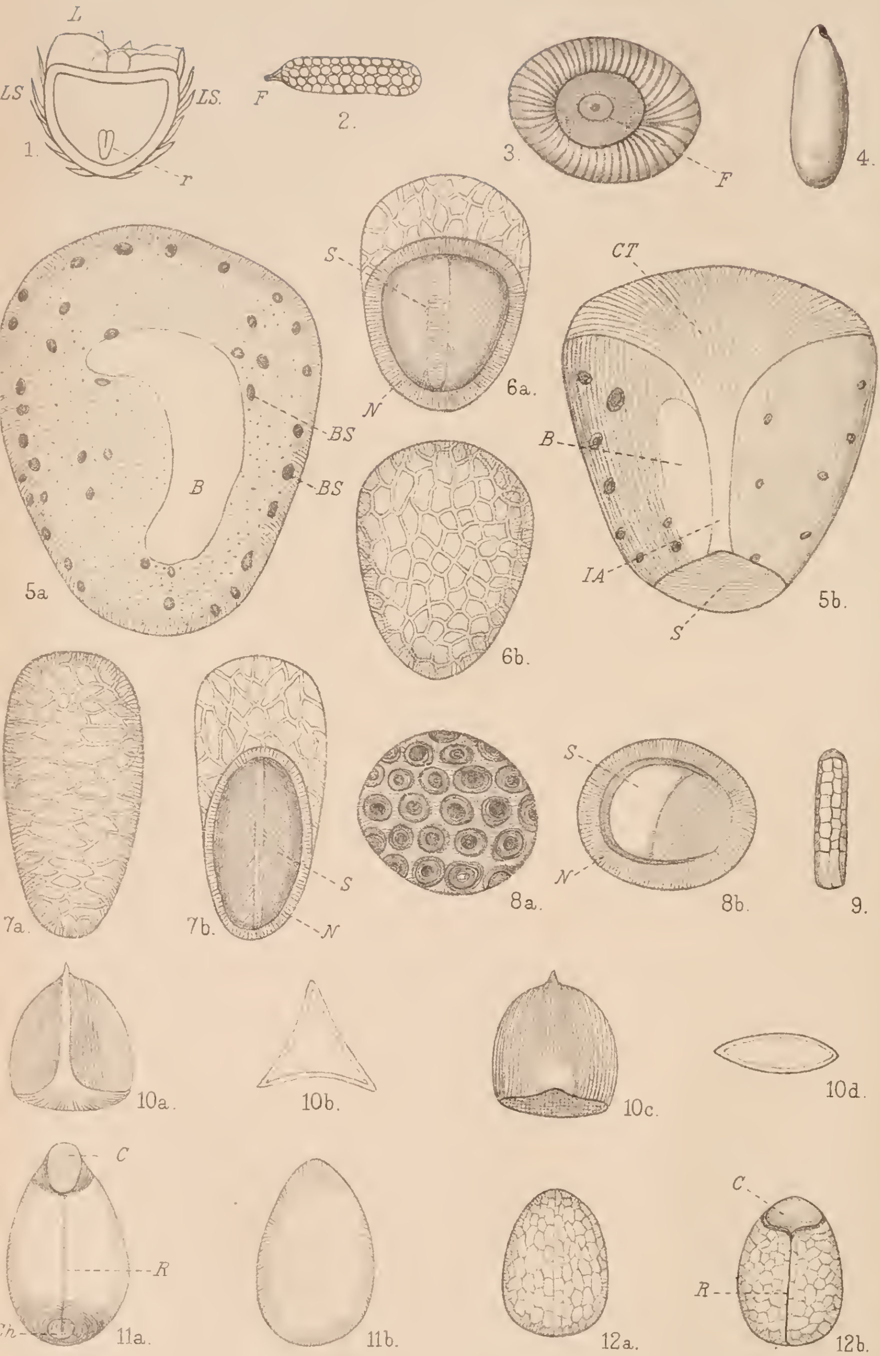
The next Meeting of the Society will take place on April 15, when Mr. F. Enock will give one of his illustrated lectures.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. Thos. Stewart Baird, Arthur Forshaw, David Gordon, Edward Geo. Howard.

The following Instruments, Objects, etc., were exhibited:—

Mr. J. Ciceri Smith:—Examples of Direct-reading Micrometer Gauges.

Mr. C. F. Rousselet:—Mounted specimens of the following Fresh-water Polyzoa:—*Victorella pavida*, *V. symbiotica*, *Pottsiella erecta*, *Urnatella gracilis*, *Arachnoidia Ray-Lankesteri*, *Hislopia lacustris*, *Membranipora monostachys* var. *fossaria*, *Pectinatella magnifica*, *P. gelatinosa*, *Lophodella Thomasi*, Statoblasts, *Fredericella Cunningtoni*, *Plumatella tanganyikæ*.



West, Newman lith.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1908.

TRANSACTIONS OF THE SOCIETY.

XI.—*The President's Address: On Seeds, with Special Reference to British Plants.*

By The Right Hon. Lord Avebury, P.C., D.C.L., F.R.S.

(*Read March* 18, 1908.)

Plate IV.

When the Council did me the honour of inviting me to accept their nomination for the Presidency, I placed before them two reasons which, while fully appreciating the honour, made me feel very doubtful whether I ought to consent. In the first place, I am not now so much in London as formerly, and, secondly, my eyes no longer permit, or are fit for, much microscopic work. The Council, however, pressed me to accept, and, perhaps too readily, I allowed myself to be over-persuaded. This came home to me still more

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EXPLANATION OF PLATE IV.

Fig. 1.—*Delphinium peregrinum.* × 12. Longitudinal section of seed. L, some of the uppermost tunics or laminæ; L S, L S, longitudinal sections of laminæ; *r*, embryo.

„ 2.—*Pinguicula vulgaris* Linn. × 16. F, funiculus.

„ 3.—*Veronica hederæfolia* Linn. × 8. Ventral face of seed, showing the funiculus or seed-stalk F in the centre of a nearly circular and deep cavity.

„ 4.—*Melampyrum pratense.*

„ 5*a*.—*Galeopsis versicolor* Curt. × 16. Dorsal aspect of nutlet. B, bald, or uniformly pale brown patch; B S, B S, black spots on a blackish brown surface, speckled with grey.

„ 5*b*.—Ditto. Ventral aspect of nutlet. S, scar of attachment to receptacle and to one another; I A, inner angle; B. bald patch; C T, convex top.

forcibly when I came to consider the question of my Presidential Address.

It occurred to me, however, that as my distinguished predecessor chose for the subject of his Address "The Flowering Plants of the Mesozoic Age," and dwelt mainly on their organs of reproduction, I might take Fruits and Seeds for my subject, with special reference to British Plants.

I propose this year to deal with the Dicotyledons, and, if it meets with your approval, next year with the Conifers and Monocotyledons, ending with some general observations.

I have elsewhere* divided fruits and seeds from the point of view of their dispersal into—

Seeds or fruits with wings, which are carried by wind.

Seeds or fruits with feathery appendages, carried by wind, and sometimes, as in Willow, floated by water.

Seeds in capsules which open at the top, the seeds being jerked out by the wind.

Seeds or fruits with hooks, which are carried by animals.

Those which are eaten, and the seeds thus carried by animals.

Those which are thrown by the plants; and, lastly,

Those which are sown by the plants themselves.

In the whole of Botany there is perhaps no more fascinating department than that which relates to Fruits and Seeds—their development and morphology, their forms and structure, size and colour—which, however, can best be dealt with when we have

* British Flowering Plants, p. 15.

EXPLANATION OF PLATE IV.—*continued.*

Fig. 6*a*.—*Ajuga reptans* Linn. × 16. Inner or ventral face of the nutlet, showing the wall of the carpel N and the partly exposed seed S.
,, 6*b*.—Ditto. The dorsal aspect of the nutlet.
,, 7*a*.—*Ajuga Chamæpitys* Schrieb. × 16. Showing the dorsal aspect.
,, 7*b*.—Ditto. The ventral aspect of the nutlet. N, ruptured wall of nutlet: S, seed partly exposed.
,, 8*a*.—*Teucrium Botrys* Linn. × 16. Dorsal aspect of a nutlet, showing wide-meshed netting of broad, blunt ridges, with pits between.
,, 8*b*.—Ditto. Face by which the nutlets are attached to the receptacle and to one another. N, shell of nutlet; S, seed partly exposed.
,, 9.—*Verbena teucroides.* × 4. Pyrene of the fruit, containing one seed inclosed in one-fourth part of the reticulated ovary walls. The species is a native of Brazil, etc.
,, 10*a*.—*Polygonum Persicaria* Linn. × 8. Triquetrous nutlet.
,, 10*b*.—Ditto. Transverse section of 10*a*.
,, 10*c*.—Ditto. Biconvex nutlet.
,, 10*d*.—Ditto. Transverse section of 10*c*.
,, 11*a*.—*Euphorbia amygdaloides* Linn. × 8. Ventral aspect of seed. Ch, chalaza; R, raphe; C, caruncle.
,, 11*b*.—Ditto. Dorsal aspect of seed.
,, 12*a*.—*Euphorbia Helioscopia* Linn. × 8. Dorsal aspect.
,, 12*b*.—Ditto. Ventral aspect. R, Raphe; C, caruncle.

the facts fully before us. The diversity is astonishing, not only in each large family, but even between nearly allied species.

RANUNCULACEÆ.—In the very first family, the Ranunculaceæ, we find an example of these remarkable differences. There are three main types. Some fruits are baccate, and adapted for dispersal by animals, especially birds. Others are dry; some are several-, some one-seeded. The latter form achenes, the seed being inclosed in the carpel.

The many-seeded fruits or follicles burst at the ventral suture, so that the seeds can fall, or be thrown out.

Our only baccate species is *Actæa spicata*.

Two of our British Ranunculaceæ—namely, *Clematis Vitalba* and *Anemone Pulsatilla*—have long feathery persistent styles, and are dispersed by the wind. It is remarkable that in the genus *Anemone* some species have an elongated and persistent style, while others have not.

Species much exposed to the wind, those, for instance, living in mountainous and open places, generally have feathery awns, while in those preferring woods and meadows the awns are more or less hooked. We find a somewhat similar division in the Rosaceæ, *Dryas* having feathery, *Geum* rather hooked awns.

The achenes are often wrinkled, netted or pitted, which would make them lighter and more easily carried by wind. Others are hairy, which would tend to the same result. Lastly, some are hooked, as, for instance, several Ranunculi, especially a Continental species, *R. falcatus*.

When the fruit consists of a many-seeded follicle, the seeds are liberated at maturity by the carpel opening at the top. The stalk at the same time hardens, and, being elastic, the seeds are jerked out by the wind, or sometimes by a passing animal. Such seeds are generally smooth, and very often black. This arrangement occurs in *Caltha*, *Trollius*, *Aquilegia*, *Pæonia*, and other genera.

The seeds of *Delphinium* are curiously wrinkled, and in *D. Ajacis* these form plaits of considerable depth, while in *D. peregrinum* they might be described as laminæ, imbricated one over another. The advantage of this arrangement is not clear to me. Perhaps the reason is to make the seed lighter (plate IV. fig. 1).

BERBERIDEÆ.—We have only one indigenous species, the common Barberry. The fruit is a berry; the ovary is 1-celled, and contains a few basal, erect ovules, only one or two of which develop into seeds. When there are two, they become plano-convex by mutual pressure. They are thickest at the chalazal end, next the apex of the fruit.

As is usual in species where the fruits are intended to be eaten by birds, the testa is crustaceous, and the surface almost smooth.

The endosperm also is hard. The seeds are generally thrown up uninjured.

The fruits are generally dark blue, purple, or red, though in some species white (*B. pruinosa*). It may be suggested that in species where the leaves are deciduous, or remain green, the red fruits would be very conspicuous; while in those where the leaves put on autumn tints, a blue-black colour would show up better. *B. vulgaris*, with red berries, is deciduous. *B. Aquifolium*, *B. Darwinii*, and *B. empetrifolia*, with persistent leaves, sometimes turning to orange or bright red, have purple berries.

Nymphæaceæ.—Of this order we have two genera, *Nymphæa*, or *Castalia*, and *Nuphar*, the yellow Water-lily.

The fruit is a berry. The ovary consists of many carpels, united to form as many cells. The ovules are numerous, and scattered over the walls of the cells. They are pendulous and anatropous, and develop into seeds about as large as grains of wheat. The testa is very thick, crustaceous, polished, and shining. The perisperm is white, mealy or floury, and the embryo is minute, lying near the micropyle. In *Nymphæa* the fruit ripens under water.

When the fruit is picked to pieces by birds, many of the slippery seeds, no doubt, would escape and float away, or in some cases adhere to the plumage and be carried away. The seeds themselves are heavy, but in *Nymphæa* the seed is enveloped in an outer coat, or arillus, and between the two is a layer of air, which enables them to float.

In *Nuphar* there is no arillus, but the walls of the carpel separate into two layers, of which the inner one, being spongy and charged with air, causes the seeds to float.

The flowers of the white Water-lily float on the surface of the water among the foliage, and when the stigmas have been pollinated by the visits of various Libellulidæ and other insects, the vase-like ovary is drawn down to the bottom of the water, and in about a month or six weeks bursts, and the seeds, which are contained in a bladder-like vesicle containing air, rise to the surface and are distributed by the action of currents and the wind. The filmy air-vesicles soon decay, the seeds sink to the bottom and are sown in the soft mud and ooze.

Papaveraceæ.—In this family the carpels are, as a rule, connate into an ovoid or oblong capsule, or a pod opening either from below upwards (*Chelidonium*), or from above downwards (*Glaucium*). In exceptional species, however, the fruit is fleshy, and in *Platystemon* the carpels are distinct.

In the Poppies the capsules are upright, divided by vertical incomplete septa; the stigmas are arranged on the summit in rays, and the capsules open by a series of valves beneath these rays (fig. 67).

The result of this arrangement is that, when the wind blows, and the poppy-heads are swung backwards and forwards, the seeds are jerked out of the capsules. As usual in such cases they are small, and deep brown or nearly black, and thus less conspicuous to birds. They are also more or less pitted. In form they are more or less reniform.

As regards our four indigenous Poppies, they may be distinguished as regards the capsules as follows:—

Capsule, club-shaped	*P. Argemone*, hairy. *P. dubium*, smooth.
„ globular	*P. hybridum*, hairy. *P. Rhœas*, smooth.

In *P. Argemone* the plant is altogether hairy, perhaps as the result of its living in dry regions, and the hairiness of the capsule probably has reference not so much to the capsule itself as to the general habit of the plant.

FIG. 67.—Capsule of a Poppy. *a*, indicates level of aperture.

In *Glaucium* (the Horned Poppy) and *Chelidonium* the fruit is a pod, and dehisces like that of the Leguminosæ, but while in *Glaucium* it opens from the apex downwards, those of *Chelidonium* do so from the base upwards.

In *Chelidonium* the base of the capsule matures, and naturally opens, first. In *Glaucium*, however, the pod is much longer, reaching from 10 inches to a foot. If the valves separated at the base, the placentas would have to support the whole weight, and would probably give way, in which case the pod would collapse, and the seeds would not be properly scattered.

The seeds of our Poppies, and of *Glaucium*, as of so many species where they are jerked out of capsules, are deeply pitted; those of *Meconopsis*, *Rœmeria*, and *Corydalis* are reticulate; those of *Chelidonium* smooth and black.

CRUCIFERÆ.—This great family is generally divided for purposes of convenience by the relative length of the pod, and the arrangement of the radicle with reference to the cotyledons, which in some cases have their edges to the radicle (accumbent), while others have the radicle folded over one face (incumbent). The fruit is generally a pod, divided into two cells by a thin partition. It is generally considered that the pod originally consisted of four carpels, but this is now the case in one genus only, *Tetrapoma*. The valves of the pod generally separate at maturity, but in a few genera the pod is indehiscent. The surface of the seed is generally smooth; but there are a few interesting exceptions. Some are very much flattened, which would obviously favour dispersal by the wind. Where the pods are narrow, as in *Nasturtium sylvestre* and *Brassica Sinapistrum* (Charlock), there is only one row of seeds; where the pod is broader, as in *Nasturtium amphibium* and *Brassica* (*Diplotaxis*) *tenuifolia*, there are two.

In many species the seeds are carried away as food by animals, and being no doubt often dropped, are thus dispersed. In others the seeds are much flattened, and no doubt carried by wind.

In some species of *Cardamine* and *Dentaria* the valves of the pod open elastically at maturity and scatter the seeds.

In some species of *Brassica* the pods terminate in a kind of beak which often contains one or two seeds. It seems possible that they may thus escape being eaten by birds.

Lepidium sativum, the common Cress, is remarkable for its tripartite cotyledons. This character is perhaps due to a longitudinal folding in ages long gone by, so as to enable the embryo to fill the seed.

A Brazilian species of *Cardamine*, *C. chenopodifolia*, produces underground pods as well as others of the common aerial type. These underground pods differ in being shorter and containing fewer seeds. We shall find one or two similar cases in other orders, and the reason I think is that if there were a number of seeds they would interfere with one another, and all but one or two would perish.

Resedaceæ.—In the genus *Reseda* the seeds are contained in a capsule as in some preceding genera, but it is unique in the fact that the cup is open long before maturity. It contains numerous seeds arranged along a number of placentas equal to that of the styles.

The seeds are rugose, but so finely that they appear smooth to the naked eye, and are black with a lustrous sparkle.

Those of *R. lutea* are much larger than those of *R. luteola*.

Violarieæ.—In the Violarieæ, again, the fruit may be an indehiscent berry, or a capsule opening elastically by as many valves (3) as there are placentas. This is the case with our only indigenous genus, *Viola*. The species, however, fall into two groups. In one (*V. hirta*, *V. odorata*, etc.), fig. 68, the capsules nestle on the ground, and are even said (as, for instance, by Vaucher) to bury themselves. They are, at any rate, pushed among moss, decaying leaves, etc., close to the ground. In other species (*V. canina*, fig. 69) the capsules when open resemble an inverted tripod. Each valve contains a row of from three to five brown, shining, pear-shaped seeds, slightly flattened at the upper (free) end. As the capsule dries the sides approach one another (figs. 70, 71), and grip the smooth seeds more and more tightly, till at length the attachment is ruptured and the seeds are thrown several feet. I have suggested elsewhere that we get a clue to the existence of the two plans if we remember the different modes of growth. The first series of species have, in ordinary parlance, no stem, and the

Fig. 68.—*Viola hirta.* *a*, flower-bud; *b*, full-sized capsule.

capsules are therefore close to the ground. In *V. canina*, on the other hand, there is a short stem, and the seeds being thus raised

Fig. 69.—*Viola canina.* Capsule with seed.

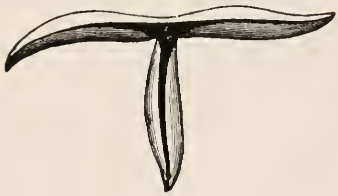

Fig. 70.—*Viola canina.* Capsule after ejecting the seeds.

some little distance above the ground, can be thrown to greater advantage.

The ejection of the seeds follows a regular order. The outer seed goes first, and then the others in regular sequence. The second carpel does not begin until the first has discharged all its seeds.

It is remarkable that among the violets the sweet, coloured flowers rarely develop seed, most of which are produced by the "cleistogamous" apetalous flowers.

FIG. 71.—*Viola canina.* *a*, bud of cleistogamous flower; *b*, older bud; *c*, capsule open.

CARYOPHYLLEÆ (the Pink Family).—The capsules are membranous or crustaceous; rarely berried (*Cucubalus*). The capsules open with a number of teeth equal to or double that of the styles. The seeds are numerous, or reduced by abortion. The seeds are always more or less flattened, but in some cases this takes place dorsally (*Dianthus, Tunica*), in others laterally. In *Dianthus* the hilum is situated about the middle of the ventral face, so that the seed is peltate. In this genus and in *Tunica* the embryo is straight; in the other genera it is curved, though sometimes only slightly. The surface is generally finely rugose, but sometimes papillose or smooth. In *Silene alpestris* and *S. quadrifida* they are quite long, and the colour is either black or brown. Some few (*Spergula arvensis, Spergularia marina*) are described in English specimens as winged. This, however, is not the case in all localities. On the Continent the variety *S. heterosperma* is described as having some seeds winged and others not.

At maturity the capsules open at the top, and when the stem is jerked by the wind, or perhaps by some passing animal, the seeds are jerked out.

In other cases they are, no doubt, carried by birds. The pointed tubercles of *Lychnis Flos-cuculi* perhaps serve for this purpose. The largest seeds of any British species are those of *Lychnis Githago.* It is an annual species. On the other hand, *Stellaria Holostea* and *Arenaria peploides,* in which the seeds are nearly as large, are both perennials.

CISTINEÆ.—The Cistineæ also are represented in our flora by a single genus—*Helianthemum,* the Rock-rose. The fruit is a capsule, 1-celled, or incompletely divided into several, and opening by 3, 5, or 10 valves. The seeds are smooth.

PORTULACEÆ.—Of this order we have only one really native species, *Montia fontana,* and one naturalised, *Claytonia perfoliata.* Of the latter I will only observe that it is another case in which seeds in capsules are black and glossy. The seeds of *Montia* are probably carried about by aquatic birds.

HYPERICINEÆ.—The fruit is a capsule, or in some foreign species a berry. *Hypericum Androsæmum* forms a connecting link between the two, as the capsule is succulent and as a rule does not open. In the other species, or most of them, the capsule opens at the summit, and the seeds are scattered by the wind.

In *H. perforatum, H. hirsutum* and some others, in fact in our British species generally, the seeds are sausage-shaped and pointed at each end. The seeds appear to be often sterile. Some of the exotic genera have winged seeds.

MALVACEÆ.—The fruit in the Mallows is formed on a very different plan from any of those which we have hitherto been considering. It is indeed in rare cases a berry, but generally, and in all our British species, it consists of many carpels arranged in a circle round a central axis. The seeds are sometimes several, but in British species one, in each carpel, to which it conforms. The surface is often rugose, but so finely as to be practically smooth, brown or black.

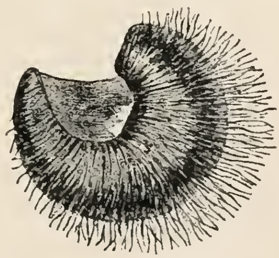

FIG. 72.—Carpel of *Malva moschata.*

The carpels are in some species glabrous: this is the case in *M. sylvestris,* which, however, has a variety, var. *lasiocarpa,* with hairy carpels. In *M. rotundifolia* they are downy, and in *M. moschata* hairy.

The hairs of course render the capsules lighter, and would thus promote dispersal by the wind. In *Althæa* the carpels are flattened and winged, which would promote the same object. It is impossible, however, not to be struck by the singular resemblance the capsules present to small green or brown caterpillars, curled up in the attitude so common to them. Many small caterpillars also are covered with long hairs, and would thus be mimicked by the hairy capsules (fig. 72). The resemblance is so striking that it can hardly be accidental, and I have suggested elsewhere that birds pick up the carpels taking them for insects, and carry them, with the seeds in them, some little distance before finding out their mistake.

Celastrineæ.—Of this order we have only a single species, *Euonymus europæus*, the Spindle. As in so many other small trees, the fruit is arranged to attract birds. It is a 4-celled and lobed capsular fruit, more or less tinged with red. Each cell contains 1–2 seeds, which are rather large and completely covered by a brilliant orange or red "arillode." When the carpels burst open, which occurs on the dorsal suture, the seeds drop, and hang suspended by a long stalk. It is one of the comparatively few plants in which the embryo early assumes a green colour.

Tiliaceæ.—In this family the fruit consists of 2–10 cells, or it is 1-celled by suppression or many-celled by false septa, or a drupe, or (rarely) a berry. The construction is therefore very various.

In our only species, the Lime, it is a small globular nut containing one or two seeds. In many trees (Sycamore, Maple, Elm, Hornbeam, Pine, Fir, etc.) the seeds are disseminated by means of wings, which, though they serve the same purpose, are of very different origin. In the Lime the peduncle of the fruit is bordered or winged halfway up by a long narrow leaf-like bract.

The seedling is very unusual. It is palmate, consisting of five lobes, the central one being the longest. This peculiar form enables it to lie in the hollow of the seed, just occupying the concavity of the cup.

Lineæ.—The fruit is a septicidal capsule, consisting of five carpels. The seeds are much compressed laterally, and the main point which I would notice in connection with the present Address is that if the seeds are moistened, as, for instance, by coming in contact with damp ground, they develop a copious mucilage which attaches them to the soil, and thus perhaps facilitates the exit of the young plant. This property is well known to us through the familiar linseed poultice.

Geraniaceæ.—In this order also the fruit presents very curious and diverse structures. Our four British genera have each totally different plans for the dissemination of the seed:

Capsule separating into five 1-seeded carpels, each with a long awn; awn elastic, not twisted (*Geranium*); awn twisted (*Erodium*). Capsule with four angles opening with as many valves (*Oxalis*). Capsule bursting elastically in five valves which roll inwards (*Impatiens*).

In the *Geraniums* the five 1-seeded carpels are arranged round a long central receptacle, and curl upwards, with a long elastic awn, which at maturity detaches itself from the beak elastically and throws the seed (sometimes with, sometimes without the carpel) to a distance of several feet.

Even in *Geranium* itself the differences are considerable. After the flower has faded the central axis gradually elongates. The seeds, five in number, are situated at the base of the column, each being inclosed in a capsule, which terminates upwards in a rod-like portion, which at first forms part of the central axis, but gradually detaches itself. When the seeds are ripe the ovary raises itself into an upright position ; the outer layers of the rod-like termination of the seed-capsule come to be in a state of great tension, and eventually detach the rod with a jerk, and thus throw the seed some little distance.

In some species (*G. Robertianum*, *G. lucidum*, *G. molle*, *G. pusillum*, *G. pyrenaicum*) the carpels detach themselves and are thrown with the seeds. In others (*G. sanguineum*, *G. pratense*, *G. sylvaticum*, *G. columbinum*, *G. dissectum*) the capsules remain attached to the awn. The seeds are retained temporarily in place by a tuft of hair.

In this genus we get a clue to the meaning of the difference of the texture of the surface of seeds. In the first group, where the valves are thrown with the seeds, the surface of the seeds is smooth. In the second they are more or less reticulated, which would make them lighter and more easily carried by wind. It might also serve to hold the seeds to the ground, and thus facilitate the exit of the cotyledons.

In *Erodium* the structure is somewhat similar, but the *modus operandi* is very different. The capsules remain attached to the awns, and closely envelop the seeds. The awns are twisted, and more or less hygroscopic. Consequently, like those of some grasses—the so-called " live oats " for instance, they elongate and contract with differences in humidity. This tends to press them into loose sand or earth, and as the seeds are more or less covered with backward-pointing hairs, they can practically only move in one direction, so that they are forced more and more deeply into the ground.

The seeds remain in the carpel, and, as in the *Geranium*, where this is the case, they are smooth.

In *Oxalis* also the seeds are thrown, but the mechanism is quite different. The force resides in the seed itself. The capsule, as in the preceding genera, is 5-chambered, but the walls are fleshy, except opposite the middle of each chamber, where they are comparatively thin. The outer coat of each seed is a transparent covering, within which is a smooth, hard black testa. The outer coat contains four to five layers of parenchymatous cells. The cells of the inner layer are smaller than those of the outer, closely compressed, and gradually becoming very turgescent. This is not the case with the outer layer. Finally, the coat splits down one side, the inner cells expand at once, thus turning the coat inside out, the inner and now larger layer coming to the outside, while the originally outer layer is turned inwards. The result of this is that the seed is jerked out to a considerable distance. Owing to the elevation of the capsule, the seeds fly clear of the leaves.

Lastly, in the Balsam (*Impatiens*), the dividing walls of the 5-chambered capsule are thin, and eventually separate themselves from the centre, which thus becomes a pillar standing in the middle of the fruit. As the fruit dries, the cells immediately below the epidermis are in a state of gradually increasing tension, more so than the layers below. Moreover, while the carpels of *Geranium* are straight, and thus assume a position like that of a watch-spring, those of *Impatiens* turn slightly to one side (the right), the result of which is that in contracting they resemble a corkscrew. Finally, the fruit bursts, the valves roll up suddenly like a watch-spring, and fly off, carrying the seeds with them. In this case, therefore, the elastic tissue is part of the ovary —not, as in the preceding genus, the outer coating of the seed itself.*

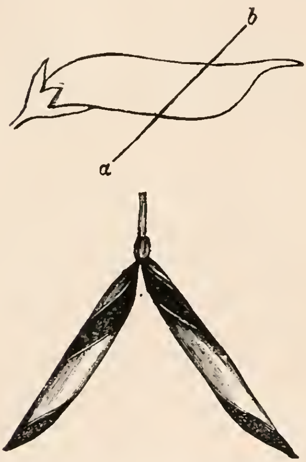

Fig. 73.—1, Pod of Common Vetch. The line *ab* shows the direction of the woody fibres. 2, Pod of Common Vetch after bursting open.

Aceraceæ.—The Maples (Aceraceæ) are trees, and have winged fruits, which are often carried by the wind to a considerable distance.

Rhamnaceæ.—Our British species of this family (the Buckthorns) are also shrubs or small trees, and the fruit, as is so often the case with small trees, is a berry. The colour is black or dark purple.

Leguminosæ.—The ovary of the Peaflower is single 1-celled, with one or more seeds arranged along the inner or upper angle. The fruit is a pod. The seeds as a rule are smooth.

With this uniformity, however, is combined much variety. In some (*Vicia hirsuta, Genista anglica, G. tinctoria, Ulex, Ononis, Lotus, Lathyrus Nissolia, L. pratensis, L. maritimus*) the pod bursts open elastically and scatters the seeds. Each valve of the pod

* Zimmerman explained the dehiscence by the tension of the woody layer; Steinbrinck, by the difference between the tension of the woody layer and of the outer epidermis, which is also Eichholz' view. (Pringsheim's Jahr. Wiss. Bot. xvii., 1886.)

contains a layer of woody cells, which however do not pass straight up the pod, but are more or less inclined to the axis. When the pod bursts it does not, as already described in *Cardamine*, roll up like a watch-spring, but twists itself more or less like a corkscrew (fig. 73).

In a thicket of Furze in dry bright weather a continuous crackling may be heard. In many genera the pods do not open.

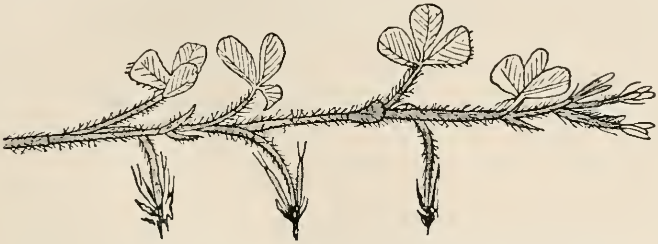

FIG. 74.—*Trifolium subterraneum.* Shoot showing buds at end, and three older flower-heads, which are turned down and beginning to bury themselves.

Some are provided (*Medicago*) with hooks and spines and are carried away by animals; in other species of *Medicago* the pods are curled in several close spires, thus forming balls or wheels, which are rolled along the ground, especially in hot dry countries, by the wind.

Several foreign species of Leguminosæ (*Arachis hypogæa, Vicia amphicarpa, Lathyrus amphicarpa*, etc.) have a similar habit. In *Astragalus* the dorsal suture is inflected, while in the allied genus *Oxytropis* the ventral suture is inflected.

Ornithopus and *Hippocrepis* have many-seeded pods, and between each two seeds is a constriction which acts like a hook. In *Trifolium dubium* and *T. filiforme* the style is persistent and hooked. In *T. fragiferum* and *T. resupinatum* the calyx is inflated, and persistent, thus probably assisting in dispersal by wind. *T. subterraneum*, a low white-flowered species which is becoming common on golf-courses, buries its seeds, which, as in other similar cases, are few in number (figs. 74, 75).

FIG. 75.—*Trifolium subterraneum.* Flower-head, slightly magnified.

ROSACEÆ.—From our present point of view the Rose family may be divided into those with a succulent, and those with a dry fruit. To the former belong *Prunus, Rubus, Fragaria, Rosa, Cratægus*, and *Cotoneaster*; to the latter, *Spiræa, Dryas, Geum, Potentilla, Alchemilla, Agrimonia*, and *Poterium*.

In the first group the fruits are adapted for dissemination by animals, and especially by birds. The seeds have very generally a hard or bony covering, so that when the fruit is eaten they pass away uninjured.

In strictness it is not, however, quite correct to say, as regards the whole of the first division, that the "fruit" is pulpy. In the Strawberry, for instance, what we call the fruit is rather the enlarged receptacle. The true fruits are what we generally regard as the seeds. The hips of the Rose, again, are an enlarged and deeply concave receptacle, on the inner face of which the true fruits, or achenes, are inserted. The seeds are protected both by the outer woody structure of the achenes, and by the stiff hairs with which they are covered. The haws of the Thorns differ from the hips of Roses in being more or less adherent to the bony mass in the centre.

In the Pear and Apple the cartilaginous carpels are completely inclosed in a firm and fleshy receptacle. In all these cases the true seeds are practically smooth.

The fruit of the Raspberry and Blackberry is quite different from that of the Strawberry. The outer coat of the achene is sweet and juicy, and is the part for the sake of which the fruit is eaten. The receptacle, which is the delight in the Strawberry, is in the Raspberry the white, fleshy, but not sweet, central cone, which we leave behind.

In the dry-fruited Rosaceæ the achenes of *Dryas* terminate in a persistent, feathery style, and are adapted for dispersal by wind. *Geum montanum* has a similar feather. In our common *Geum urbanum* the carpels are hairy and terminate in a style, which is hairy in the middle and smooth at each end. Immediately below the hairy tract a projection develops (fig. 76), which gradually elongates and curves. Finally, when the seed is ripe, the upper part of the style detaches itself (figs. 77, 78, 79), so that the fruit terminates in a hook, which entangles itself in the hair of any passing animal. It will be seen, however, from the arrangement that the fruit cannot be torn away until it is ripe. Any one who has walked through a field where this species flourishes can testify to the effective manner in which the achenes attach themselves to a passing animal.

Potentilla Fragariastrum remarkably resembles the Strawberry, and differs mainly in the absence of the fleshy receptacle.

Some of the foreign species have winged seeds, and are evidently adapted for dispersal by the wind.

ONAGRARIEÆ.—In this family we have six British genera, which differ materially in the structure of the fruits and the mode of dispersal of the seeds.

The fruit of *Epilobium* is a pod, which opens from above downwards. The seeds are numerous, and at the upper end have a tuft of long, silky, white hairs. They are therefore adapted to be driven by the wind.

In *Circæa*, the Enchanter's Nightshade, the fruit is obovoid, 1–2-celled, with one seed in each cell, conforming to the interior of the cell. The fruit is covered with bristly, spreading, hooked hairs. They would thus, with the seed in them, be carried away by passing animals. When the fruit is ripe the pedicel turns downwards. It is thickened and articulated at the base.

The other three genera are aquatic plants, with small seeds. They are probably carried with mud by birds from one pond to another.

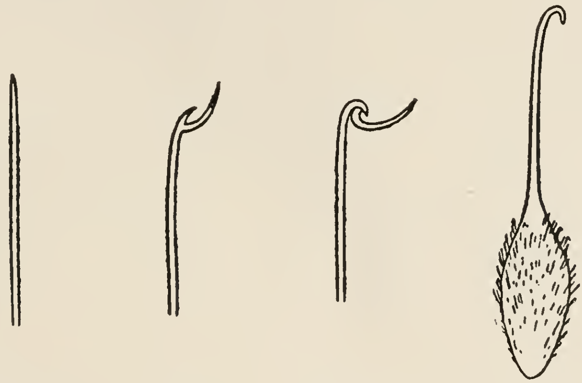

FIG. 76. FIG. 77. FIG. 78. FIG. 79.

Figs. 76–79.—*Geum urbanum.* Fig. 76, young style; Fig. 77, older; Fig. 78, still older; Fig. 79, ripe fruit.

CUCURBITACEÆ.—Our only British species of this family is the Common *Bryony.* The fruit is a berry, red or orange in colour, and the leaves are deciduous. This accords with the suggestion made already.

The seeds are flat and nearly orbicular.

CRASSULACEÆ.—The seeds are generally small, and therefore easily carried by the wind. They adhere also to almost any surface.

RIBESIACEÆ.—The fruits are berries with more or less sweet juice. The seeds are suspended on long stalks.

SAXIFRAGACEÆ.—The fruit is a capsule, which, as in so many cases, opens at the top, so that the seeds are jerked out by the wind. As a rule they are very small. Those of *S. oppositifolia* are decidedly papillous, which would tend to make them adhere the more closely to the fur of animals.

In *Parnassia* and *Drosera*, as in some other plants of a similar habit (*Narthecium*, etc.), the testa is spongy and loose in texture.

This would make it lighter and enable it to float, or perhaps prevent it from sinking too deeply into the herbage of the *Sphagnum* in which it so often lives.

Each of our species of *Drosera* differs somewhat from the others in the texture of the surface of the seeds. There must, I suppose, be some reasons for these differences, but they are not very apparent.

In *D. intermedia* the seeds are densely covered with small elevated points, as in some species of *Arenaria, Silene,* and other Caryophylleæ. These would, no doubt, lighten the seeds.

Umbelliferæ.—There are two carpels, coherent into a 2-celled ovary, each cell containing one ovule, suspended from the top. The fruit is 2-celled, dividing into two portions (mericarps) often suspended at the top of single or double axis. The surface has ten ridges, sometimes produced into wings. The furrows between the main elevations are sometimes occupied by subordinate ridges. The seed is pendulous. The fruit is often compressed; sometimes laterally, in which case a slice cut through the seed has an oval form, the division being across the narrow diameter. When the compression is from back to front, the division is across the broadest diameter. In this order the seeds are comparatively uniform, and the main differences occur in the fruits.

The fruits are dry and in some cases eaten by birds, but the principal modes of dispersal are by hooks or wings.

It might have been expected that these different methods of dispersal would have prevailed in different groups of the order. As, however, we have seen in other cases, this is not the case. Hooks, for instance, occur in several genera (*Sanicula, Anthriscus, Daucus, Caucalis*) by no means nearly allied. *Anthriscus vulgaris,* for instance, in which the carpels are armed with hooked bristles, is so nearly allied to *Chærophyllum temulum* and *C. sylvestre* that Bentham in the "Handbook of the British Flora" places it in the same genus as *C. Anthriscus.*

In *Eryngium* the carpels are covered with chaffy scales, which are longest on the primary ridges. These would serve to lighten the fruit, but they would also help to entangle them in the fur of animals.

In other cases the persistent styles are recurved, forming hooks which would serve for the same purpose (*Ægopodium, Sium, Pimpinella*).

Winged fruits occur in *Angelica, Smyrnium, Crithmum, Myrrhis, Sium,* etc. These, as we should expect, are glabrous.

In *Scandix Pecten-veneris* the fruit is developed into a long beak, and when the bases of the carpels split away, they diverge widely. Perhaps this facilitates their being torn off by any passing animals.

The aquatic species, as usual, are glabrous. In some Umbellifers, especially those of dry regions, the seeds are extraordinarily light.

Araliaceæ.—Of this order we have only one species, the Ivy, *Hedera Helix.* It is as a rule the last of our English species to flower. The fruit is a black, 5-celled berry, with one seed in each cell. These are somewhat irregular in form, convex on the back, and wedge-shaped from being arranged round a centre, so that the five together form a sphere.

Loranthaceæ.—The fruit of this interesting plant is also a berry, the Mistletoe (*Viscum*), and no doubt is intended for dispersal by birds. It is white, and contains a single seed imbedded in a peculiarly glutinous pulp, which serves to make it adhere to the bark of any branch on which it is deposited. For seeds which rest on the ground such a provision would be unnecessary.

Cornaceæ.—The fruit of the Cornels is, in ordinary language, a berry, but technically it is a drupe, i.e. a berry in which the "pericarp" consists of two distinct layers, the outer one fleshy or pulpy, the inner one dry and cartilaginous or woody. This layer is, in *Cornus*, very hard, and no doubt effectually protects the seeds when the fruit is eaten. It is 2-celled, with one seed in each cell.

The fruit of *C. sanguinea* is black, and thus conspicuous against the leaves, which are a bright red in autumn. *C. suecica* has red fruit.

Caprifoliaceæ.—The fruit is a berry, generally 1-seeded, green in *Adoxa*, but generally either red or black. The fruits are evidently intended for dissemination by birds, and the actual seeds are protected as usual in such cases by the hardness of the inner coat or "endocarp."

In the Honeysuckle the divisions of the cells soften or disappear.

Stellatæ.—Of this family, or sub-family, we have four genera.

In *Rubia* the fruit is a small, black, 2-lobed berry.

In the large genus *Galium*, *G. Cruciata* has almost succulent fruits. In others, for instance *G. boreale* and *G. Aparine* (Cleavers), the fruits are hooked. With the exception of *G. boreale*, which has hooked bristles on the fruit, the perennial species are smooth, while the annual species have reversed spines or hooks, if not on the fruit; at any rate on the stems. I am inclined to suggest that parts of the plant are torn off and carried away, the fruits, of course, going with them. In *G. tricorne* the pedicels are turned back, and thus form a hook.

The rough fruits of *Sherardia* are surmounted by the enlarged calyx, which has spreading teeth.

Solanaceæ.—The Solanaceæ have two carpels, cohering into a two-celled ovary. The fruit is technically a capsule, a berry either dry or pulpy, or a "pyxidium," i.e. a box with transverse dehiscence, as in the Pimpernel.

In two of our four English genera, *Solanum* and *Atropa*, the fruit is a many-seeded berry.

In *Solanum* the fruits are deeply, but finely pitted and rugose, and are no doubt scattered by birds when eating the pulpy fruit. In *S. nigrum* the fruit is black. In *S. Dulcamara*, which has a climbing or straggling habit, they are red and very conspicuous in autumn after the fall of the leaf. On the Continent they are sometimes black, sometimes red, sometimes yellow or yellowish-green, and are said to come true from seed. *Atropa Belladonna* has a rather large, black berry.

In *Datura Stramonium* the fruit is a large, globular, prickly capsule, which opens at the top. The seeds are large, numerous, and wrinkled, flattened by mutual pressure, and black.

In our fourth genus, the Henbane (*Hyoscyamus niger*) the fruit is also a capsule. It is crowned by the persistent and enlarged calyx, which forms a cup, from which the seeds are gradually scattered by the wind, when the cap of the capsule has been thrown off. The seeds are numerous, laterally much compressed, reniform, and approximately orbicular, but varying a good deal in shape and size. They are somewhat deeply pitted.

Valerianeæ.—The fruit is small, dry, and seed-like, 3-celled, each with one ovule, two of which, however, come to nothing. The empty cells, no doubt, serve to lighten the seed. In *Centranthus* and *Valeriana* the border of the calyx develops into a beautiful feathery pappus. In *Valerianella* there is no pappus. The fertile cell is larger than the others. The fruits present curious little differences in the different species.

Dipsaceæ.—In this order, which is very nearly allied to the Valerianeæ, though in appearance more nearly resembling Composites, we have two genera, *Dipsacus* and *Scabiosa*. In *Dipsacus* the bracts surrounding the flower-head form a sort of cup surrounding the seeds, and from which they are ejected. In the Fuller's Teasel, which is generally regarded as a mere variety of *D. sylvestris*, but the origin of which is not known, the scales are hooked.

In *Scabiosa* the calyx terminates in fine bristles, which must often get entangled in the hairs and wool of passing animals.

Compositæ.—Of this great family we have nearly fifty British genera. As to the number of species, there are great differences of opinion. This is due in great measure to the difficulty of determining the number of species in the very complex and variable genus *Hieracium*. The ovary is inferior, 1-celled, 1-ovuled. The fruit is always dry; it is an "achene," generally sessile, sometimes provided with a long beak.

The modes of dispersal of the seeds, or, to speak more technically, the achenes, are very various. When they are small, as in the Daisy, they probably adhere to the feet of animals, especially in wet weather. In many cases, no doubt, they are carried by birds. In *Bidens* the achenes terminate in barbed bristles. In the Burdocks (*Arctium*) the bracts surrounding the flower-head are strongly hooked at the apex, and evidently arranged so that the whole head should be carried away by some passing animal.

In a large proportion of the species the achenes are distributed by the wind in consequence of the presence of a pappus. In some cases it is but slightly developed. In *Arctium* it has possibly degraded, being replaced by the hooked barbs.

Other genera possibly represent cases in which it is even now being evolved. In *Centaurea*, for instance, it is short, and cannot be very efficient.

In many genera, however, it is highly and beautifully developed. The hairs of the pappus are in some species simple, and in others, which seem to represent the highest development, plumose.

The life-history of the plant seems often arranged with reference to them. In the common Dandelion the bud lies prostrate on the ground; when the florets are ready to open, the flower-stalk raises itself so as to get all the sun, and be as conspicuous as possible to insects. Every evening and in wet weather it closes, so as to preserve its precious charge from too much wet. I once kept one awake, however, all night by keeping it in the light of an Argand lamp. When the flower is fertilised, the stalk once more becomes horizontal, or nearly so, thus endeavouring to avoid the dangers which might befall it if it remained upright while the seeds were maturing. This takes about a fortnight, and when the seeds are ripe the flower-stalk again rises perpendicularly, thus assuming the position most favourable to assist in the dispersal of the achenes by the wind. Where the grass is short, as for instance on lawns, the intelligent plant keeps its flower-stalk also short!

In the Dandelion (*Taraxacum*), the Lettuce (*Lactuca*), and some others, the achenes terminate in a long beak. The object of this, perhaps, may be to carry the upper end further from the disk of the flower-head, and thus give more space for the expansion of the pappus.

In the species hitherto mentioned, the seeds are all alike.

In *Leontodon hirtus*, however, most of the fruits have a well-developed pappus; but those of the outer row have none.

In *Hypochœris glabra* the pappus of the outer florets is sessile, while the inner ones are on a long beak.

The common *Calendula* (Marigold) (fig. 80) of our gardens is an even more interesting case. Three devices for dispersal are united in each head. The outer achenes (fig. 81) are narrow, and bent into a curve forming three parts of a circle, and well adapted to hang on to the fur of any passing animal. Then follow a certain number which are puffed out with wide wings (fig. 82), and are evidently intended for dispersal by wind. Towards the centre the achenes are smaller, and much resemble small green or brown caterpillars (fig. 82). These, it has been suggested, are picked up by birds, and then dropped when they discover their mistake. Between the extreme types there are many intermediate forms.

Fig. 80. Fig. 81. Fig. 82.

Figs. 80–82.—Seeds of *Calendula officinalis*, showing various forms.

Ericaceæ.—The fruit is a capsule, a berry, or a drupe. The ovary has generally as many cells as the lobes of the corolla, with one to many seeds in each.

The genera with berries are *Vaccinium*, *Arbutus*, and *Arctostaphylus*. *Vaccinium Vitis-idæa*, *V. Oxycoccus*, and *Arbutus Unedo* have red berries and evergreen leaves. *Vaccinium Myrtillus*, *V. uliginosum*, and *Arctostaphylus alpina* have black berries and deciduous leaves, in accordance with the general rule.

In the remaining genera, *Andromeda*, *Loiseleuria* (*Azalea*), *Menziesia*, *Calluna*, *Erica*, *Pyrola*, and *Monotropa*, the fruit is a capsule. The seeds are small. In *Monotropa*, as in so many parasites, the seeds are very small. They are nearly cylindrical, and covered with a loose testa, produced at both ends.

In *Andromeda Polifolia* the seeds are black and glossy, as is so often the case in species where this arrangement prevails. Those of *Calluna* are reticulated and light.

Campanulaceæ.—The fruit is a capsule, with many-seeded cells. The seeds are numerous and minute, and, as in other cases, are jerked out by the wind or by passing animals. In the latter case they would readily adhere to the fur, and so be carried away. In some species of the genus *Campanula* the capsule opens as usual at the top or near the top (*C. Rapunculus, C. patula, C. persicifolia, C. cenisia, C. hybrida*, etc.) In others, on the contrary, the openings are at or near the base (*C. rapunculoides, C. rotundifolia, C. Trachelium, C. latifolia, C. Medium*, etc. I have suggested as the explanation of the difference that in the former species, however, the capsules are upright, in the latter group they hang down. In both cases, therefore, the openings are at the upper end, so that the seeds cannot drop, but must be shaken out.

PRIMULACEÆ.—The fruit is a one-celled capsule, containing more or less numerous seeds.

In *Primula, Lysimachia, Cyclamen*, and *Samolus*, it opens at the top; in *Anagallis* and *Centunculus* transversely, the upper half becoming detached, leaving the seeds in a sort of cup. Along

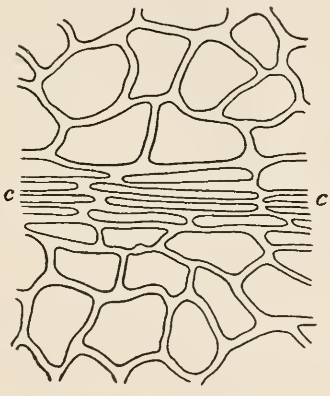

FIG. 83.—*Anagallis arvensis.* Wall of the capsule.
c c, elongated cells along the line of dehiscence.

the line of dehiscence (fig. 83) the cells are elongated transversely, and are but slightly attached to one another, while above and below they present irregular outlines, which tend to keep them together.

The seeds are attached to the receptacle by their ventral face, while the outer one is rounded or flattened by the walls of the capsule. They are more or less pitted.

AQUIFOLIACEÆ.—The holly is a typical berry-bearing tree. If we speak of a berry, the holly is one of the first we think of. Botanically, however, the fruit is a drupe rather than a berry. The ovary is 3–5, generally 4-celled, with one seed in each cell.

The fruit is red, as usual with evergreens, and we all know how they show up against the green leaves.

LENTIBULARIACEÆ.—Fruit, a capsule. We have two genera, *Pinguicula* and *Utricularia* (plate IV. fig. 2). The seeds of *Pinguicula* are relatively large, oblong, terete or nearly so, with a furrow on one side corresponding to the raphe, netted, with the meshes in longitudinal lines, light brown and shining. They are slightly prolonged at the base and the funiculus is partly persistent.

They are very light and adhere readily to the fingers, so that they could often be carried away by any animal treading on them.

The British *Utricularias* are all water-plants, celebrated for their curious "eel traps," which serve to capture minute water-animals. The seeds are small, oblong and striated.

Jasminaceæ.—The structure of the fruit presents again, in this family, great differences. In some genera it is a capsule, in others a berry.

We have two genera, *Fraxinus*, the Ash, with dry capsules, commonly called keys, which, including the wing, are about an inch and a half in length, thin and light, so that they are easily carried by the wind. They have a slight twist, as in other similar fruits, and this probably tends to carry them further.

Such winged fruits are very typical of high trees. On the other hand, our second genus of the family, *Ligustrum* (the Privet), like so many other bushes and low trees, has a berry fruit. In the early stages there are two ovules in each cell, but, as in so many other cases, only one comes to maturity.

The fruit is black, and the leaves nearly evergreen. It is evidently intended to be eaten by birds, and the embryo is probably protected by the hard endosperm.

Apocynaceæ.—The fruit consists of two oblong or elongated capsules or follicles, each of a single cell, diverging as they ripen.

Vinca minor, the lesser Periwinkle, is the only truly British species. It has oblong-cylindrical seeds, terminated abruptly at each end. They are probably disseminated by birds and small quadrupeds.

Gentianaceæ.—Fruit a capsule, dehiscing along the margins of the carpels; many-seeded. The fruit is generally a capsule, but sometimes, though not in British genera, a berry. The capsules of *Limnanthemum*, as in some other water-plants, sink below the surface while the seeds are ripening. As in so many seeds which are intended to be scattered from capsules, those of *Gentiana Amarella* are pitted and glossy.

Polemoniaceæ.—The fruit is a 3-celled capsule, opening by three valves opposite the middle of the cells. The seeds have a narrow wing, but are probably more effectively dispersed by being jerked from the capsule.

Convolvulaceæ.—The fruit is either a capsule, with valves detaching from the septum, or a berry. In most of our species there are four seeds, each forming a quarter of a sphere, so as to fill up the capsule.

We have two genera—very different in habit and appearance.

Convolvulus has an indehiscent capsule. In *C. sepium* the seeds are rather large and heavy. In the smaller species we have a somewhat rare case, the form of the capsule depending on the number of seeds which are fertilised. If the capsule has its full complement of four seeds, it is 4-angled.

In *Cuscuta europæa* (the dodder) the capsule bursts transversely at the base. It seems probable that the long, filiform, twisted and curling stems often get torn away by passing animals, carrying the seeds with them.

Boragineæ.—The ovary as a rule is deeply 4-lobed, with a simple style inserted in the centre. The fruit consists of four small nuts, resembling seeds, and inclosed in, or surrounded by, the calyx.

In *Symphytum* the seeds are hard, smooth, and polished, resembling small pebbles. They are probably distributed partly by water and partly by birds. Those of *Lithospermum* are similar, and in *L. officinale* bright blue, which makes them very conspicuous. Birds are fond of them, and, as they are so slippery, must often drop them about.

In *Myosotis*, the Forget-me-not, the calyx tube contracts more or less over the nutlets, so that they generally remain for some time together. The species may be divided into three groups. In *M. cæspitosa*, *M. palustris*, and *M. repens*, the hairs on the calyx are straight and depressed. The nutlets readily adhere to the fingers, and may probably thus be carried about by animals.

In *M. versicolor*, *M. arvensis*, and *M. collina*, this is evidently the case. The calyx is covered with bristly hairs, many of which are hooked. They cling tenaciously to any woolly or rough surface. In *M. sylvatica* there are three kinds of hairs, adpressed and short, long and arching, while some are hooked and of intermediate length.

The most highly modified fruits in this direction are those of the Hound's-tongue, *Cynoglossum*. The nutlets separate from the receptacle, and only remain attached to the central axis by the produced upper ends, which makes them more liable to be carried away by animals. This is still further promoted by the fact that the nutlets are densely covered with conical, "glochidiate," or many-barbed warts, which readily catch in, and hold tight to any woolly or rough surface.

Orobanchaceæ.—The Orobanchaceæ are all parasitic, and, as is usual in such cases, the seeds are small, in some species so small as to resemble dust. The fruit is a capsule. Green leaves are entirely wanting.

Scrophulariaceæ.—The fruit is generally a capsule, sometimes, however, though rarely, and not in any of our British species, a berry. The seeds are generally more or less sculptured, though some are smooth. These are generally quite small. Those of some species of *Linaria* (*L. vulgaris*, *L. Pelisseriana*) and *Rhinanthus Crista-galli* are winged. In *Linaria Cymbalaria*, which lives habitually on walls, the flowers face outwards, but after they are fertilised the flower-stalks turn towards the wall, thus tending to protect the seeds and often to sow them in some cranny. They are ridged and very light, so as to be easily carried about by the wind. In other species of *Linaria* the capsules open at the top, and the seeds are jerked out by the wind, as is also the case with those of the Foxglove (*Digitalis purpurea*).

The seeds of *Veronica* are peltate, being attached to the placenta by the middle. In some species they are deeply cup-shaped, owing to the curvature of the edges, so as to occupy all the space available in the cells of the capsule. This makes them very light, and thus esily carried by wind (plate IV. fig. 3). The species differ much in the size of the seed, those of the aquatic species being very small.

In the Snapdragon the seeds are covered with high longitudinal ridges. These would serve to lighten them, and perhaps tend to protect them from being eaten, as well as against great cold. A similar arrangement occurs in some foreign species, notably, for instance, in *Maurandia Barclayana*.

Those of *Euphrasia* are of an unusual type. They are large, oblong, narrowed to both ends, flattened on one side and ribbed longitudinally. The ribs are greyish.

Melampyrum offers a very interesting case. The seeds mimic the cocoons of ants. They are of the same form, size, and colour, white with a black spot at one end. I have observed that they are, as a matter of fact, carried away by ants, being, I think, taken for cocoons (plate IV. fig. 4).

Labiatæ.—Ovary of two carpels, each with two cells, free or in pairs. Fruit consisting of four achene-like lobes or nutlets.

The fruit of the Labiatæ recalls that of the Boragineæ. As in that order, it consists of four nutlets, which, however, in the Labiatæ are as a rule smaller, and do not present so many differences. They closely resemble, and are often taken for seeds. The calyx in the Labiatæ is either small or tubular, and the base is always narrow. When the nutlets are small they are more or less spherical; when they are larger they are often more or less trigonous by mutual pressure (plate IV. figs. 5*a*, 5*b*).

The nutlets having assumed the character and functions of seeds, have also developed a style of sculpture which is generally confined to true seeds. They are often netted or covered with small warts.

Some of the larger forms are remarkable in being variegated or spotted (*Galeopsis angustifolia*, *G. versicolor*, *G. Tetrahit*, *Lamium* *amplexicaule, L. hybridum,* etc.). No explanation of this has yet been suggested.

Many species have a ring of hairs in the throat. This would tend to protect the nutlets when young and delicate, but its principal use perhaps may be to prevent them from falling out, unless thrown out by a high wind, which of course would increase the distance to which they would be jerked. It is remarkable that in the genus *Calamintha,* the ring of hairs is present in *C. arvensis* and *C. officinalis,* but does not occur in *C. Clinopodium.*

It would almost seem as if in some species—for instance, in *Mentha rotundifolia* (Mint), *Nepeta Cataria,* and in Marjoram, *Origanum vulgare*—the nutlets are intended to be dispersed in the calyx, and in the latter species the bracts also appear to aid in the dispersal. In *Marrubium vulgare* the calyx has ten spinous teeth, one for each rib, recurved and strongly hooked at the tip. *Stachys sylvatica* also has recurved teeth. In some species the calyx teeth are covered with long, bristly hairs, which, besides their usual function, may serve to assist the dispersal of the seeds. In the Mint (*Mentha sylvestris*) the surface is covered with little points and depressions, and in water absorb moisture, and swell up into globular, transparent sacs.

In *Salvia Verbenaca,* and other species of the genus, the nutlets become mucilaginous when wetted. This perhaps may be useful in causing them to adhere to damp ground. In *S. pratensis* the nutlets when placed in water emit long colourless filaments, which are more or less spirally coiled. In *S. Horminum* the mucilaginous tissue in places extends to half the depth of the whole, and as soon as it comes in contact with water it swells out with great rapidity, increasing to many times its original thickness. It develops into thick threads, which move and, so to say, wriggle about like so many worms.

The Skull-cap (*Scutellaria*) is so called because the calyx bears a curious resemblance to an ancient helmet, with the visor down. The upper lip is closely pressed down on the lower one, thus protecting the nutlets. When ripe the top of the helmet flies off at a touch, and the nutlets are at the same time jerked away.

In *Galeopsis versicolor* the calyx has stiff glandular hairs, which would cause it to be torn off if brushed against by animals. The seeds are large and peculiar. It is now a weed of cultivation, but no doubt its peculiarities go back to a period before the cultivation of corn (plate IV. fig. 5*a*). The nutlets are large, oblong, bluntly trigonous in the lower half, strongly rounded or convex on the upper half of the inner face, which slopes away to the ridge forming the two lateral edges, convex on the dorsal aspect. The surface is granular and dark brown, more or less densely marked with grey specks.

The nutlets of *Ajuga* are also peculiar. Those of *Ajuga reptans* (plate IV. figs. 6*a*, 6*b*) are large and strongly netted, the meshes being arranged in longitudinal lines. The base of the inner face is angled, with a flat crescent-shaped area on either side of of the angle where they come in contact with one another. Those of *A. Chamæpitys* (plate IV. figs. 7*a*, 7*b*) are more elongated, united for more than half their length, and prominently netted with strong, obtuse ridges, the meshes being arranged in longitudinal lines.

In *Teucrium Botrys* (plate IV. figs. 8*a*, 8*b*) the nutlets are globular, relatively large, united over a considerable area at the base, netted with broad ridges, and a deep pit in each mesh, more or less covered with sessile mealy glands.

Verbenaceæ.—This family differs from the preceding principally in having the ovary entire. The fruit is four-celled, with one seed in each cell, and at maturity separates into four nutlets, each of which is oblong, truncate at the apex, four- to six-ribbed on the dorsal aspect. The seed, which is entirely filled by the embryo, closely conforms to the interior of the nutlet.

That of *V. teucroides* (plate IV. fig. 9), a native of Brazil, has a somewhat peculiar form.

Plantagineæ.—The fruit is a capsule, opening transversely, or indehiscent. The seeds are sometimes few and comparatively large, in other species more numerous and smaller. Wind is probably the principal agent in distribution, but birds feed on them, and no doubt sometimes drop them. In some species they are mucilaginous.

Chenopodiaceæ.—The ovary is 1-celled. The fruit a utricle, that is to say the outer covering formed of the ovary, loosely surrounds the single seed, or in some rare cases the fruit is a berry. The flower is often persistent, and incloses the fruit. This probably facilitates dispersal by wind.

The seeds may be either vertical or horizontal, both forms occurring in the same genus, and even in the same species (*Chenopodium Bonus-Henricus*, *C. rubrum*). In this family also we meet cases where, as in *Chenopodium fœtidum*, the testa is mucilaginous.

In *Atriplex hortensis* there are two kinds of seeds. They differ in size and colour. The larger seeds are the more numerous. Larger seeds suborbicular, laterally compressed and concave on the sides, entirely encircled by the embryo, which is annular and peripheral, thickest round that edge containing the cotyledons of the embryo. Testa pale yellowish-brown, or testaceous, thin but tough, very shallowly rugulose on the surface. The concavities at the sides are due to the shrinking of the central endosperm or to the fact of there not being sufficient to fill the seed properly.

The smaller seeds are reniform-orbicular or simply orbicular, laterally compressed, but biconvex. Testa black, shining and showing itself through the membranous utriculus, finely but distinctly rugose, very dark reddish-brown by transmitted light, crustaceous and brittle.

They are mixed indiscriminately on the panicle. The large brown ones germinate much more quickly than the small black ones, which would seem, under natural conditions, to be more adapted to remain in a resting condition in the ground during the winter and germinate in spring. If such is the case they would enable the plant to exist in a colder climate than the large ones would. The plant occurs in Britain as a garden escape.

Some fruits inclosed in the dry wing-like perianth were dropped in a tumbler of water, and all of them floated for seven days. At that time, contrary to what might have been expected, the larger fruits containing the larger-sized seeds with the thin grey testa and covered by the broad perianth segments had sunk, and the seeds had commenced to germinate. At the end of twenty-one days many of the seedlings had risen above the water, and the cotyledons, already green, had commenced to expand. The small black seeds with the crustaceous testa, covered by a small perianth, were still floating after twenty-one days, and on examination proved to be quite fresh and sound.

A. hastata also has two forms of fruit.

POLYGONACEÆ.—Fruit a berry, utricle, or nut. In our English species the fruit is a small, seed-like nut, inclosed in the persistent flower, and containing one seed. The prevailing form is trigonous. There are three styles, indicating the presence of three carpels.

The persistent perianth leaves evidently serve as wings.

The sepals of the Docks (*Rumex*) have one or more, often red, glands. These perhaps induce birds to carry them off, thinking they may be sweet and good to eat. The persistent sepals no doubt lighten the fruits, and in some species are deeply toothed or laciniate, which would help to entangle them in the fur of animals.

In *Polygonum Hydropiper* the nutlets are of two forms, triquetrous or biconvex. The latter are much the more numerous. In *P. Persicaria* also there are two forms (plate IV. figs. 10*a*, 10*b*, 10*c*, 10*d*).

In *P. viviparum*, a high Alpine form, more than one-half of the flowers on the lower part of the stem are replaced by small bulbils or enlarged buds that fall away and reproduce the plant. At high elevations the growing season is often so short and the conditions so adverse that the plant is unable to produce and mature seeds before the return of winter. The flowers on the upper portion of the stem seldom ripen seeds, but fall away some time after flowering.

This *Polygonum* may be compared with *Saxifraga cernua*, which produces numerous clusters of bulbils along the stem, and usually only one flower on the top. *S. stellaris* and *S. nivalis* sometimes behave in the same way. Akin to the above are the viviparous forms of *Poa alpina* and *Festuca ovina*.

Thymeleæ.—The fruit is a nut, drupe, or berry. We have only one genus, *Daphne*, with two species, which are small shrubs. The fruit is a berry, with one large seed. *D. Mezereum* flowers early, and the red berries show up well against the green leaves. *D. Laureola* has black berries. The leaves are persistent. The fruits are poisonous, but not apparently to birds.

Elæagnaceæ.—The order is a small one, and we have only one British species, the Sea Buckthorn, *Hippophae rhamnoides*. The fruit bears a close superficial resemblance to that of *Daphne*, but the structure is very different. The base of the calyx, or at least of the perianth, is in this genus persistent, and assumes the character of a pulpy berry, inclosing a nutlet, also of uncommon construction. The ovary wall is thin and membranous, enveloping a large oblong-obovoid seed, with a crustaceous, smooth, and shining black testa.

In this country *Hippophae* is confined to the sea-coast, but on the Continent and in Asia it extends far inland, especially on river banks, and ascends to a considerable height.

Though it belongs rather to the domain of entomology, I may mention that the full-grown caterpillar of the Hawkmoth (*S. hippophæs*), which feeds on this species, bears (and is the only one which does so) large yellow spots closely resembling the fruit, both in size and colour.

Santalaceæ. — Of this family we have only one species, *Thesium linophyllum*, an inconspicuous shrubby plant nestling amongst the dwarf herbage of chalky downs, and of parasitic habit. The fruit is a small green nutlet, marked with several longitudinal ribs. There are three ovules, but as a rule only one comes to maturity.

Aristolochiaceæ.—Fruit an indehiscent, ovoid globular capsule, crowned by the persistent perianth.

Euphorbiaceæ. – The fruit is dry or fleshy, naked or sometimes adnate to the perianth. The seed is pendulous. Of the three genera, *Euphorbia* has three carpels, each containing a single seed, *Mercurialis*, Dog's Mercury, has a 2-celled capsule, with two seeds, or rarely 3 cells with three seeds; while *Buxus*, the Box, has a 3-celled capsule with one or two seeds in each cell.

The seeds of our western European Euphorbiaceæ are as a rule smooth, but in *E. Lathyris* they are rugose and reticulated; in *E. Helioscopia*, *E. pterococca*, *E. Taurinensis*, *E. segetalis*, and *E. Peplus*, they are alveolated or pitted; in *E. pubescens* ridged; in *E. Myrsinites* and *E. pithyusa* rugose; in *E. exigua* tuberculated; in *E. portlandica* irregularly pitted; in *E. sulcata* longitudinally, and in *E. falcata* transversely, furrowed (plate IV. figs. 11*a*, 11*b*).

The capsules are in some species rough, verrucose (*E. spinosa*, *E. hyberna*), or even hairy (*E. pubescens*). In some species it is possible that the capsules are disseminated with the seeds in them.

The seeds in some species resemble small beetles, such as Lady-birds, and may perhaps be carried by birds (plate IV. figs. 12*a*, 12*b*).

In *Mercurialis perennis* the capsule is hairy and may easily be carried away with the seed by rabbits and other animals.

The Box lives on chalk hills, and the seeds are also probably transported in the same way.

EMPETRACEÆ.—*Empetrum*, the Crowberry, is a low heath-like shrub. The fruit is a drupe; it is 6- to 9-celled with a seed in each cell. The walls are in two layers: the inner (endocarp) is thick and bony; the outer one fleshy. When ripe the fruit is black, globular, and about the size of a pea.

CALLITRICHINEÆ. — *Callitriche* is an aquatic floating herb. There is no perianth. The fruit is entire, with a single seed.

URTICACEÆ.—The fruit is small, dry, rarely succulent (the Mulberry), 1-seeded. We have three genera; the Nettle, the Pellitory, and the Hop.

In the Nettles (*Urtica*), the fruit consists of a minute nutlet, inclosed in the persistent calyx, which bristles with short stiff hairs, and thus probably adheres to the feet and fur of animals. The fruit of the Pellitory (*Parietaria*) is formed on the same plan.

In the Hop (*Humulus Lupulus*), the achene is broadly ovoid subcompressed, smooth, and somewhat glossy. The seed conforms to the interior of the achene, and the embryo is coiled up so as to fit itself in. Each fruit is inclosed by the incurved base of a large membranous bract, more or less densely covered by yellow glands. The large and light catkin is readily blown about by the wind, which is evidently the principal agent in the dissemination of the seeds.

ULMACEÆ. — Ovary, 1- to 2-celled. Fruit, a samara or a nut; 1-seeded; seed inverted. In the Elm (*Ulmus montana*), the ovary is 2-celled with one ovule in each cell, only one of which, however, develops into a seed. The fruit is a samara, flat, thin, and leaf-like, slightly thickened at the centre, broadly ovate or orbicular, six to nine lines long, with a notch at the top. The seed is suspended in a small cavity near the centre of the fruit. The trees flower in February and March, before the leaves appear. The fruit ripens, detaches itself, and is carried away by the wind in June. The wing develops on both sides, from the base of the calyx, along the stalk of the fruit, and the fruit itself, to the style, beyond which it extends on both sides.

AMENTACEÆ.—The ovary may be 1- or several celled, but the fruit is always 1-celled, and is either a nut or a several-seeded capsule, opening with two valves. The catkin scales sometimes form an involucre, around or below the fruit.

The wide distribution of the order over the world indicates great antiquity. The anemophilous character of the flowers and their independence of insects tend to corroborate this view, while the willows suggest to us how plants may have originally passed from anemophilous to entomophilous fertilisation.

In the species with large edible fruits (hazel, oak, Spanish chestnut, etc.), as in some other similar cases, the cotyledons are thick and fleshy, and remain in the seed. In the two former they are plano-convex, and each occupies one-half of the interior of the nut, to which it conforms. Those of the Spanish Chestnut are more or less wavy, and ruminate, or unequally folded.

The fruits are more or less inclosed in a cupule or involucre. In the Birch it takes the form of a scale consisting of a bract and two bracteoles, connate into one piece, trifid at the apex, and falling with the nutlet. They closely overlap one another, forming a cylindrical spike. In the Alder they form an oval spike, and the scales when mature spread out, and let the nutlets drop away. In the Hornbeam to the right and left of the bract there is a three-lobed bracteole, partly enveloping the nut, enlarged and leafy upwards, especially the one in the middle.

In the Hazel there are two greatly enlarged bracteoles, more or less toothed or fringed at the margins. There are originally two ovules in each cell, but only one comes to maturity.

The cupule of the Oak consists of many bracteoles, united into one piece but carried with the free imbricated points of the bracteoles. It forms the well known cup in which the acorn sits. There are two ovules in each cell, but only one matures.

The fruits of the Spanish Chestnut are inclosed, two or three together, in a cupule of four pieces, which are densely covered with long prickles. These open when the fruit is ripe, but serve to protect it when young, and also, no doubt, assist in its dissemination. In this species also there are two ovules, but only one seed.

The cupule of the Beech consists of four lobes or valves, covered on the back with numerous loose, pointed scales, perhaps representing the original bracteoles. It incloses two or three fruits, which are more or less winged at the edges. The cotyledons are folded up like a fan, so as to occupy the interior of the nutlet.

The seeds of the Willow (*Salix*), as already mentioned, are minute, furnished with long silky hairs, and further lightened by a hollow, not being quite filled by the embryo.

In the Poplar also the seeds are minute, and have a parachute of silky hairs. The fruits are very varied in form and structure.

In some (Willows and Poplars) the fruits are minute, and provided with, and carried about by long silky hairs; in the Birch and Hornbeam they are winged, and transported by the wind; in others (Oak, Beech, Hazel, Spanish Chestnut, etc.) they are large and carried about by animals as food. The fruit of the Alder, which grows near streams and lakes, is light, and probably carried mainly by water.

The arrangement of the seeds is also very interesting. Fig. 84 is a diagram of a nut with the parts somewhat separated from one another, so as to show the relations more clearly. The micropyle *m* is at the apex of the seed. The ovule, however, is not straight and orthotropous, which would be, or at any rate seem to be, the simplest arrangement. Quite the contrary, for we find a long placental axis *pl*, which extends to the apex of the nut, from which starts a raphe *r*, which returns about half-way back again to the place where the true attachment or chalaza *ch* is situated. I am not prepared to suggest any circumstances which would render this complex arrangement specially adapted to present conditions. It would seem as if it would be simpler, and give Nature less trouble, if the ovule sat directly with its base on the stalk, thus doing away with both the placental axis *pl* and the raphe *r*. This view is strengthened by the fact that such an arrangement has actually

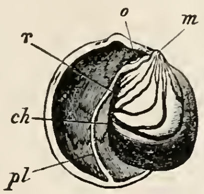

FIG. 84.

FIG. 85.

been nearly attained by the Oak. The ovule in this genus is theoretically anatropous, but the placental axis and the raphe are both greatly shortened, so that the distance which the nourishment has to traverse is much less, though the actual place of attachment remains the same. The Oak, in fact, seems to have appreciated the difficulties of the situation, and to have in great measure neutralised them. Is it fanciful to imagine that some ages hence the Oak may be practically orthotropous? (fig. 85).

But why should these species be anatropous if it is an advantage to be orthotropous? On this question some light is thrown by the fact that while one seed only comes to maturity, the ovary contains originally several cells, each with one or two ovules, though none of the others comes to anything. They can, however, easily be seen, either at the apex of the seed, as in the Nut and Beech (*Fagus*), or, as in the Oak, near the base. Their presence appears to indicate that these species are descended from ancestors, the fruit of which was composed of several cells, each with more than one seed—a state of things, therefore, very unlike the present, and in which the anatropous condition would be an advantage. If this view be correct, the structure of the fruit in the Nut, Beech, and others becomes peculiarly interesting, because it represents a case in which the present arrangements are not those, in all respects, most convenient to the plant, and renders it probable that the same explanation may apply to other cases of difficulty.

The seeds of the Willow closely resemble those of *Epilobium*; like them are inclosed in a capsule, and are wafted about by means of a tuft of long hairs. In *Epilobium*, however, these are situated at the summit, in *Salix* at the base of the seed. In *Epilobium* the hairs can easily grow upwards and overlap several seeds above them. When the capsule opens, moreover, they are thus more readily dried by the outer air. In *Salix*, on the other hand, the capsules are short. The hairs, therefore, grow along the seeds. If they started from above, they would have to turn round and downwards, which would be a disadvantage; but starting as they do from the base of the seed, they are able to accommodate an additional length, equal to that of the seed, and when the capsule begins to open the free ends escape into the open air.

The Amentaceæ complete the Dicotyledons. If the Society approve, I shall hope to deal with the Conifers and Monocotyledons next year, and then terminate with some general remarks. It only remains for me, in conclusion, to thank the Society for their kind and constant support, and for the honour they have conferred on me in electing me to the Presidency for another term of office

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Note.—For permission to reproduce figs. 67 to 85, from "Notes on British Flowering Plants," by Lord Avebury, we are indebted to the courtesy of Messrs. Macmillan and Co., Limited.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Origin of Gonocytes in Amphibians.‡—A. P. Dustin has made a study of the origin of the sex-cells in Amphibians, with a view to determining (1) what part of the embryo gives rise to the first rudiment of the sexual organ, and (2) whether the cells of which the primary rudiment is composed go to form, in whole or in part, and with or without the assistance of other elements, the later definite sex-cells. After reviewing the literature on the subject, the investigator describes his researches on *Triton alpestris*, *Rana fusca*, and *Bufo vulgaris*, the larvæ of *Rana* being studied up till the final metamorphosis. He found that the course of development was fundamentally the same in *Triton* and *Rana*, but that some stages which were successive in *Triton* were simultaneous in *Rana*. His general conclusions are as follows. The first rudiments of the reproductive organs of Amphibians are paired, symmetrical, and of purely mesoblastic origin. These rudiments represent morphologically a part of the primitive cœlom (gonocœle). They do not exhibit metameric arrangement except in the Urodela, where traces of such arrangement may be discerned. The unpaired genital rudiment of Amphibians results from the union along the median line of the paired bilateral primordia. The rudiments of the definitive bilateral glands result from the emigration of the cells of the primary rudiment into a peritoneal crest projecting into the cœlom, and ultimately from the localised proliferation of the cells of the peritoneal epithelium, forming the crest and investing the primary gonocytes. A certain number of the cells of

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Arch. Biol., xxiii. (1907) pp. 411–522 (2 pls.).

the primary bilateral rudiment become actual sex-cells; the rest degenerate at ontogenetic stages varying according to the species. A second lineage of gonocytes arises by modification of the germinative cells due to the proliferation of the peritoneal epithelium. These invest the surface of the reproductive organs and form a germinative epithelium. The number of gonocytes is subject to considerable fluctuations. The gonocytes of both first and second lineage may become capable of fertilisation. They never fuse together, and never become follicular cells. If from any cause sexual development is arrested, these cells undergo degeneration.

The last part of the paper discusses the bearing of these results on the general theory of the evolution of genital organs. The author considers that they bring the organogenesis of the reproductive organs entirely into line with what is known in regard to other Vertebrates, differing in this opinion from Bouin, whose investigations on *Rana* led him to regard Weismann's theory as inapplicable, and even to deny that there is any cellular specificity.

Origin of Germ-cells in Mammalian Embryos.*—W. Rubaschkin finds that in the rabbit on the thirteenth day the cœlomic epithelium of the median part of the Wolffian body attains the character of a germinal epithelium. At this stage there are found also single germ-cells outside the germinal ridge, lying mainly under the aorta in the mesenchyme tissue. On the eleventh day the germinal epithelium (in the old sense) is not formed, only single germ-cells are to be found in the epithelium of the median part of the Wolffian body. On the tenth day no germ-cells are to be found here, although single germ-cells are found in the dorsal parts of the mesentery, and in larger numbers in the ventral mesentery and surrounding the hind gut. These last exhibit amœboid movement. The youngest stage at which germ-cells were traced was in ninth-day embryos, in which they lie close to the epithelium on the hind gut and mainly in its ventral section. Thus it appears that the place of origin of the germ-cells lies at some distance from the germ-gland region, and that the germ-cells occur much earlier than has hitherto been assumed.

Development of the Frog's Head.†—Agnes I. M. Elliot deals with the development of the segments of the occipital region of the skull. In front of the myotome associated with the first spinal nerve and its ganglion there are in the 9 mm. tadpole two myotomes. Cartilaginous arches appear in connection with these and fuse with the parachordals from which they are still distinct in a 20 mm. tadpole. Both these myotomes and a rudimentary ganglion associated with one of them disappear, while the cartilaginous arches corresponding to them form the occipital region of the skull. The vagus arises by numerous roots. It is suggested that the hinder roots may represent ventral roots of the nerves of the missing post-otic segments and also of the segment in which the first myotome is developed. The segmentation of the post-otic region of the skull agrees in *Rana* with that in *Necturus*.

* Anat. Anzeig., xxxii. (1908) pp. 222–4.
† Quart. Journ. Micr. Sci., li. (1907) pp. 647–57 (2 pls.).

Determining Factors in Metamorphosis of Anura.*—P. Wintrebert has experimented with tadpoles of *Rana temporaria*, and finds that tadpoles of about 43 mm. long removed quite abruptly from the water to moist air are not injuriously affected, and that in fact metamorphosis is sharply accelerated.

Portal Circulation in the Embryonic Metanephros of Mammals.†
Ivar Broman finds in the embryos of man, pig, and mole blood-vessels in the rudiments of the metanephros. In a human embryo of 16 mm. these were very distinct, as also in an 8 mm. mole and in pigs of 14–22 mm. It was suspected but not confirmed that the vessels branched off from the arterial vasa efferentia of the primitive kidney. On the other hand the author has traced some of these to the posterior cardinal veins, and others to the venae revehentes of the pronephros. Hence it is assumed that the kidney vessels found are all veins, and that the one group is afferent and the other efferent. In other words, the metanephros of the mammals examined very probably possesses at this stage (before the kidney arteries have developed) a so-called portal circulation.

Studies of Placentation.—F. Muller ‡ describes the pre-placentary and placentary stages in the squirrel, and compares them with those in other rodents. Hans Strahl § gives an account of the uterus puerperalis of the hedgehog, which is very distinctive, differing in many ways from that of rodents.

Bodily Identity of Twins.‖—H. H. Wilder has made a study of the ridge patterns of the hands and feet of twins. As the patterns are ordinarily very variable he thought that they might illustrate the organic agreement of the twin individuals more exactly than bodily form, physical measurements, features, etc. He found a remarkable agreement, and gives an illustration of the right hand of each of a pair of twins which shows this in a striking way. While he admits that caution is necessary in drawing conclusions, he suggests that in the case of twins resulting from the bipartition of a single egg the agreement of the ridge figures is due to the dominance of a determining substance within the egg, which even here fixes the form they are to assume. The agreement is only in the larger features and does not extend to individual lines, so that the theory involves the notion that the details are determined by forces acting later on in development.

b. Histology.

Structure and Function of Rectal Gland in Elasmobranchs.¶—Helen L. M. Pixell has studied the rectal gland, which Sanfelice and Howes called the appendix digitiformis, in *Scyllium canicula* and *Raja punctata*. It has a compound tubular structure, the walls of the tubules consisting of low cylindrical cells interspersed with numerous goblet-cells.

* C.R. Soc. Biol. Paris, lxiii. (1907) pp. 257–9.
† Anat. Anzeig., xxxi. (1907) pp. 94–7.
‡ Proc. Acad. Amsterdam, Section of Sciences, ix. (1906) pp. 380–9.
§ Op. cit., xiii. (1907) pp. 1–22 (3 pls.).
‖ Anat. Anzeig., xxxii. (1908) pp. 193–200 (2 figs.).
¶ Tom. cit., pp. 174–8.

Testing for urea, which has been said to be abundant in the gland, gave no result. An extract of the gland confirmed Blanchard's statement as to the presence of ferments similar to amylopsin and lipase.

Cytological Notes. — Fr. Meves * describes the mitochondria, or "chondriokonts" (chains, or rods or granules), in embryonic cells, and supports Benda's view that they must be regarded as definite and individualised components of the cells.

Achille Russo † discusses the origin of the mitochondria and the formation of the deutoplasm in the oocytes of mammals.

Neurological Studies.—A. Wallenberg ‡ gives an account of his researches on the brain and cranial nerves, with especial reference to the sensory tracts, in Teleosteans and Selachians. F. Livini § describes the cerebrum and thalamencephalon of a marsupial, *Hypsiprimnus rufescens*, with especial reference to the nerve-tracts.

Myelin-bodies in Nervous System.‖ —A. Capparelli describes corpuscles containing myelin in the central nervous system of higher animals, and discusses their relations to the protoplasmic prolongations of the nerve-cells. They occur chiefly in the grey matter of the brain and spinal cord, as egg-shaped or spherical bodies, with an envelope of a nervous network, the meshes of which are sometimes so close as to suggest a homogeneous membrane. This network surrounds true myelin masses. These myelin-bodies are in contact with the protoplasmic endings of the nerve-cells and with the surface of the cell. They probably supply nutritive and functioning material for the nerve-cells and nets.

c. General.

Young Red Kangaroo.¶— W. H. Sheak describes a young red kangaroo (*Macropus rufus* Desm.) which was born in the Barnum and Bailey menagerie. He first saw it when it was beginning to put its head out of the pouch, and was apparently about two months old. A month later it began to come out of the pouch, but would run back when alarmed, going in head first and turning round, but leaving the tail and hind legs protruding 18–20 in. The mother was very solicitous for his safety, and at first tried to prevent his coming out by holding him with her paws. The father shared the cage, but took no notice of the young one. The young one showed the brick-red colour of the father from the first. It was seen to protrude its head from the pouch and nibble at the grass while the mother was feeding.

Asymmetry of Caudal Poles of the Cerebral Hemispheres in Man.** G. Elliot Smith deals with this subject and with its influence on the occipital bone. The area striata is described, and its relations to the

* Anat. Anzeig., xxxi. (1907) pp. 399–407.
† Atti (Rend.) R. Accad. Lincei Roma, xvi. (1907) pp. 292–6.
‡ Anat. Anzeig., xxxi. (1907) pp. 369–99 (46 figs.).
§ Tom. cit., pp. 1–11. ‖ Op. cit., xxx. (1907) pp. 580–8 (10 figs.).
¶ Amer. Nat., xli. (1907) pp. 724–5.
** Anat. Anzeig., xxx. (1907) pp. 574–8 (3 figs.).

squama occipitalis and the direction of the venous sinuses. A symmetrical form of brain is commoner in negroes than in Egyptians or Europeans. In this respect the negro is distinctly more Simian than the non-negroid races. In the white races there seems to have been a greater specialisation of the two cerebral hemispheres than in the case of the negro, and in the former the resulting dissimilarity of shape in the cerebral hemispheres produces a cranial asymmetry. The symmetry of the negro cranium is thus a sign of inferiority.

Pleural Cavity of Elephant.*— G. Vasse has had an opportunity of examining the lungs of a fully grown female elephant in the Portuguese colony of Gorongoza. He publishes a note establishing the fact that the lungs are quite free in the pleural cavity. "They detached with the greatest facility—just as easy as the respiratory apparatus of a ruminant—and at no point did any adherence exist."

Pigment of Suprarenal Glands.† — P. Mulon establishes a relation between the amount of pigment and the functional activity in the gland. He finds that in guinea-pigs, when the suprarenals have functioned long, or much, or one has taken up the work of two, there is an increase of pigment and a reduction of fat.

Structure of Soricidæ.‡—Augusta Ärnbäck-Christie-Linde, with a view of clearing up questions of relationship amongst the Insectivora, has planned a memoir upon the structure of the Soricidæ. In the present instalment she deals with the integument, musculature (except that of the pelvis), brain, sexual apparatus, digestive organs, spleen, respiratory system, heart and vessels, as illustrated in several species of *Crocidura* and of *Sorex*. General phyletic conclusions are deferred until the skeleton and teeth have been dealt with.

Studies on the Cloaca and Phallus in Amniota.§—W. Dürbeck and A. Fleischmann conclude these studies. The present memoir deals with the external genitals of the adult pig, and the development and transformations of the phallus in the pig embryo, and the external genitals of the house-cat. A tabular review of the genital development in Mammalia is given by Dürbeck, and Fleischmann reviews the facts and offers some general theoretical considerations.

Penis in Birds.‖—Ulrich Gerhardt refers to the usual statement that a true penis is confined to Ratitæ and Lamellirostres. A rudimentary one is said to occur in *Crax*, *Crypturus*, and a few other Carinatæ. Gadow quotes Tschudi's report as to a penis $1\frac{1}{2}$ in. long in *Penelope abourri*. Gerhardt has found a similar organ in *Crax alector*. In its structure it resembles that of some Anatidæ, like *Dendrocygnus* and *Mergus*. The author also found a well-developed penis in *Tinamus rufescens*, quite different from that of *Crax*, but resembling that of *Apteryx*.

* Comptes Rendus, cxliv. (1907) p. 1290.
† C.R. Soc. Biol. Paris, lxii. (1907) pp. 905–6.
‡ Morphol. Jahrb., xxxvi. (1907) pp. 463–514 (35 figs.)
§ Tom. cit., pp. 515–69 (4 pls. and 29 figs.).
‖ Zool. Anzeig., xxxii. (1908) pp. 649–51.

Hybrids of Peacock and Cochin-china Hen.*—G. Pays-Mellier and E. Trouessart record the successful hybridisation of *Pavo cristatus* var. *nigripennis* ♂ and *Gallus gallus* var. *sinensis* ♀. The male parent was the more prepotent.

The authors remark that the hybrid of *Pavo cristatus* and *Numida meleagris* has been known for long, and they refer to *Gallus* × *Numida* and to the crossing of *Phasianus* with the nearly allied genera *Chrysolophus*, *Gennæus*, and *Catreus*, and with the more distant genera *Gallus*, *Acomus*, *Lophura*, and *Tragopan*. The alleged crossing of *Crax alberti* and the fowl seems doubtful.

Fasting Powers of the Swift.†—Albert Hugues refers to Brehm's statement that a swift can fast for six weeks, and relates some of his own observations, the most striking case being that of a fast of 21 days less 3 hours, during which the weight decreased from 57 to 21 grm.

Air-sacs of Pigeon.‡—B. Müller has made a study of the morphology of the air-sac system of the pigeon, with a view to throwing more light on the problem of its function. After giving a description of the methods by which he succeeded in hardening the air-sacs in a relatively distended condition, and in obtaining an idea of the relative degrees of expansion during the various phases of breathing, the author gives a general account of the air-sac system, its distribution, and its relation to the diaphragmatic membranes. The pulmonary and abdominal diaphragm, the lungs, the ostia, and the different air-sacs with their diverticula, are then described in detail, followed by a critical consideration of the most important hypotheses as to the function of the air-sacs. The author concludes that their importance as respiratory organs has been over-rated, and believes that their effect is mainly mechanical. He regards them as structures selectively developed for the purpose of increasing the size of the thorax without increasing its weight, and for facilitating the movements of the organs in it, especially the heart. The air-spaces are not organs with a positive function, but rather empty spaces whose value lies in their emptiness, and their shape is of no importance, their asymmetry being simply due to the asymmetry of the spaces they have to occupy between the viscera. The connection with the lungs is a consequence of their phylogenetic development, and has no physiological significance other than that they assist in renewing the air in the trachea. A copious bibliography is appended.

Head-muscles in Sauropsida.§—F. H. Edgeworth has investigated the head musculature in *Gallus* and other Sauropsida. The distinctive features of birds as compared with living reptiles are set forth in detail. Birds resemble the Rhynchocephalia in possessing an upper portion of the mandibular myotome inserted into the pterygoid process, but the adult condition in the latter group is clearly a secondary modification correlated with a fixation of the pterygo-quadrate. These are features

* Comptes Rendus, cxlv. (1907) pp. 1203–5.
† Bull. Soc. Zool. France, xxxii. (1907) pp. 106–8.
‡ Smithsonian Misc. Coll., l. (1907) pp. 365–414 (5 pls.).
§ Quart. Journ. Micr. Sci., li. (1907) pp. 511–56 (39 figs.).

of resemblance which at first sight suggest a very distant Chelonian relationship for birds, but which are in reality only ancestral traits, which are also present in embryonic stages of other Sauropsidan groups. The Rhyncocephalia have preserved two features more archaic than are found in any other Sauropsidan group—the continuity of the ceratohyal and the condition of the branchio-hyoid muscle—but in the upgrowth of the external pterygoid muscle and in the condition of the lingual muscles they are less primitive than the Chelonia. Like the Chelonia and Crocodilia they have preserved a fixed pterygoid bone. These are but a few of the many points of an instructive and important memoir.

Herpetology of Japan.* — Leonhard Stejneger gives a valuable systematic account of the amphibians and reptiles of Japan and adjacent territory, with analytical keys, notes on variation and distribution, and abundant illustrations.

Peculiarities of Vision in the Chamæleon.†—E. P. Fortin refers to the acuteness of the chamæleon's vision for near objects. The precision with which it picks up a very small insect at a distance of 15 cm. is remarkable. This acuteness of vision is mainly due to peculiarities in the fovea, which has a remarkable resemblance to that of man. The visual field of the chamæleon is small compared with man's, but the eyes are raised up, have highly developed muscles and great freedom of movement. This makes up for the small visual field. From an opthalmological point of view there is much interest in the way the chamæleon can alter the shape of its pupil. The independence of movement possessed by each of the eyes is seen also, according to Huot, in sea-horses and pipe-fishes.

Dinosaurs of Madagascar.‡—Armand Thévenin finds that most of the Dinosaur bones found in Madagascar are of Jurassic or Cretaceous age. All the Jurassic bones belong to *Bothriospondylus madagascariensis*, a Dinosaur 3·5 m. high and 15 m. long. It resembles *Morosaurus*, a North American form, and *Cetiosaurus oxoniensis*, and appears to have lived about the same time as these two.

Phagocytic Action of Kidney-cells in Frog.§— W. M. Smallwood gives an account of a case of *Rana pipiens*, in which one of the fatty bodies was found in a hæmorrhagic condition. Examination of sections revealed the fact that within the fatty body the blood-cells were undergoing degeneration, and that this was even more the case in the kidney. It was rare to find in the kidney any red cells with a nucleus, and the cells of the tubules as well as the tubules themselves were filled with disintegrating blood-cells in all stages of degeneration. The tubule-cells were evidently behaving in a phagocytic manner. It was found on examination that the ilium had been broken, and it seems likely that this breakage was the cause of the hæmorrhage.

Secretion of Thumb-swelling in Rana.‖—A. Nussbaum finds that by stimulating the Ramus cutaneus antebrachii et manus lateralis of the

* Bull. U.S. Nat. Mus., No. 58 (1907) pp. i.–577 (35 pls. and 409 figs.).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 346–7.
‡ Comptes Rendus, cxliv. (1907) pp. 1302–4.
§ Anat. Anzeig., xxxii. (1908) pp. 201–5 (8 figs.).
‖ Op. cit., xxx. (1907) pp. 578–9 (2 figs.)

N. brachialis longus inferior (ulnaris), he obtained a widening of the exit duct of the thumb-gland, which he regards as a sign of increased secretion. The experiment was performed upon a copulating male of *Rana fusca*.

Response of Toads to Sound-stimuli.*—S. A. Courtis has made a study of the response of toads to sound-stimuli during the breeding season. He removed a female which had been seized by two males and placed her about 10 feet away. One of the males uttered a shrill trilling note sustained for 15–20 seconds. The female immediately swam towards him and mating took place. This experiment was repeated with many pairs, and the distance between males and females was increased to 30 feet, but in every case the females responded to the call of the males. Only a few of the males uttered the call, and other males moved in the direction of it. The observer's general conclusions are that both male and female toads can hear and locate in space the call of the male; that the response is unintelligent and mechanical; that to the sound of the mating call a motor response is given which serves to bring the sexes to the same place; that motion is the stimulus which starts the clasping reflex; that neither sex is able to recognise the other without actual contact; and that toads do not profit quickly by experience.

Tongue of Teleosteans.†—J. Chaine has examined this organ in a series of types. He finds that it is completely devoid of muscle, but possesses resisting ligaments. The commonest relation observed is that of two lateral ligaments separated throughout their entire length. A second type is that exhibited in *Callionymus lyra*, which possesses only one aponeurotic formation extending from the extremity of the entoglossa to the hyoidean apparatus covering the whole breadth of the ventral face of the tongue. A third type—the most complex—is exemplified in the pike, which has two very powerful ligaments, an external and an internal. The latter is inserted on the entoglossa behind the former. Both are in the form of a small flat band.

Abnormality of Brook Trout.‡—R. de Drouin de Bouville describes a peculiar condition which seems not very uncommon in *Salvelinus fontinalis*. The joint between the lingual and the basihyal is enormously stretched, its resistance becoming inadequate to maintain the curvature of the cornua of the hyoid and the branchial arches. These pieces straighten out, affecting in their movement the operculum and the branchiostegal rays. The fishes look as if they had a projecting collar. According to the author all this is due to adeno-carcinoma of the thyroid gland, which brings about the displacement of the branchial and opercular skeletal pieces.

New Lamprey.§—H. W. Fowler establishes a new genus, *Oceanomyzon*, with *O. wilsoni* as the type. The supra-oral lamina is not especially contracted, its two converging teeth are well separated and distinct. The infra-oral lamina is crescentiform and spout-like at the middle, with denticles obsolete. The innermost teeth of the disk, or

* Amer. Nat., xli. (1907) pp. 677–82.
† C R. Soc. Biol. Paris, lxii. (1907) p. 924.
‡ Op. cit., lxiv. (1908) pp. 229–31.
§ Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 461–66 (2 figs.).

those along each side of the orifice, are bicuspid, large, and similar to those on the supra-oral lamina. In this combination of characters, the new type, which was found in the open Atlantic, differs from *Bathymyzon* and *Petromyzon*. A small black fresh-water lamprey, Abbott's *Ammocœtes æpytera*, also known as *Lampetra wilderi* Gage, is re-named *Lampetra æpytera* (Abbott).

Faunistic Results of German South Polar Expedition.* — H. Lohmann summarises the distributional data. The distribution of Oligochæta and Isopoda does not support the idea of the previous existence of an Antarctic Continent uniting the three Southern Continents. Regarding plankton—Pteropods, *Salpa*, *Appendicularia*, Tintinnæ—the Antarctic region is throughout richer in species than the Arctic. The majority of the polar forms deviate widely, yet bipolar varieties and species groups have been proved. Of sea mites, only Halicaridæ were found in the Antarctic region. Of these a small species group of *Polymela* proves to be bipolar. This family also predominates in the Kerguelen Islands. On St. Paul and at the Cape the Antarctic species and most of the Kerguelen forms are absent. A brief description of the sea mites found is given.

Bipolarity of Marine Animals.†—W. Kükenthal discusses this subject, treating of littoral, abyssal, and pelagic forms. A number of littoral animals show marked bipolarity. With regard to abyssal forms no very valuable results appear to have been attained, yet the author regards the existence of bipolar animals as possible. It is most strongly indicated amongst plankton. The author considers that migrations of different kinds have been the cause of bipolarity, e.g. in the case of pelagic forms from the warm water areas. The floor of the sea has probably been the former connecting path for many littoral forms; in others the west coasts of the continents may have made an exchange possible.

Northern Animals.‡—Fritz Römer has published an interesting lecture on the northern animals in their relation to the fauna of temperate zones, and in their special adaptations to boreal conditions.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Chromatophores of Cephalopods.§ — W. Marchand reviews the literature—more particularly the works of Rabl, Steinach, Chun, and Hertel—on the subject of the structure and function of these bodies. The play of colour in the skin of Cephalopods is conditioned by the iridocytes and by the chromatophores. The latter possess a distinctive

* Schrift. Natur. Verein. Schleswig-Holstein, xiv. (1906) pp. 1–14. See also Zool. Zentralbl., xiv. (1907) pp. 392–3.

† Veröffentl. Institut. f. Meereskunde, heft 11 (1906) 28 pp. See also Zool. Zentralbl., xiv. (1907) p. 392.

‡ SB. Senckenberg. Nat. Ges., 1907, pp. 63–112.

§ Zool. Zentralbl., xiv. (1907) pp. 289–301.

motor apparatus. On every chromatophore may be distinguished a peculiar pigment-body and a number of radial fibres issuing from it. There is a diversity of opinion as to whether the pigment-body is unicellular or multicellular. Both Chun and Steinach found that the radial fibres, often anastomosing, occasionally pass directly over into the skin musculature. Chun found in *Bolitæna* that there is a connection between one (and often several) of the radial fibres and fine side-branches of the skin-nerves. Numerous observations on the physiology of the chromatophores are quoted, but at present unification of the results seems difficult.

β. Gastropoda.

Hermaphroditism in a Chiton.*—Harold Heath has found that *Trachydermon raymondi* is normally hermaphrodite. In the early stages ova appear in typical fashion; when the animal becomes half-grown (4–5 mm. long) some of the primitive sex-cells form clusters of spermatozoa. In 1851 Middendorf reported hermaphroditism in *Amicula pallasi*, but Plate, in 1899, failed to confirm this, and thought that Middendorf has misinterpreted sperm mother-cells as immature ova. With this single and doubtful exception, all known Chitons have been reported as diœcious, but Heath has shown that *Trachydermon raymondi* is an indubitable exception.

The number of spermatozoa is always comparatively small, and they are seemingly shed almost continuously during the winter and spring. A number occur grouped together during the breeding season, so that a large number of spermatozoa is not so essential as with the majority of species. The young are brooded over by the parent as in *Chiton poli*, *Ischnochiton imitator*, and a few other species.

The gonad seems to arise as two proliferations of cells of the anterior pericardial wall, and each gonoduct seems to be almost wholly an outgrowth of the wall of the gonad, and not in large measure an ectodermal product.

Sugar-reducing Power in Helix pomatia.†—Mlle. Bellion finds that the liver, albumen-gland, and muscles of *Helix pomatia* contain substances which have a sugar-reducing property, and that in the period of activity following hibernation these substances are considerably diminished. This diminution is particularly marked in the liver.

Pedal Waves of Reptant Molluscs.‡—F. Vlès finds that there are several interesting varieties in the type of wave-motion to be seen on the foot of creeping Molluscs. These are classified, first, as direct, i.e. those in which the waves are propagated in the same direction as that in which the animal is moving; and retrograde, where the waves move in an opposite direction, i.e. from front to back. The direct forms are further sub-divided as follows:—monotaxic, with one or more waves visible traversing the whole width of the foot, e.g. *Helix*, *Limax*, *Arion*; ditaxic, having two systems of waves, each occupying one-half of the

* Zool. Anzeig., xxxii. (1907) pp. 10–12.
† C.R. Soc. Biol. Paris, lxiii. (1907) pp. 238–40.
‡ Comptes Rendus, cxlv. (1907) pp. 276–8.

foot with the median line unaffected by the waves, e.g. *Haliotis*, *Trochus* (these forms move rapidly); tetrataxic, with four systems, two sets of lateral alternating waves, seen in small species of *Littorina*. Amongst the retrograde forms, both monotaxic (e.g. *Chiton*), and ditaxic (e.g. *Littorina littorea* and *L. rudis*) occur. It is noteworthy that the retrograde forms correspond with the locomotor waves in various other Invertebrate types, e.g. Oligochætes, Nemerteans, Gephyreans, insect larvæ, etc.

δ. Lamellibranchiata.

Nervous System of Razor-shell Clam.*—Gilman A. Drew has made experiments with *Ensis directus*, which is well suited for the physiological study of the nervous system. Continued stimulation of any portion of the body has in time an effect on all the ganglia. The siphons, collar, and foot may be so gently stimulated as to cause them to be withdrawn without disturbing organs that receive their nerves from other ganglia. The relation of the ganglia of a pair is intimate. Stimulating nerves connected with one, causes organs connected with both to respond promptly. Association fibres, by which ganglia communicate with each other, are found only in commissures and connectives. Although the anterior pallial nerves are united, so that a connection is formed between the cerebral ganglia, and the circum-pallial nerves connect the cerebral and visceral ganglia of corresponding sides, there is no evidence that the ganglia are able to communicate through them. Both cerebral and visceral ganglia are provided with sensory and motor cells. The pedal ganglia are apparently dependent upon the cerebral for initiative. When the pedal ganglia are isolated from the others, stimulation of the surface of the foot causes only local responses, due to the direct stimulation of muscle-fibres. It would seem that the sensory neurons have neither endings nor collaterals in the pedal ganglia, but are continued to the cerebral ganglia. Impulses may pass in both directions through any of the commissures and connectives. Stimulation may cause impulses to be sent by roundabout connections when the usual connections are destroyed, but the stimulation must be of considerable duration, and the result is often considerably delayed.

Distribution of Petricola pholadiformis.†—Bronislaw Debski points out that C. Boettger's record of this mollusc in the German "Watten-See" requires to be supplemented by other records of its occurrence in England in 1896 and subsequently, and in Belgium in 1903.

Arthropoda.

α. Insecta.

Treatise on Insects.‡—A. Berlese's treatise on insects continues to appear, the latest part dealing mainly with the alimentary system, including the Malpighian tubules. The first volume is not yet completed, but the 800th page has been reached and the 1000th figure.

* Journ. Expér. Zool., v. (1908) pp. 311–26 (1 pl.).
† Zool. Anzeig., xxxii. (1907) p. 1.
‡ Gli Insetti, Milano, 1908, pp. 713–800 (1 pl. and figs. 892–1000).

Histolysis of Wing-muscles in Ants after Nuptial Flight.* — Charles Janet has previously described the histolysis of the vibratory muscles of the wings of ants after the wings are lost. He now inquires into the fate of the ordinary non-vibratory muscles associated with the wings. Here, too, there is necrobiosis, a sort of premature senescence. Finally the remains of the muscle undergo digestion. There is no phagocytosis.

Uncommon Dipterous Larva.† — P. Cerfontaine describes a rare dipterous larva of the genus *Microdon*, of which a few specimens were found in the stumps of hornbeam and oak trees near Liège. The general aspect, form and movements of this larva are so peculiar and Gastropod-like, that it is not surprising that it should have been classed as a mollusc before its metamorphosis was observed. The investigator gives an account of the general structure of the larva, and describes and figures in minute detail the various chitinous structures on the surface of the body. The results agree in the main with those of Hecht, but he finds that the buccal armature is much more complex than Hecht described, and that the so-called chitinous stylets are simply the extremities of the antennæ. He also finds on the dorsal surface a series of sensitive organs which have not hitherto been described. These organs are of the same type as those on the ventral surface, but have a much more elongated cone; they are metamerically arranged.

Just before metamorphosis not only the larval respiratory mechanism but the respiratory horns of the nymph, and the outline of the stigmata of the perfect insect, can be seen. As metamorphosis was not observed it was impossible to determine to which of the two species, *M. mutabilis* or *M. devius*, the specimens in question belong.

Fat-bodies of Muscidæ in Metamorphosis.‡—Ch. Perez states that for a time during metamorphosis the fat-body functions as a storing kidney (rein d'accumulation). As the imaginal organs develop they digest within their protoplasm some of the inclusions. Whenever the Malpighian tubes are differentiated they commence to function even before the emergence of the imago; the urates provisionally heaped up in the fat-cells are dissolved and circulated. They reach the cells of the Malpighian tubes, and finally pass from their lumina to the intestine as an abundant meconium.

Larval Habits of Tiger-beetles.§—V. E. Shelford gives a preliminary account of the habits of the larvæ of some American tiger-beetles, which he reared from the egg in a glass-covered vivarium. The species chiefly described is *Cicindela purpurea*, but other eleven races were studied at the same time. Adults were caught in April and mating took place in a few days, there being no "courting" on the part of the male. Some days later the female bored vertical holes, 7–9 mm. in depth, and deposited a single elongated egg of a clear translucent cream-colour in each hole. About fifty eggs were laid by one female. Small larvæ appeared in two weeks. The first larval stage lasts about a month.

* Comptes Rendus, cxlv. (1907) pp. 1205–8 (1 fig.).
† Arch. Biol., xxiii. (1907) pp. 368–410 (2 pls.).
‡ C.R. Soc. Biol. Paris, lxii. (1907) pp. 909–11.
§ Journ. Linn. Soc., xxx. (1908) pp. 157–88 (4 pls.).

The larvæ hibernate in the third stage, emerging in April and feeding till June, when pupation takes place. The perfect insect hibernates again and does not become sexually mature until the first warm days of the third spring, when it lays its eggs and dies. In other species the eggs are not laid till midsummer, and the imagos emerge the following July and mature quickly, so that adult life lasts only two months. Temperature, moisture, and food influence the length of the stages. Pigmentation and final hardening of the cuticle takes place in the pupa in those parts which are employed in the final ecdysis, and the bristles of the imago assist in the removal of the exuvium.

Life-history and Bionomics of Lomechusa.*—H. St. J. Donisthorpe communicates some interesting facts regarding this beetle, which is a dweller in the nests of the robber-ant, *Formica sanguinea*, and whose life-history has been worked out by Father Wasmann. *Lomechusa* possesses short aborted labial palpi and patches of golden hairs upon the abdomen, whence the ants obtain a sweet secretion. The secretion exudes from orifices under the hair. The beetles ask to be fed by the ants by tapping them with their antennæ. They may, however, feed themthemselves, sucking the honey given to the ants, and biting at dead ants and larvæ. In courtship the male and female *Lomechusa* face each other, bringing their antennæ and mouths together, and tapping each other quickly. In copulation the male turns his tail over his head, meeting the upturned female abdomen which is in front. The male in these circumstances is carried hanging back in the air or walking on the tips of his front pair of legs. They separate, and after caressing each other the process is repeated and copulation resumed. *Lomechusa* defends itself successfully against the attacks of foreign ants, *F. rufa*, *F. exsecta*, etc., introduced into the nest. They emit an odour when seized, which comes from glands in the posterior part of the abdomen. The larva mimics the ant larva ; it is valued and protected by the ants themselves ; they feed it and place it even upon their own larvæ, many of which it devours. Some interesting facts are stated regarding the relation of *Lomechusa* to the production of "pseudogynes" in the ants' nests. Recently this beetle has been found to be not uncommon in England.

Variation of Nycteribiidæ from Ceylon.†—H. Scott has examined a hundred specimens of *Cyclopodia sykesi* Westwood, a parasite upon *Pteropus medius* in Ceylon, with a view to ascertaining to what extent variation occurs. He records that in 57 males there is no appreciable variation in size, structure, and colour. In the 43 females only one striking variation was noted, viz. in the numbered arrangement of the large tubercles on the dorsal surface of the abdomen. These are so variable that they cannot be relied on as a specific character.

Semi-aquatic Aphid.‡—C. F. Jackson describes *Aphis aquaticus* sp. n., which was found infesting *Philotria canadensis* and other aquatic plants. Three pairs of lateral wax-glands on the thorax make a secretion which keeps the insect from getting wet, and other adaptations to the semi-aquatic life are noted.

* Trans. Entom. Soc. London, 1907, pp. 415–20. † Tom. cit., pp. 421–8.
‡ Ohio Naturalist, viii. (1908) pp. 243–9 (1 pl.).

Accessory Chromosome in Aplopus mayeri.*—H. E. Jordan traces the history of the accessory chromosome in the Phasmid, *Aplopus mayeri*, from its first origin in the secondary spermatogonia, through its various changes during the growth and maturation processes, to its final disappearance in the head of the ripening spermatozoa. He reserves theoretical considerations for future discussion, and summarises the results of his investigation as follows. The accessory chromosome appears in the resting stage of the secondary spermatogonia as a chromatin nucleus characteristically close to the nuclear wall. At the last spermatogonial division it passes over into the resting stage of the primary spermatocyte without entering a reticular stage, as do the ordinary chromosomes. Both the primary and secondary spermatogonia have a metaphase group of thirty-five chromosomes. Metaphase groups of the follicle cells of the ovary contain thirty-six chromosomes. Synapsis occurs in the early stages of the growth period by an end-to-end union of pairs of univalent elements. Equatorial plates of primary spermatocytes contain eighteen chromosomes. The accessory chromosome passes undivided to one pole of the first maturation spindle, and thus produces a dimorphism of the daughter-cells and the resulting spermatozoa. The first maturation division is reductional, the second is equational. Equatorial plates of secondary spermatocytes show a disparity in the number of chromosomes; one group contains a large U-shaped element peripherally and numbers eighteen; those groups which lack a body of such form contain only seventeen chromosomes. The accessory chromosome can be traced as a specific structure from the resting stage of the last order of spermatogonia through all the various phases of synapsis and maturation, until it disintegrates in the head of the ripening spermatozoon.

Excretion in Thysanura.†—L. Bruntz finds labial renal organs opening to the exterior in *Machilis* and *Lepisma*. There are also nephrocytes like fat-cells in the connective-tissue which bounds the pericardial sinus in *Machilis*. Similar elements in *Lepisma*, but quite unlike fat-cells, occur in connection with the pericardial sinus. Phagocytosis is exhibited by blood-corpuscles and by the pericardial septum in some species (*Lepisma saccharina* and *Ctenolepisma lineata*).

β. Myriopoda.

Habits and Structure of Scutigerella immaculata.‡—S. R. Williams has studied this member of the Symphyla, that interesting group of Arthropods that seems to partake to a certain extent of the characters of the millipedes, the centipedes, and the Thysanuran order of insects. It lays eggs and hatches its young (in the latitude of southern Ohio) during late May and early June. The time of laying is influenced by the temperature. In the laboratory at least the adult is needed to keep off destructive fungi from the eggs. The egg is covered by a vitelline membrane and a much-ridged chorion.

The larva has seven pairs of legs and ten dorsal scutes, and is

* Anat. Anzeig., xxxii. (1908) pp. 284–95 (35 figs.).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 231–3.
‡ Proc. Boston Soc. Nat. Hist., xxxiii. (1907) pp. 461–85 (3 pls.).

hatched more nearly like the adult than in Diplopods. It is more like the adult than the newly-hatched *Lithobius* among Chilopods. "It is, therefore, a highly specialised young rather than a generalised ancestral form such as the hexapod larva of other Diplopoda is considered to be."

It seems probable that *Scutigerella* is carnivorous, and it seems to secrete a peritrophic membrane about the contents of its mid-gut, as do some of the lower insects.

The first joint of a typical walking leg is moved by five slender muscles, which originate on the dorsal scutes. In its mode of locomotion, though not in its rate, *S. immaculata* resembles the Diplopods. Ecdysis seems to occur shortly before oviposition. The most common method of escape from the cast skin is by freeing the head and then creeping forward out of the old husk; but this is not the only method.

Segmentation of the Head in Diplopoda.* — Margaret Robinson has examined embryos and larvæ of *Archispirostreptus* from South Africa, from which she draws certain conclusions as to the head segments. The embryo has two additional head-segments, the possession of which would seem to give the Diplopoda a place in the Arthropod system nearer to the Chilopoda and Hexapoda than that recently assigned to them. These additional segments are (1) a tritocerebral segment representing the tritocerebral rudiments found in Hexapoda and *Scolopendra*, and also the tritocerebral segment in Crustacea; (2) a pair of rudimentary maxillæ lying in front of the pair which forms the gnathochilarium in the adult. These are probably homologous with the first maxillæ in Chilopoda and Crustacea, and with the superlinguæ (Folsom) of Hexapoda. The gnathochilarium is probably a part of the head, and the post-maxillary segment of Heymons and Silvestri is purely a body segment.

δ. Arachnida.

So-called Malpighian Tubes in Scorpions.†—L. Bordas has studied these structures in *Buthus europæus*, and finds that they are inextricably associated with the liver, being, in fact, excretory ducts of that organ, differing in detail from the large ducts which open into the gastric region.

ε. Crustacea.

Periodic Change in Phototropism of Hermit Crabs.‡ — Anna Drzewina finds that specimens of *Clibanarius misanthropus* Risso in an aquarium show periodic changes from positive to negative phototropism, which approximately synchronise with the changes of the tide. During the period corresponding to neap tides the Pagurids show marked and very constant negative phototropism, but as the tides become higher towards the spring-tides, positive phototropism sets in. The possible meaning of the parallelism is discussed, but, as the observer points out, there is need for extended observations.

* Quart. Journ. Micr. Sci., li. (1907) pp. 607–24 (1 pl., 6 figs.).
† Bull. Soc. Zool. France, xxxii. (1907) pp. 167–9.
‡ Comptes Rendus, cxlv. (1907) pp. 1208–9.

Variations in the Norway Lobster.* — D. C. McIntosh has examined a large number of specimens of the Norway lobster (*Nephrops norvegicus*), procured from Newhaven fishmarket or trawled in the Firth of Forth and the Moray Firth. In regard to the relative size of males and females, it was found that less than 1 per cent. of the females and 30 per cent. of the males examined were over 16 cm. in length: while 20 per cent. of the males, as against 80 per cent. of the females, were under 12·5 cm.; so that in general the female adult is shorter than the male. Of 5894 specimens only 703, or scarcely 12 per cent., were females. It was found, however, that the proportion of females was much greater in hauls taken with a smaller meshed net, and it is suggested that the well-known scarcity of females in boxes procured for laboratory purposes may be partly accounted for by the method of capture. It was found that variation in the number and arrangement of the male genital apertures was not uncommon. The normal apertures were present in every case, but in 6·5 per cent. there were additional openings, the variation ranging from the normal two up to six. These extra openings occur without any regard to bilateral symmetry. The number of individuals showing abnormality decreases as the extent of the abnormality increases. Particulars as to the material examined, the number and extent of variations, etc., are clearly arranged in tables.

New British Terrestrial Isopod.† — Alexander Patience describes *Trichoniscus linearis* sp. n., from Kew Gardens, where it was found under flower-pots along with *Haplophthalmus danicus* Budde Lund. Another species, *T. stebbingi*, was found in the flower-pots, and six other Trichoniscidæ were taken at Kew on the same day. The new species is at once distinguished from all the other British species of *Trichoniscus* by its conspicuously linear form, approaching nearer to *T. pygmæus*, G. O. Sars, in this respect than any other member of the genus.

Life-history of Sacculina.‡—G. Smith has experimentally infected *Carcinas maenas* with this parasite and followed out the life-history. It is briefly as follows. The eggs undergo maturation in the brood-pouch and are self-fertilised. Development up to the nauplius stage proceeds here; the nauplii are expelled to the exterior and lead a free-swimming existence for four days, undergoing four moults. The cypris stage is reached on the fifth day, and after two or three days of free existence the cypris larvæ attach themselves by their antennules to a hair upon any portion of a young crab, preferably upon the appendages. The cypris casts off its thoracic appendages, the ectoderm draws away from the shell and comes to surround a mass of mesodermal cells; it secretes a chitinous coat, and in this manner the *Kentrogon* larva is formed. The cypris shell, including all the larval organs, is thrown off. The embryonic cells of the *Kentrogon*, consisting of ectoderm and mesoderm, pass through an ectodermal hollow dart into the hæmocœle of the crab, and are carried in the blood-stream till they reach the intestine. They are inclosed in a thin chitinous cuticle. The *Sacculina interna*

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 129–42.
† Ann. Nat. Hist., i. ser. 8,, pp. 280–2 (1 pl.).
‡ Quart. Journ. Micr. Soc., li. (1907) pp. 625–32 (6 figs.).

migrans now proceeds to grow rapidly, to throw out roots in all directions, while the central tumour grows down the intestine toward the junction of thorax and abdomen of the crab. At this time the adult organs are differentiating in the most posterior portion of the central tumour, which soon arrives at the position of evagination of the adult *Sacculina*. Here differentiation proceeds, and the pressure of the growing tumour upon the epithelium of the crab causes it to degenerate, and thus when the crab next moults a hole is left in the new chitin, through which the *Sacculina* protrudes and so gains the exterior.

New Barnacles.*—A. Gruvel makes a preliminary note on the collection of stalked Cirripeds made by the German Antarctic Expedition. It includes four new species of *Scalpellum*.

Metamorphosis of Mytilicola intestinalis.†—Otto Pesta gives an interesting account of this Copepod parasite of *Mytilus galloprovincialis*, in whose life-cycle are included extremes of feeding habits, from those of a free life to that of parasitism. At the change of habit, swimming legs are transformed into crawling ones, their now useless or even injurious bristles becoming either rudimentary or thorny. Thorny bristles may secure fixation. Similar transformations occur in the thoracic limbs. A reduction of the number of segments sets in when the gut lumen of the host is nearly filled up by the further growth of the parasite, and a long worm-like creature results, which moves by alternate extension and contraction of certain body segments. For definitive onward movements the legs, now greatly modified, serve as struts pressing rhythmically upon the gut-wall.

Annulata.

Metamorphosis of Echiurus.‡—W. Salensky returns to a study of the development of *Echiurus*, and gives an account of the assumption of the definitive form, the differentiation of the skin, and the establishment of the larval and adult nervous system.

Studies on Maldanidæ.§—Ivar Arwidsson has studied a large number of Scandinavian and Arctic Maldanidæ, and gives an account of the whole family, in which he recognises five sub-families—Lumbriclymeniæ, Rhodininæ, Nicomachinæ, Euclymeninæ, and Maldaninæ. The elaborate memoir contains descriptions of numerous new forms.

Earthworms as Planters of Trees.‖—E. A. Andrews gives an account of some observations showing that earthworms may aid in the germination of the seeds of at least one important kind of tree, by their habit of plugging up the mouth of their burrows. On May 3 it was noticed that the ground under a group of silver maple trees was covered with the little key-fruits or samaras that had fallen from the trees, and in many places these were collected into little heaps a foot or more apart. Each

* Bull. Soc. Zool. France, xxxii. (1907) pp. 157–62.
† Zeitschr. Wiss. Zool., lxxxviii. (1907) pp. 78–98 (1 pl.).
‡ Bull. Acad. Sci. St. Petersbourg (1908) No. 3, pp. 307–28 (16 figs.).
§ Zool. Jahrb., xxvi. (1907) pp. 1–308 (12 pls.).
‖ Amer. Nat., xli. (1907) pp. 711–14.

heap contained from twelve to fifty fruits, some lying loose, some partly buried, and bound together with earth and a few fibres, probably grass. The ground for a radius of several inches round each heap was markedly free from seeds and clean, so that it seemed as if the earthworms had reached out as far as possible and dragged back all the seeds they could find to the mouths of their burrows. In every collection, three, four, or more seeds had sprouted, while outside the heaps not a single sprouting seed was found. Several weeks later some dozens of young trees, three or four inches in height and with two or three pairs of leaves, were found under the parent trees, standing, with the remains of the heaps still visible about them, apparently on the site of the earthworms' burrows.

Systematic Position of Chætognatha.*—R. T. Günther concludes that this class approaches in its structure and development nearer to the Mollusca than to any other group. He points to the following resemblances:—the worm-shaped body, which recalls the Amphineura Aplacophora; the bilateral symmetry in general, and particularly of the body-cavity; the presence of an abdominal sac behind the anus: the absence of undoubted segmentation; the jaw armature in *Sagitta* and *Proneomenia*; buccal and visceral commissures in the nervous system; the pre-oral ciliary wreath or velum; the endoskeleton in the head of *Nautilus* and *Spadella*; the lateral and tail fins in *Sagitta* and the Dibranchiate Cephalopods; the two paired openings from the cavity of the gonads; the hood and the circumoral propodium of Cephalopods; the development of the eggs within a follicular epithelium and their growth upon stalks; the tendency in pelagic molluscs for shell, mantle, gills and foot to disappear, e.g. *Phyllirhoë*. On the ground of these and other observations, Chætognatha are regarded as the living representatives of that phyletic stage which is represented by veliger larvæ, and from such a free-swimming ancestor the creeping Polyplacophora, worm-shaped Aplacophora, and the swimming Cephalopods may have arisen independently. A systematic scheme of the Mollusca is put forward in which Chætognatha and Cephalopoda are grouped together as Nectomalacia, and all other Molluscs as Herpetomalacia. The characters of these groups are defined.

Nematohelminthes.

Nervous System of Ascaris.†—D. Deineka describes the sensory and motor nerve-cells. He recognises two types of sensory cell. Those of the first type are connected with each other by means of their short processes, along which the neurofibrils of one cell pass over into the body of another, and also by means of central processes which, branching greatly as they meet, form an intimate network. The cells of the second kind are connected by means of short, greatly branched dendrites. The two kinds of cell are closely intermingled in the sensory end apparatus; they share by means of their fibrils in the formation of the thin nerve-tufts of the papillæ, and also form the network of delicate nerve-branches which constitutes the main mass of the papillæ. The motor-cells are

* Zool. Anzeig., xxxii. (1907) pp. 71–2.
† Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 242–307 (9 pls. and 7 figs.).

only connected more or less closely with one another when they possess strongly branched dendrites which form networks. There are four types of motor-cell.

Platyhelminthes.

Orientation of the Cestoda.*—Ludwig Cohn makes some striking suggestions on this subject. He holds that the key to the morphological significance of the Cestode body is to be found in the oncosphere. Its front end is the hook-bearing end, which in movement is directed anteriorly. In all tailed Cysticercoids the embryonal hooklets of the oncosphere are found on the caudal appendage, which is thus to be regarded as the anterior end of the Cysticercoid. There is a stage in all Cestodes when the whole anterior body is lost, and in the proliferating scolices we have animals which without possessing a real anterior end, i.e. a head, fix themselves by the hinder end to the gut wall, and hang with their relatively most anterior end freely suspended in the gut. This thesis thus assumes (1) that in Cestodes the anterior and the posterior body arise separately from a middle piece; (2) that the hinder part detaches itself and alone enters into the composition of the sexual animal; (3) that the zone of growth of Cestodes occurs not on the front end close behind the head, but, on the contrary, away from it. These points are fully discussed in the paper.

Sterility in Cestodes.†—Al. Mrázek found an example of *Tatria acanthorhyncha* which possessed only male organs and a receptaculum seminis. Another individual possessed in the youngest (anterior) proglottids distinct rudiments of single parts of the sex-organs, e.g. cirrus sac, etc., but in the oldest proglottids had not the slightest trace of these organs or their rudiments. It is regarded as probable that the development had proceeded so far and stopped, and that the rudiments then disappeared. It is possible that these phenomena have some relation to the rare cases of Cestoda in which the sexes occur separate.

Hemiuridæ.‡—A. Looss deals with the anatomy and classification of the members of the Distomid family Hemiuridæ, giving a detailed account of its sub-families, genera, and species. The members of this family are inhabitants of the alimentary canal of marine bony fishes. They are entirely or nearly cylindrical, and in some, though not in all, the body consists of two regions, trunk and abdomen (Schwanzanhang). The skin is always unarmed, and the suckers, which are muscular and powerful, are set close together. The eggs are extremely numerous, thin-shelled, and relatively small, usually about 0·02 mm., exceptionally 0·03 mm. in length.

Rhythmic Behaviour of Convoluta Roscoffensis.§—Louis Martin has made some new and interesting observations on this subject. He finds that darkness inhibits the movements, which synchronise with the tides. *Convoluta* does not rise in darkness, or if it have done so, it

* Zool. Anzeig., xxxii. (1907) pp. 51–66.
† Centralbl. Bakt. Parasitenk., xlv. (1907) p. 234–5.
‡ Zool. Jahrb., xxvi. (1907) pp. 63–180 (9 pls.).
§ Comptes Rendus, cxlv. (1907) pp. 555–7.

descends. An interesting exception is the fact that on moonlight nights, and especially at full moon, the rhythm is maintained, and that even although the sky is dark. It is also found that various physical, chemical, or physiological influences are capable of disturbing this rhythm.

Planaria angulata Müller.*—J. Wilhelmi clears up the confusion in connection with the terminology of *Planaria angulata* Müller. The name has been given to a Nemertine, a marine Triclad, and a larva whose development has been regarded by several embryologists as in the category of Polyclads. *P. angulata* Müller must be classed as a Nemertine. The form named by Agassiz as *P. angulata* has no claim to the title, and further, in consequence of his brief description, is difficult to identify again, although many circumstances point to its being the Bdellurid which lives upon *Limulus*. Owing to Agassiz' uncertain determination there is great doubt as to the value of the observations made by Balfour and by Korscheldt and Heider on the development of *P. angulata*.

Structure of Fresh-water Triclads.†—Joh. Ude has published a memoir dealing with the anatomy and histology of *Planaria gonocephala* Dug., *Dendrocœlum angarense*, and *D. punctatum*. An examination of the characters of *Planaria wytegrensis*, as stated by Sabussows, shows it to be much more probably a variety merely of *P. gonocephala*.

Early Development of a Polyclad.‡—Frank M. Surface has studied the early stages in the development of *Planocera inquilina* Wh. The cleavage is strictly spiral in the dextral sequence until a late stage (forty-four cells). Three quartets of ectomeres are given off in alternating dexiotropic and læotropic directions. At the next division a fourth quartet is formed, the cells of which are of very large size and contain most of the yolk. The "macromeres" are very minute cells, which remain at the vegetative pole until the closure of the blastopore. The markedly degenerative character of their nuclei and the small amount of cytoplasm indicate that they degenerate without giving rise to any structure.

At the stage with forty cells there are formed at the animal pole four small "apical" cells, like those in Annelids and Molluscs. At the forty-four-cell stage the posterior cell of the fourth quartet, $4\,d$, buds a single large cell into the interior of the embryo. Both of these cells, $4\,d$ and $4\,d^2$, next divide bilaterally. Of these four cells the two upper and inner give rise to a portion of the mesoderm, and possibly a small part of the endoderm. The lower pair of cells, lying on the surface of the embryo, give rise to practically all of the endodermal part of the alimentary canal. Thus the history of this cell, $4\,d$, shows a remarkable resemblance to its homologue in Molluscs and Annelids.

The three anterior cells of the fourth quartet, $4a$, $4b$, and $4c$, seem to function only as the bearers of food-yolk, and apparently give rise to

* Zool. Jahrb., xxvi. (1907) pp. 1–10.
† Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 308–70 (3 pls. and 3 figs.).
‡ Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 514–59 (6 pls.).

no morphological structure. The very large nuclei of these cells can be followed until the beginning of the pharyngeal invagination. The yolk in these cells breaks up into spherules, probably through the action of enzymes from the large nuclei. This liquefied yolk is afterwards absorbed by the endoderm cells.

A large portion of the ectoderm is formed by the successive budding or delimination of small cells from larger, deeper-lying cells. A portion of the mesoderm, chiefly that part lying around the pharynx, is derived from cells of the second quartet, and thus corresponds to the "secondary" mesoblast or "larval" mesenchyme of Annelids and Molluscs.

In the spiral cleavage, the segregation of the ectoblast in three quartets, the formation of a large part of the mesoderm from 4 *d*, the formation of the apical cells, and in many other details, the development corresponds to that of Annelids and Molluscs. On the other hand, in the development of the entire alimentary canal from a portion of the mesentoblast, 4 *d*, and in the consequent degeneration of the "macromeres" and of the remaining cells of the fourth quartet, this Polyclad is unique.

Nematocysts of Turbellaria.*—C. H. Martin has experimentally proved in a series of Turbellaria that their nematocysts are derived from their food. For example, if *Microstoma lineare* is fed upon *Cordylophora*, the nematocysts of this polyp are found under its skin. Ordinarily its nematocysts are derived from *Hydra*, upon which it feeds. The same process probably occurs in the other Turbellaria, with the possible exception of *Anonymus virilis*, and therefore there is no ground for the generally accepted homology between nematocysts and rhabdites.

Rotifera.

New French Rotifers.† — P. de Beauchamp describes *Proalides tentaculatus* g. et sp. n., a remarkable footless Notommatid adapted for free-swimming. It has affinities with *Proales*, *Taphrocampa*, and possibly *Adactyla*. The author also describes *Proales similis* sp. n. and *Rattulus cylindricus* Imhof, var. *chattoni* var. n.

New Scottish Rotifers.‡—James Murray, in a supplementary note on Scottish Rotifers collected by the Lake Survey, gives lists of species found, mostly in moss, in various parts of North Scotland, Orkney and Shetland. Amongst these are the following new species: *Philodina convergens*, *Callidina minuta*, *C. circinata*, *C. plicata* var. *hirundella*, which are described and figured.

Stomachal Excretion in Rotifera.§—P. de Beauchamp describes a process observed in the stomach of Rotifera in which a selective action is exercised whereby from amongst the substances swallowed, e.g.

* Quart. Journ. Micr. Sci., lii. (1908) pp. 261–77 (1 pl.).
† Bull. Soc. Zool. France, xxxii. (1907) pp. 148–57 (3 figs.).
‡ Trans. Roy. Soc. Edinburgh, xlvi. (1908) pp. 189–201 (2 pls.).
§ Comptes Rendus, cxliv. (1907) pp. 1293–5.

chlorophyll, some parts are digested and retained in the form of basophile globules and fat, while others are excreted from the cells into the gut in the form of strongly acidophile grains.

Echinoderma.

Regeneration of Spines and Pedicellariæ in Sea-urchins.*—O. Poso has experimented with *Sphærechinus granularis*, *Echinus microtuberculatus*, and *Strongylocentrotus lividus*, and finds that there is regeneration of spines and pedicellariæ. He was led to this research by the state of some of the sea-urchins collected at Naples some time after the eruption of Vesuvius in 1906, which showed delicate spines, disproportionately young looking. On a sudden change from a large reservoir to a small glass vessel a specimen of *Sphærechinus* shed most of its spines and seemed about to die. It recovered, however, and began to regenerate what it had lost.

Luminosity of Ophiuroids.—Reichensperger † has studied *Ophiopsila annulosa* (Sars), *O. aranea* Forbes, *Amphiura filiformis* Müller, and *A. squamata* Sars. In the first there are peculiar glandular structures in the lateral spines; in *A. filiformis* there are similar structures in all the spines. In *A. chiajei*, which is not luminous, there are no glandular structures of this sort, but they occur again in *A. squamata*. In *O. aranea*, however, they are not to be found. Reichensperger thinks that in the three species above noted the glandular structures associated with the spines are the luminous organs. He does not agree with Irene Sterzinger's conclusion that in *A. squamata* the tube-feet produce luminous mucus.

Ernst Mangold ‡ has studied the same four species, and he also has concluded that the luminosity is associated with skeletal plates and spines, not with tube-feet. He criticises Irene Sterzinger's argument. He also discusses the climbing powers of Ophiuroids, and concludes that the attachment of the tube-feet is not mainly due to a secreted glutinous substance. The theory that the fixation is due to glutinous secretion is not convincing. There is more to be said for the theory that the tube-feet may act as muscular suckers.

Development of Ophiothrix fragilis.§—E. W. MacBride communicates the results of his investigation of this subject. The early development varies with the condition of the egg at the moment of fertilisation, and the development of the unripe egg resembles in certain features that of *Ophiura brevis*. The cœlome originates as a single vesicle from the apex of the archenteron, and this appears to be true for all classes of Echinoderms. This segments into three somites on each side. The middle somite on the right occasionally assumes a five-lobed form, proving beyond doubt that it is a right antimere of the water-vascular system. Metamorphosis is initiated by a preponderant growth of the organs of the left side, which affects the larval arms and the sides of the œsophagus, and which not only carries the hydrocœle round the

* Anat. Anzeig., xxxii. (1907) pp. 14–16.
† Biol. Centralbl. xxviii. (1908) pp. 166–8. ‡ Tom. cit., pp. 169–76.
§ Quart. Journ. Micr. Sci., li. (1907) pp. 557–606 (6 pls, 4 figs.).

œsophagus, but also the madreporic pore and the left anterior cœlome, so that these come to be near the right hydrocœle. The origin of the perihæmal canals is described. From their walls originate the motor ganglion cells and in all probability the ventral intervertebral muscles. The primitive germ-cells originate from the left posterior cœlome covering the stone canal.

Monograph on Apodous Holothurians.*—Herbert Lyman Clark has completed a valuable monograph on the Synaptidæ and Molpadiidæ. It has been based on the collection of over two thousand specimens in the United States National Museum, and is intended as a complete account of all the apodous Holothurians known to science. The author deals with structure, functions, habits, inter-relations, development, and classification. Of Synaptidæ there are 21 genera and 88 species; there is every reason to believe that the common ancestor was a small 10-tentacled apodous form, probably with wheel-shaped calcareous particles; *Rhabdomolgus* seems to be the nearest living representative of the ancestral stock, though it is not necessarily close to it; *Polyplectana*, *Protankyra*, *Polycheira*, and *Acanthotrochus* are the most highly specialised forms on the four different branches on which the Synaptid genera may be arranged. Of Molpadiidæ there are 8 genera and 46 species; the ancestor of the group was probably a 15-tentacled pedate Cucumarian; to this it may be that *Himasthlephora* is nearest, while *Gephyrothuria* is also primitive. The author is to be congratulated on the completion of a very fine piece of work.

Cœlentera.

New Types of Alcyonarians.†—Louis Roule refers briefly to two new types which he found in a collection from Amboina. The first is *Pachyclavularia erecta* g. et sp. n., in which the mesoglœa of the basilar membrane is so thick that the encrusting mode of growth characteristic of Clavularids is replaced by one more or less erect. The second is a Virgularid — *Svavopsis elegans* g. et sp. n., which has no pinnules or calices.

Association of Alcyonarian and Alga.‡—Ch. Gravier describes a case of association in very large numbers of a unicellular alga with an Alcyonarian, *Sarcophytum mycetoides* Grav. In the first stages the algæ are regarded as parasitic, but once established and its nutrition assured, the relationship becomes symbiotic. The case is regarded as parallel with that of *Convoluta* and its green cells.

Spines of Antipatharia.§—Louis Roule has investigated the question of the morphological significance of these structures. His conclusion is that they are abortive branches, and correspond to branches of the axis. Antipatharians with undivided colonies have only these abortive structures, while those that branch exhibit a normal development. These conclusions have been arrived at by a comparison of Antipatharians with a complete colony of a new Gorgonid genus *Rhopalonella*, from the Antarctic seas.

* Smithsonian Contributions to Knowledge, xxxv. (1907) 231 pp., 13 pls.
† Comptes Rendus, cxlv. (1907) pp. 946–7.
‡ Op. cit., cxliv. (1907) pp. 1462–4. § Tom. cit., pp. 1453–4.

Development of Gonophores in Siphonophora.*—W. Richter has studied this in *Rhizophysa*, *Physalia*, and *Hippopodius*. Only some of the more general facts elucidated in the paper can be quoted here. In all the gonophores—male and female—examined, the origin of the radial canals from stomach-grooves, independently of the bell-nucleus, is established. The germ-cells arise in the endoderm ; only in *Physalia* could the ectodermal origin of the spermatoblasts be proved with any probability. In none of the forms does a wandering of the germ-cells to the ectoderm take place. The development of the gonophores into the medusoid structure goes on in the usual way in the female gonophores and in the male of *Hippopodius*. The male of *Rhizophysa* shows a simplification in so far as that a typical bell-cavity is not developed ; further development is by a downwardly directed growth, accompanied by a progressive blending of the tæniolæ edges. The most important result is the demonstration that the old Agassiz-Weismann theory of the origin of the Medusa cannot be held for the Siphonophora, as Goette has already shown for the Hydromedusæ. A new light is here thrown upon the question of the origin of the Siphonophora from the Hydromedusæ.

Australasian Hydroid in North Sea.†—James Ritchie gives an interesting account of a colony of *Sertularia elongata* picked up in the North Sea. The colony was complete, with naturally terminated stems and perfect pinnæ, upon practically every one of which in the more mature colonies are perched exceedingly delicate, loosely attached gonangia. The preservation of these delicate structures is regarded as evidence that the colony was not artificially transported, e.g. in ballast on board some ship loading at an Australasian port, but was borne on ocean currents.

Nuclear Cycle of Gonionemus murbachii A. G. Mayer.‡—H. B. Bigelow gives an account of the mitosis in the somatic cells of adult tissues of this Cœlenterate, of its entire course of spermatogenesis, the early nuclear development of the oocyte, and the nuclear phenomena connected with fertilisation. An interesting point is that in fertilisation nuclear union may take place either by fusion or by apposition ; the determining factor is believed to be the relative sizes of the nuclei at the time of their union. In the first cleavage spindle there are the full number of somatic chromosomes. In the second cleavage there is a reduced number, each of which is a bivalent structure resulting from the pairing of univalent chromosomes. The number of chromosomes in the third cleavage has not been observed, but in the fourth and subsequent cleavages all nuclei have the full somatic number of chromosomes.

Porifera.

Coalescence and Regeneration in Sponges.§—H. V. Wilson describes the formation of plasmodial masses in moribund specimens of *Microciona prolifera*. When fragments are squeezed through a cloth so

* Zeitschr. Wiss. Zool., lxxxvi. (1907) pp. 557–618 (3 pls. and 13 figs.).
† Proc. Roy. Phys. Soc. Edinburgh, xvii. (1907) pp. 80–3 (1 pl.).
‡ Bull. Mus. Comp. Zool. Harvard, xlvii. (1907) pp. 287–399 (8 pls.).
§ Journ. Exper. Zool., v. (1907) pp. 245–58 (4 figs.).

that the cells pass out, the same kind of phenomenon is seen. The cells aggregate into true syncytial masses with pseudopodia. The syncytia fuse into an incrustation, and regeneration occurs. Flagellate chambers appear in great abundance, canals arise as isolated spaces which come into connection with one another; oscula are developed. The syncytia consist mainly of spheroidal granular cells (amœbocytes or archæocytes), but collar cells and more or less hyaline cells also enter into their composition. The author also describes the fusion of the larvæ of a species of *Lissodendoryx*, and makes some very interesting general suggestions, e.g. by comparing the behaviour of the dissociated cells of sponges with the plasmodium formation in Mycetozoa and Proteomyxa. The tendency to fusion exhibited by two similar sponge-syncytia is probably adaptive. The additional safety from enemies and accidents, accruing from increase in the size of the mass, more than compensates for the reduction in number of the individual masses that start to grow. Experiments show that masses of considerable size are frequently able to withstand conditions that wipe out very small masses.

Protozoa.

Minute Structure of Amœba proteus, Pall.*— S. Awerinzew has investigated the structure of Amœba by the aid of sections. The protoplasm immediately beneath the outer pellicle is highly vacuolar, but the vacuoles are very small in comparison to those layers within. Here there is a layer of radially arranged relatively large vacuoles, and within this a central region in which the nucleus lies, and in which the vacuoles increase in size and numbers from its periphery towards the centre. The vacuoles of this central protoplasmic mass are on the whole larger than those of the layer immediately beneath the pellicle. The walls of the vacuoles are beset with granules. The nuclear structure resembles that of the protoplasm. The nuclear vacuoles of the external layer nearly all show chromatin corpuscles, stainable with nuclear stains. Similar corpuscles occur also in the walls of the meshes of the remaining nuclear mass. These, however, appear to be distinguished by their chemical qualities from the peripheral nuclear granules, and are smaller in size. The appearances of protoplasm and nucleus here described have nothing to do with reproductive processes, but represent a stage in those transformations induced by heightened feeding and the accelerated growth consequent on this.

Degeneration in Opalina.†—C. C. Dobell describes the degenerative changes undergone by *Opalina* when the host is starved for some time. It changes form and assumes all sorts of indefinite shapes. These modified *Opalina* do not divide in the normal manner, but simply constrict off pieces, which completely lose their cilia and give rise to globules of a substance of high refractivity in their cytoplasm, which are "eosinophile" in character. These globules ultimately run together into large masses within the cell. The chromatin of the nucleus in these atrichous forms becomes massed in granules at the periphery, whilst the

* Zool. Anzeig., xxxii. (1907) pp. 45–50.
† Quart. Journ. Micr. Sci., li. (1907) pp. 633–46 (1 pl. and 2 figs.).

nucleus itself increases sometimes to double the original diameter. In the larger atrichous forms, division may take place, both of nucleus and cytoplasm. Buds may be given off without nuclei, but they appear to disintegrate and die. As a rule, the chromatin of the nucleate forms is cast out into the cytoplasm, and later to the outside, when the organism dies. The author discusses the "extraordinary parallel" which exists in the changes he describes and certain so-called "sexual" processes in Protozoa.

Light-reactions in Volvox.* — S. O. Mast describes in detail the reactions of *V. globator* and *V. minor* to light. The eye-spots are situated on the outer posterior surface of the individuals. *Volvox* rarely moves exactly in the direction of the light-rays, but deflects, apparently under the influence of gravity, up or down or to the side, the degree of deflection being least for strongly positive colonies exposed to light of optimum intensity. The motion is regulated by the relative intensity of the light on opposite sides of the colony. Orientation is not the result of "trial and error," but is brought about by motor reactions in the individuals composing the colony. *Volvox* is positive in comparatively low, and negative in comparatively high light-intensities, but there is great variation in regard to this, depending upon the physiological state of the colonies. Weber's law seems to hold for the light-reactions of *Volvox*.

Trypanosome of the Eel.†—C. França gives an account of *Trypanosoma granulosum* Laveran and Mesnil, which is very abundant in *Anguilla vulgaris* in Portugal. The species has very distinctive nuclear characters, and it occurs in two well-marked varieties, *parva* and *magna*. Culture in the blood of the eel gives rise to "herpetomonad" forms. No endocellular stages are found in the eel's blood.

New Piroplasma from a Rodent.‡—C. Nicolle describes a new *Piroplasma* from *Ctenodactylus gondi* Pallas, an Octodont of North Africa. It appears to be common: it resembles the Leishman body in appearance, and has the peculiarity of dividing into four, not two, daughter-cells. The author names it *Piroplasma quadrigeminum*.

Structure and Life-history of Copromonas.§—C. C. Dobell gives an account of *Copromonas subtilis* from the rectum of *Rana temporaria*, and discusses various points in flagellate morphology. There is an asexual and a sexual cycle in the life-history. During the former, multiplication takes place by longitudinal division. After a time the monads conjugate in pairs, and reducing divisions of the nuclei take place, followed by encystation. The cysts are capable of being dried up. These are swallowed by frogs and toads, and reach the rectum by way of the digestive tract. As a rule the cysts do not liberate their contents (a small hyaline monad) until the fæces have left the frog, but sometimes the monads emerge from their cysts and lead a semi-parasitic life in the large intestine. Development does not appear ever to be completed inside the frog.

* Journ. Comp. Neurol. and Psych., xvii. (1907) pp. 99–180 (15 figs.).
† Bull. Soc. Portugaise Sci. Nat., i. (1907) pp. 94–102 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxiii. (1907) pp. 213–16 (1 fig.).
§ Quart. Journ. Micr. Sci., lii. (1908) pp. 75–120 (2 pls. and 3 figs.).

Trichomonas and Megastoma in Human Intestine.*—A. Ucke has observed organisms in fresh fæces which he is inclined to regard as stages in the development of *Trichomonas*. Besides the typical pear-shaped organism, pointed posteriorly, with three flagella anteriorly, undulating membrane, nucleus and vacuole, there were the following phases :—The pear-shaped body is rounded off, and becomes oval. The vacuole increases in size and the protoplasm is crowded into the periphery. After the whole has become spherical the protoplasm is collected at two opposite poles, whilst it thins out in the equatorial plane. Here there begins a segmentation, which gradually increases and leads to the segmenting off of two spherical but smaller bodies of a signet-ring form. It is regarded as probable that further division goes on. Out of 138 cases examined, the author found 9 infected with *Megastomum entericum*, which occurred in both vegetative and encysted forms.

Biology and Affinities of Spirochætæ.†—H. B. Fantham discusses the movements, structure, and general affinities of *Spirochæta* (*Trypanosoma*) *balbianii* Certes and *Spirochæta anodontæ* Keysselitz. The motion of these organisms is resolvable into at least two components—(1) a vibratory motion of flexion of the body mainly for progression; and (2) a spiral or corkscrew movement of the body as a whole, due to the winding of the membrane. The membrane is a spirally wound lateral extension of the ectoplasmic periplast. It is characteristic of the genus *Spirochæta* as now defined. Only asexual modes of multiplication, principally by longitudinal fission, are known with certainty. Spirochætes are regarded as having affinities both with bacteria and the Protozoa; they are undoubted protists. The author is inclined to accept the protozoan nature of these organisms, and considers that a provisional new class of the Protozoa, viz. Spirochætacea, might be instituted for their reception when our knowledge of them is a little more extensive.

* Centralbl. Bakt. Parasitenk., Orig., xlv. (1907) pp. 231–3.
† Quart. Journ. Micr. Sci., lii. (1908) pp. 1–73 (3 pls. and 11 figs.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Blepharoplast and Centrosome of Marchantia polymorpha.* — Eud. Escoyez has studied the so-called centrosomes which occur in the spermatic mitoses of *Marchantia polymorpha*, and finds that these bodies only occur in the last division, and that while in form and position they resemble true centrosomes, their real function is that of blepharoplasts. They are, in fact, organs *sui generis*, and the relation between them and the spindle can be simply explained by the special mode of division of the mother-cell of the spermatozoids.

Nucleus and Karyokinesis in Zygnema.†—The same author has investigated karyokinesis in *Zygnema*, and draws the following conclusions from his observations. All the chromosomes are produced from a chromatic network; the nucleolus only provides chromatic material for the chromosomes, but contributes no morphological elements. The chromosomes are elongated rods which split longitudinally in the usual way; this is seen most clearly in the metaphase. In the telophase, the chromosomes, which are at first crowded together, spread out into the nuclear vacuole, and are united by their drawn-out ends. The nucleolus is formed at this stage, not from the united chromosomes, but quite independently from the chromatic network. The chromosomes appear to retain their individuality from one mitosis to another. The pyrenoids and chromatophores multiply by simple fission, independently of the nucleus.

Nuclear Structures in Synchytrium.‡—F. L. Stevens has described some unusual nuclear figures from the large nucleus of *Synchytrium decipiens*. One of these is a nucleus without a membrane, consisting wholly of chromatin and a large nucleolus; this form appeared always in cells with one nucleus, and therefore before any division had taken place. Other phenomena noted were the asters variously connected with nuclei, and evidently of extranuclear origin; but the absence of a complete series of figures made it impossible to identify the different stages, and so to explain the nature of the various bodies seen. The development of the resting spore is followed, and of the sporangia.

Peroxydiastase in Dry Seeds.§—Brocq-Rousseu and E. Gain have experimented with seeds of different ages obtained from plants of

* La Cellule, xxiv. (1907) pp. 247–54 (1 pl.).
† Tom. cit., pp. 354–64 (1 pl.).
‡ Ann. Mycol., v. (1907) pp. 480–4 (1 pl.).
§ Comptes Rendus, cxlv. (1907) pp. 1297–8.

numerous families and of widely different habitat, with the object of proving whether, as suggested by Bertrand and others, they contain a diastase. The authors conclude that dry seeds usually contain peroxydiastase (i.e. diastase and peroxide of hydrogen). It appears to be located in the embryo, but does not maintain its existence indefinitely. The duration of its existence will be made the subject of a future research; at present it appears to have some relation to the age of the seed. It may also be supposed that there is some connection between the peroxydiastase of the resting seeds and the true oxydases of active, living plants.

Structure and Development.

Reproductive.

Origin and Fruit-development of Acorus Calamus.*—M. Mücke has investigated the fruit-formation of *Acorus Calamus*, and is of the opinion that the cause of the arrest of fruit-development must be sought in the unfavourable climatic conditions of its new habitat, since it was originally a native of the warm regions of eastern Asia, and was not brought to Europe until about the middle of the sixteenth century, when it was imported into Germany. Indian and European plants show a certain difference in their habit and behaviour under different conditions of culture. *Acorus* has a stratified perisperm which incloses characteristic albuminous cell-contents, and is absorbed by the growing embryo-sac. The pollen and ovules in *A. Calamus* undergo an arrest of development which prevents seed-formation, while, on the contrary, there is normal development in *A. gramineus*, which therefore produces seeds capable of germinating.

Pollen-development of Sarracenia.†—M. L. Nichols has made cytological studies of the pollen of *Sarracenia flava*, *S. purpurea*, *S. variolaris*, *S. rubra*, and *S. psittacina*, and also of hybrids of *S. flava* × *S. variolaris*, and *S. flava* × *S. purpurea*. The writer agrees with those authors who believe that there is a connection between the nucleolus and the formation of chromatin, and quotes the relations of the nucleolus and the chromatin in the prophases of the first maturation division in support of her opinion. The variation in the staining properties of the nucleolus at this period indicates some sort of chemical change, and the material thus elaborated escapes into the nuclear sac, is absorbed by the linin, and distributed along its threads. The nucleolus does not appear to have the same definiteness of function as the chromosomes and centrosomes, and it is probable that it represents a different physiological activity at different times and in different cells. The present investigation has not made it possible to determine whether there is a conjugation of chromosomes during the synapsis stage, neither does the behaviour of the nucleolus entirely favour the individuality of the chromosomes.

* Bot. Zeitschr., lxvi. (1908) pp. 1–23 (1 pl.).
† Bot. Gazette, xlv. (1908) pp. 31–7 (1 pl.).

Physiology.

Nutrition and Growth.

Grafting of Plants containing Hydrocyanic Acid.*—L. Guignard has made experiments with the object of discovering whether there is any migration of chemical substances from the graft to the stock, or *vice versâ*. The researches hitherto made in this connection dealt with the migration of alkaloids, e.g. atropine, but the author regards them as unsatisfactory, since it is not certain what part is played by alkaloids in plant physiology. On the other hand, the various compounds of hydrocyanic acid are known to have an important function in food-elaboration, and are very easy to detect, and therefore the present experiments deal with plants rich in these substances. The plants used as grafts and stocks were *Phaseolus lunatus* and the ordinary Haricot bean; and *Photinia* and *Cotoneaster*, with the hawthorn and the wild quince. The results show that when a plant containing a hydrocyanic glucoside is grafted on a plant destitute of this substance, or inversely, there is no migration of the substance. Among the Rosaceæ such migration did occur, but only in different species of the same genus, both of which had the power of elaborating the same glucoside. The author concludes that, in spite of the interchange of substances between stock and graft connected with common nutrition and development, certain organic principles remain localised in the one or the other. Grafting represents an artificial symbiosis, in which each species retains its own individuality.

Seed and Soil Inoculation for Leguminous Crops.†—W. B. Bottomley publishes the results of his experiments with crops inoculated with nitrogen-fixing bacteria. The author distributed more than a thousand specimens of his culture, and about 80 p.c. of the reports received showed an increase in crop. Fifty-two reports are quoted, but only nineteen cases give figures, and there is so great a disparity in the results that no discussion is possible. So far as they go, it appears that a culture has been obtained which, in suitable cases, may increase the yield of leguminous crops 30 to 50 p.c. It is not claimed, however, that the culture cures "sickness" or increases the frequency with which leguminous crops can be grown, and inoculation is found to fail when the soil is too acid, or when it is deficient in lime, potash and phosphates, or when drainage is needed.

Formation of Aleurone Grains.‡—J. Beauverie contributes a note upon the globoids of aleurone grains. The metachromatic properties of the globoids render it easy to follow the different stages in the formation of the aleurone grain. The appearance of the globoids precedes that of the crystalloids and the amorphous substances. The granulations possessing the properties of the globoids appear early in the nucellus and endosperm, and even in the integuments where no globoids are formed. It appears that, contrary to the usual opinion, the globoid-substance has an independent existence within the grain, and can exist apart from the

* Comptes Rendus, cxlv. (1907) pp. 1376–80.
† London, 'Country Life' Office. See also Nature, lxxvii. (1908) pp. 330–31.
‡ Comptes Rendus, cxlv. (1907) pp. 1345–47.

grain. Some seeds, which are without aleurone-grains, are now known to possess a substance having properties similar to those of globoids.

Chlorophyll-formation.*—W. Lubimenko contributes a note upon chlorophyll-formation in the higher plants, under different intensities of light. The results of his experiments show that there is a maximum intensity for chlorophyll-formation. This intensity is less than the natural intensity, and varies with different species, and also with the same species at different temperatures. These facts are of importance in showing that a green plant can adapt itself to a weakened illumination by increasing its production of chlorophyll.

Carbon Assimilation of Penicillium.†—H. Hasselbring has conducted a series of culture experiments with various substances in order to advance our knowledge of the nutrition of fungi. Naegeli had stated that food-value depended on the specific linkage of certain atomic groups, but this has been disproved, and it is now held that no general relation has been established between the atomic structure of a substance and its food-value. Assimilation depends on the nature of the plant as well as on the chemical reactions of the medium used, and though such medium has nutritive value for one plant it will not serve for all plants. Hasselbring found that alcohol and acetic acid, and the substances from which the acetic acid radicle is easily derived, are assimilated by *Penicillium glaucum*. The effect of different media is discussed, and the results given in detail.

Irritability.

Influence of Light on Respiration of Fungi.‡—A. Löwschin has studied the lower fungi with the object of testing the statements made by certain authors as to the effect of light on their respiration. The author has performed a series of experiments upon *Cladosporium*, *Penicillium*, *Aspergillus*, and *Oidium*, but in no case did the light produce any regular acceleration of respiration, which was independent of the warmth produced in the culture by actinic rays.

General.

Arechavaleta, J.—**Flora Uruguaya.**
[The author concludes his account of the Compositæ of this flora.]
Anales del Museo Nacional de Montevideo. VI. Flora Uruguaya, iii. pp. 229–502 (figs. in text).

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Development of Stolons in Nephrolepis.§—A. Sperlich continues his studies on *Nephrolepis*, by describing the developmental history of the stolons. He has ascertained the exact time when the first stolon is produced, its function, its position, its relation to leaf-rudiment, and to

* Comptes Rendus, cxlv. (1907) pp. 1347–9.
† Bot. Gazette, xlv. (1908) pp. 176–93.
‡ Bot. Centralbl., xxiii. pt. 1 (1908) pp. 54–64 (3 pls.).
§ Flora, xcviii. (1907) pp. 341–61 (figs.).

the segmentation of the apical cell. The first stolon's rudiment appears after the third or fourth leaf of the embryo. The first lateral axes of the embryo *Nephrolepis* are in function root-bearers. The stolon, like the leaf, is the product of a special segment of the apical cell. The first stolons of epiphytic species serve to anchor the plant, and are very hydrotropic.

Physiological Sheaths in Ferns.*—P. Bäsecke publishes detailed results of his studies upon the physiological sheaths of the axes and fronds of the Filicineæ, and upon the substitution of cork. He discusses the endodermis at great length from the points of view of development, structure, biology, and physiology. He then treats of the formation of cork, the dividing layers between rhizome and frond, the lenticels and the intercellular cuticularisation, the mechanical tissues of rhizome and frond, and their lignification. He appends a long bibliography.

Revision of the American Species of Dryopteris.†—C. Christensen having, when preparing his "Index Filicum," realised the extremely confused condition in which the numerous forms allied to the two species, *Dryopteris opposita* and *D. Sprengelii*, had been left by the authors of the "Synopsis Filicum," has studied some 1200 specimens of the group and published a complete revision, in which are described 82 species, based upon the following characters — nervature, outline of frond, pubescence, texture, position of sori, etc. He supplies an analytical key to render determination more easy. He gives full synonymy and distribution of the species, critical notes, and often a figure. There are nine new species, and some new varieties. In the appendix, two more new species belonging to other groups are described.

North American Ferns. — W. N. Clute ‡ describes and figures *Asplenium Ferrissi*, a new species collected in the canyon region of Arizona by J. H. Ferriss. Other unique species have been recorded from the canyon country which borders on Mexico.

The same author § gives a simple account of the life-history of the ferns, and describes a new extreme form, *Nephrodium cristatum Clintonianum* f. *silvaticum*.

He also ‖ brings to an end his check-list of the North American Fernworts.

W. A. Terry¶ describes a new pubescent variety of the ostrich fern, transplanted from Plainville into his own garden at Bristol (Conn.).

A. Hans ** describes the result of hybridising the American species, *Polystichum acrostichoides* with four forms of *P. angulare*. The latter species is European, and not able to withstand the full rigour of the North

* Bot. Zeit., lxvi. (1908) Abt. 1, pp. 25–87 (3 pls.).

† Kgl. Danske Vid. Selsk. Skrift., ser. 7, Sci. iv., No. 4 (1907) pp. 247–336 (52 figs.).

‡ Fern Bulletin, xvi. (1908) pp. 1–2.

§ Tom. cit., pp. 5–13.

‖ Tom. cit., pp. 16–23.

¶ Tom. cit., pp. 3–5.

** Tom. cit., pp. 14–15.

American winter. But in the hybrid plants the strain of the American parent confers immunity from the frost.

Descriptions of New Tropical Ferns.*—E. Rosenstock gives descriptions of ten new species of ferns from German East Africa, Brazil, Uruguay, Ecuador, Sumatra, and indicates their affinities.

New Species of Lindsæa.†—L. M. Underwood and W. R. Maxon describe two new species of *Lindsæa*, one collected in Colombia by Pittier, and the other in Cuba by Wright and other botanists.

Ferns of Paraguay.‡—H. Christ publishes descriptions of some nine new species of ferns collected in Paraguay by E. Hassler, and adds notes upon two other rare species.

Bryophyta.

(By A. Gepp.)

Sexuality in the Mosses.§—J. Cardot treats of the question of sexuality in the mosses, and gives a summary of the results obtained by El. and Em. Marchal. The Marchals investigated the life-history of three dioicous mosses—*Barbula unguiculata*, *Bryum argenteum*, *Ceratodon purpureus*—with a view to determining whether or not the numerous plants arising from the spores of a given sporogonium, itself the product of one and the same fertilised egg, are all of one sex. They found them to be of different sexes. And, further, they ascertained that the sex of the ultimate plant is already predetermined in the spore; that the protonema unfailingly transmits the sex of the spore to the young plants—that is to say, that the protonema buds off plants which are solely male or solely female; that a secondary or regenerative protonema is equally faithful in the transmission of sex. Hence dioicism originates at the time of sporogenesis, at the time of the division of the spore-mother-cells, when reduction of chromosomes takes place. Previous to the time of this nuclear reduction all the cells of the sporogonium (both stalk and capsule) possess a bisexual potentiality. And when at this stage portions of the sporogonial wall or stalk are made to regenerate as a consequence of traumatic injury, an aposporic protonema is obtained. And the Marchals state that in case of the three dioicous species—*Bryum cæspiticium*, *B. argenteum*, *Mnium hornum*—the aposporic protonema produces gonophytes, which in the great majority of cases have a male character, while some bear synoicous flowers, and a few exhibit a female character only. But are the sexual characters of these axes maintained by the products of their vegetative reproduction? Experiments instituted to settle this question have brought out this important fact: that the products of the second diploid generation are bisexual, whatever be the sex manifested by the axes of first generation whence they arose; these latter are then in every case

* Fedde, Repertorium, iv. (1907) pp. 2–6, 292–6.
† Smithsonian Misc. Coll., l. (1907) pp. 335–6.
‡ Bull. Herb. Boissier, sér. 2, vii. (1907) pp. 922–8.
§ Rev. Bryolog., xxxv. (1908) pp. 8–11.

potentially bisexual. And this fact is in perfect harmony with the theory. In the haploid or sexiferous phase the cells of a moss present only one series of chromosomes (one sexual determinant); and the unisexual polarity is absolute, and is transmitted without alteration by vegetative propagation. On the other hand, the sporophyte (diploid phase) has, as the result of fertilisation, reunited in its cells two series of chromosomes, including the two sexual determinants. And if we avoid sporogenesis by obtaining direct vegetative reproduction from the wall or stalk of the sporogonium, the resulting gonophytes exhibit by their bisexuality the presence of male and female determinants. Even on the unisexual axes of first aposporic generation the unisexuality is only apparent; it conceals, as has been shown, a potential hermaphroditism; and the sexual bipolarity, whether it manifests itself or not, impregnates all the cells of the aposporic moss-plant. The Marchals have therefore succeeded in producing out of a strictly dioicous species a new hermaphrodite, or, more precisely, an androgynosynoicous form which is capable of reproducing itself indefinitely as such by vegetative methods. It remains to be determined whether the gametes of this new form could produce an oospore developing into a sporogonium with $4n$ chromosomes, and what would be the spores of such a capsule. And the Marchals are investigating this problem—a problem of great interest to the systematic bryologist, as explaining, in case of many genera, the existence and meaning of allied species which are almost completely alike in their vegetative characters, and differ in scarcely anything but sexuality.

Phenomena of Torsion in Mosses.*—W. Lorch has investigated the phenomena of torsion in the stems of Polytrichaceæ and of *Dicranum undulatum*. He describes and figures the apparatus he employed, and gives details of his experiments and results. He finds that the stems of one and the same species may twist to right or left, the direction of the spiral upon which the leaves are set being, in his opinion, due to the direction followed by the successive segments cut off from the apical cell.

Asexual Multiplication in Blasia and Riella.—H. Buch † gives the results of his experiments on the vegetative reproduction of *Blasia pusilla*, which confirm and complete the researches of Leitgeb. His very detailed and incompressible résumé is reproduced in Hedwigia, xlvii. (1908) Beibl., pp. 74–6. K. Goebel ‡ describes in detail the formation of gemmæ in *Riella*, giving figures of *R. Cossoniana*, *R. Clausonis*, and *R. Battandieri*, and compares the results with those previously recorded for *R. Americana* by Howe and Underwood. He finds marked analogies with the formation of gemmæ in *Marchantia* and *Lunularia*. And he finds other reasons for concluding that the Riellaceæ are allied to the Marchantiaceæ rather than to the Jungermanniaceæ, despite certain difficulties. The Marchantiaceæ stand at the head of the following four groups: Riccieæ, Corsiniaceæ, Riellaceæ, Marchantiaceæ.

* Ber. Deutsch. Bot. Gesell., xxvi. a. (1908) pp. 78–87 (fig.).
† Ofv. Finsk. Vet. Soc. Förh., xlix. (1906–7) No. 16, 42 pp. (2 pls.).
‡ Flora, xcviii. (1908) pp. 308–23 (figs.).

Leucolejeunea, a New Genus of Hepaticæ.*—A. W. Evans separates off from *Archilejeunea* Schiffn. a new genus, *Leucolejeunea*, proposed for the reception of three North American species, *A. clypeata*, *A. Sellowiana*, and *A. conchifolia*, described (or redescribed) and figured by the author six years ago. And with them he associates *A. xanthocarpa*, of wide distribution within the tropics and outside, and also *A. rotundistipula*, a Cape species. He gives a detailed description of the genus, and, having had the opportunity of studying the type-material of *Lejeunea unciloba* Lindenb., he is able to show that it agrees with *A. Sellowiana* and takes precedence of it.

Bryological Notes.†—V. Schiffner publishes a continuation of his notes upon Bryophytes. 38. *Cephalozia connivens* has been found among some North American material of *Telaranea nematodes*, and is thus shown to be a circumpolar species. 39. *C. gracillima* var. *viridis* Douin, hitherto recorded only for France, has been found in Dalmatia. 40. *Scapania calcicola* Ingh. is distinguished from *S. aspera* by having larger leaf-cells, and a new form of it is described. *S. calcicola* was first found in Sweden and France; it is absent from England, but has recently been found in Bosnia and Lower Austria. 41. *Riccia pseudo-Frostii* Schiffn. receives a more complete description, founded upon material gathered near Regensburg by Familler. The openings of the air-cells do not arise by resorption or dying off of epidermal cells. The species has been found by Nicholson in Sussex. 42. The vegetative reproduction of *Leptoscyphus cuneifolius*, a rare and sterile European species, is brought about by the breaking off of the small obcuneate leaves at their bases. These are carried away by wind or water, and sprout at their margins. A similar process occurs in some tropical species of *Plagiochila*.

European Hepaticæ.‡—K. Müller publishes the sixth part of his monograph of the "Lebermoose" in Rabenhorst's Kryptogamen-Flora, treating of the following genera:—*Riella* (continuation with descriptions of five more species); *Aneura* (6 species); *Metzgeria* (4); *Blyttia* (1); *Mörckia* (3); *Pellia* (3); *Blasia* (1); *Petalophyllum* (1); *Fossombronia* (generic description). Figures of each species are supplied.

Mosses of Sussex.§—W. E. Nicholson publishes an enumeration of the mosses of Sussex, comprising 344 species and numerous varieties. In an introductory note he gives a sketch of the geology and physical geography of the county, a brief account of the principal bryologists who have collected in Sussex, and a list of papers in which previous records have been published. Nearly all the species in the present enumeration have been actually observed in the field by Nicholson himself during the last fifteen years. He adds a list of 15 more species which have been found just outside the borders of the county, and may reasonably be expected to occur in Sussex itself.

* Torreya, vii. (1907) pp. 225–9.
† Oesterr. Bot. Zeit., lvii. (1907) pp. 454–8.
‡ Leipzig: E. Kummer, 1908, pp. 321–84.
§ Hastings and East Sussex Nat., i. (1908) pp. 79–110.

Mosses of Hampshire and Isle of Wight.*—A. B. Jackson publishes a moss-flora of Hampshire and the Isle of Wight, containing 220 species and several varieties. It is based partly on the earlier published records of Venables, C. B. Clarke, H. Reeks, F. T. Warner, H. N. Dixon, and sundry manuscript lists.

Notes on the Harpidia.†—W. Ingham gives the results of his observations of the Harpidia in their natural habitats in the Plain of Yorkshire, and of the changes which they undergo as their environment alters from wetness to dryness, etc., during successive seasons and years. He states his conclusions as to the passing of one form into another as the deep water of a pool drains or evaporates away or completely dries up. His observations are directed to *Hypnum aduncum*, *H. fluitans*, and *H. lycopodioides*.

European Forms of Catharinea.‡—W. Krieger gives the results of his further studies of the European species of *Catharinea*. He maintains that *C. undulata* is not a series of separable forms, but a group of variations which pass directly into one another. Almost every visible part of the plant is variable. While *C. Hausknechtii* is a good species, *C. pallida* Peterfi must be reduced, being synonymous with *C. undulata* var. *chlorocarpa*. The author provides a key to the forms of *C. undulata* and the few other European species, and concludes with notes on special forms, adding a reference to two new forms of Polytrichaceæ of which he has become possessed.

Systematic Position of Mnium riparium.§—R. Sebille recalls the dispute between H. Müller and W. P. Schimper forty-five years ago about the moss now known as *Mnium riparium* Mitt. (1864), which is distinguished from *M. serratum* by the inflorescence only. *M. riparium* is strictly dioicous, whilst *M. serratum* is synoicous, but sometimes bears flowers which are solely female. Müller at first designated *M. riparium* as *M. serratum* var. *dioicum*, but after a controversy with Schimper he was constrained, against his own conviction, to regard the plant as a separate species. Sebille now, after a study of numerous specimens of *M. serratum* confirming its marked tendency to separate its sexes, is inclined to regard *M. riparium* as a dioicous form of the synoicous but variable *M. serratum*, especially in view of the broader modern views as to the liability of the nature of the inflorescence to vary under the influence of climate or of the chemical constitution of the soil. He comes to the conclusion that *M. serratum* is an Alpine species growing in rich humus, and that its dioicous variety, *M. riparium*, is a lowland race proper to poor alluvial soil. It had previously been recorded from Germany, North Italy, Britain, and Scandinavia. And now France is added to its distribution.

Swiss Mosses.‖—P. Culmann describes and figures *Bryum sagittæfolium*, found associated with *Philonotis tomentella* at an altitude of

* Papers and Proc. Hampshire Field Club (1907) 12 pp. (reprint).
† Rev. Bryolog., xxxv. (1908) pp. 35–8.
‡ Hedwigia, xlvii. (1908) pp. 200–3.
§ Rev. Bryolog., xxxv. (1908) pp. 12–13.
‖ Tom. cit., pp. 17–28 (fig.).

6000 ft. on the Susten. It is nearly allied to *B. Duvalii*. The author adds to this description an enumeration of Swiss mosses and hepatics principally gathered in the Bernese Oberland. He includes 41 hepatics and 70 mosses, appending critical notes to some of them.

Hepaticæ of Baden.*—K. Müller records the additions made to the hepatic flora of Baden in 1905–6, mostly by three collectors. In all 104 species are enumerated, 10 of which are new to Baden, raising the flora to 159 species.

Muscineæ of the Arlberg Region.†—L. Loeske gives the bryological results of an expedition of about three weeks into the Arlberg region of Tyrol. He was accompanied by Osterwald, and they wandered well over the district, reaching heights of 2600 m., 2400 m., etc. The author does not in any way pretend that this list is exhaustive, but he merely gives the species found, and adds in some cases critical notes on other species found elsewhere. He records 88 species of hepaticæ, 9 sphagna, and 264 mosses. He exhibits in parallel columns the specific differences between *Philonotis marchica* and *P. rivularis*, and discusses the effect of running water upon the leaf-cells of *Amblystegium filicinum*, *A. fallax*, and other mosses.

Bryophyta of Austria and Hungary.—K. Warnstorf ‡ gives a sketch of the vegetation of Schreiberhau in the Riesengebirge, and includes a list of the mosses, among which are four new forms. He notifies an occurrence of Nematode galls on *Jungermannia incisa*, and figures the *Anguillula* which forms the galls. This is the second time that such galls have been recorded for the hepatics. He criticises the work of Röll in regard to certain Sphagnaceæ, and refers some of Röll's new species to already existing species. F. Quelle § gives a list of four Jungermanniaceæ and about forty Bryineæ gathered in the neighbourhood of Innsbruck and in the region of the Ortler. F. Straub ‖ gives a list of 87 mosses gathered by him and his pupils at several Hungarian localities. I. Györffy ¶ publishes notes upon *Bruchia palustris* var. *Degenii* and *Dicranum scoparium* var. *nigrescens*, both new to science and both found on the Hohe Tatra of Hungary. The genus *Bruchia* had never previously been recorded for Hungary. The author gives a detailed description of the first plant, with a figure and a table of measurements of the sporogonium.

Genus Cephalozia in Italy.**—C. Massalongo has monographed the Italian species of *Cephalozia*. These are twenty-seven in number, and fall into five subgenera:—*Eucephalozia* (7 species), *Nowellia* (1), *Pleuroclada* (1), *Cephaloziella* (16), *Hygrobiella* (2). The species are described in full. A detailed synoptical key to them is supplied.

* Beih. Bot. Centralbl., xxii. (1907) Abt. 2, pp. 241–54.
† Hedwigia, xlvii. (1901) pp. 156–99.
‡ Abh. Bot. Verein. Prov. Brandenburg, xlix. (1907) pp. 159–88 (figs.).
§ Mitt. d. Thür. Bot. Ver., n.f. xxi. (1906) pp. 98–100.
‖ Növén. Közlemén. vi. (1907) pp. 176–9, and Beibl., p. 63.
¶ Rev. Bryolog., xxxv. (1908) pp. 38–40.
** Malpighia, xxi. (1907) pp. 289–339.

Xerophytic Mosses of the Limestone around Odessa.* — A. A. Sapehin regards the cushion-shaped tufts of mosses as an adaptation to the conditions of life in dry places, the cushions being permeated with capillary passages which enable the colony to absorb every drop of water that falls upon the tuft. Tortuous capillary passages are produced by the appression of the leaves against the stem when either dry or moist; and the leaves often imbricate over one another. In great drought the apical leaves die, turn brown, and so protect the leaves beneath them. The hairs and papillæ of the leaf-surface serve to disperse the sun's rays that strike the plant.

Spanish Species of Marchantia.† — A. Casares Gil writes of the differences between the two native Spanish species of *Marchantia*, *M. polymorpha*, and *M. paleacea*; and shows how they may be distinguished even in the barren state, especially by the shape of the inner opening of the barrel-shaped stomata. In the former species this inner opening is quadrate (porus internus quadratus), whereas in *M. paleacea* the inner opening is cruciate (porus internus cruciatus). These differences are shown by figures.

New Madeiran Moss-genus, Tetrastichium.‡—J. Cardot gives the history of *Lepidopilum fontanum* Mitt., a moss which occurs in Madeira, the Azores, and the Canaries, but has hitherto been known in the sterile state only. Mitten, in describing it in 1863, established for it the subgenus *Tetrastichium*, but subsequently employed that name in different sense for a group of South American mosses (*Crossomitrium* of C. Müller). Cardot having now had the opportunity of examining a Teneriffe specimen of *L. fontanum* with a single old deoperculate capsule, which is horizontal, short, asymmetrical, inflated below, shows that the plant belongs to neither *Lepidopilum* nor *Crossomitrium*, but has more affinity with *Hookeria lucens*. He therefore designates it as *Tetrastichium fontanum*, the representative of a new genus. It is not closely allied to *Lepidopilum virens* Card., an Azores species with 8-ranked leaves, which probably is a true *Lepidopilum*. *Tetrastichium* is the second endemic moss-genus recorded for the Atlantic Islands, the other being *Alophosia* Card., a Polytrichaceous genus.

North American Muscineæ. — E. G. Britton § publishes notes on nomenclature, and calls attention to *Hypopterygium canadense* Kindb., a member of a tropical or subtropical genus which does not occur north of Mexico and Cuba, except in case of the above species, which grows in Queen Charlotte Island, British Columbia. This is an anomalous instance of distribution of a tropical genus, which finds its parallel in the occurrence of *Hookeria laetevirens* at Killarney. A. J. Grout ‖ enumerates 133 mosses collected in the mountains of western North Carolina in the summer of 1907. H. N. Dixon's paper¶ on Nematode

* Bull. Jard. Imp. Sci. St. Pétersbourg, vii. (1907) pp. 81–4 (figs.).
† Boletin R. Soc. Española Hist. Nat., viii. (1908) pp. 107–112 (figs.).
‡ Rev. Bryolog., xxxv. (1908) pp. 6–7.
§ Bryologist, xi. (1908) pp. 24–5.
‖ Tom. cit., pp. 25–30.
¶ Tom. cit., p. 31.

Galls on Mosses (Journ. of Bot., Sept. 1905) is reprinted. C. C. Haynes * has compiled a list of helpful literature for students of North American hepaticæ, being principally the papers of A. W. Evans, M. A. Howe, and L. M. Underwood.

Hepaticæ of Puerto Rico.†—A. W. Evans, continuing his studies of the hepaticæ of Puerto Rico, publishes his eighth article upon the Lejeuneæ, in which he treats of the genera *Symbiezidium*, *Marchesinia*, *Mastigolejeunea*, *Caudalejeunea*, and *Bryopteris*. *Symbiezidium* is a revived name, first published by Trevisan in 1877, and now utilised by Evans to replace *Platylejeunea* Spruce. Four species of *Symbiezidium* are treated of in the present paper. The genus *Marchesinius* was first employed in 1821 to contain the species *Jungermannia Mackaii*; and the synonyms which have usually replaced it are *Phragmicoma* Dumort. (1822) and *Homalolejeunea* Spruce. Evans follows Trevisan and Schiffner in reviving Gray's genus with a feminine termination, and treats of one species. *Mastigolejeunea* is represented by one species in Puerto Rico, and *Caudalejeunea* by one species only, the author being of opinion that the five so-called American species are simply forms of a single one. Finally, one species of *Bryopteris* occurs in Puerto Rico. The author carefully redescribes in detail and figures or annotates the species of which he treats.

Tropical American Mosses.‡—R. S. Williams publishes some lists of determinations, namely, twenty Colombian and two Guatemalan mosses collected by H. Pittier, and eleven Cuban mosses collected by W. R. Maxon. Among them are descriptions of four new species.

West African Mosses.§ — E. G. Paris gives a list of thirty-eight mosses collected by Pobeguin in Fouta-Djallon in French West Africa. Among them are thirteen species new to science. Appended are determinations by F. Stephani of six hepatics from the same collection.

Hepaticæ of New Caledonia and Tonkin.‖ — F. Stephani gives descriptions of twenty new species of hepatics, seventeen of which were collected in New Caledonia and three in Tonkin by Le Rat and his wife.

Japanese Hepatics.¶ — A. W. Evans gives an account of twelve hepatics from the province of Tosa in Japan, most of them being new records for Japan. Seven of them are described in detail and figured, and five of them are new to science. The Japanese hepatics are of unusual interest, and already more than 250 species have been recorded. These are partly of northern, partly of southern type, as might be expected in view of the many degrees of latitude over which Japan extends. At least two endemic genera are found there, *Cavicularia* Steph. and *Makinoa* Miyake, both monotypic. And a number of species

* Bryologist, xi. (1908) pp. 32–3.
† Bull. Torrey Bot. Club, xxxiv. (1907) pp. 533–68 (4 pls.).
‡ Tom. cit., pp. 569–74.
§ Rev. Bryolog., xxxv. (1908) pp. 1–6.
‖ Tom. cit., pp. 28–35.
¶ Proc. Washington Acad. Sci., viii. (1906) pp. 141–66 (3 pls.).

occur in Japan which, though referable to well-known genera, present peculiarities so anomalous as to necessitate a revision or amplification of the original generic characters.

Muscineæ of China and Indo-China.*—E. G. Paris publishes his seventh article on the Muscineæ of Eastern Asia, comprising fifteen mosses gathered by the missionaries Courtois and Henry in China, in the provinces of Ngan-Hoei and Kiang-Sou; twenty-four collected by Eberhardt in a very humid climate in the south-east of Tonkin; and twenty-five collected by the scientific exploring mission of Indo-China in Laos upon the Than-Hoa-Luang-Prabang road, which follows the parallel 19° 40′ lat. N. In all thirty-one species new to science are described, and appended are descriptions of two new species of *Calymperes* obtained from Panama and New Caledonia. Finally, F. Stephani supplies a list of five species of Hepaticæ from Laos.

Indian Bryophyta.—E. Levier† publishes some corrections of mosses issued in his "Bryotheca Exotica," Series I. (1907). J. F. Duthie ‡ has revised and supplemented Sir Richard Strachey's "Catalogue of the Plants of Kumaon." On pp. 234-242 is an enumeration of 102 mosses and 18 hepatics collected by Strachey and Winterbottom in 1846–9 in Kumaon and neighbouring districts, and determined by Mitten. E. Levier,§ commenting upon Strachey's Catalogue, adds a personal note upon the great services rendered to bryology by J. F. Duthie when superintendent of the Saharunpur Gardens, and by his successor, W. Gollan, now deceased. These two, by their own efforts and by the employment of English and Indian collectors, amassed considerable quantities of Bryophyta from the North-West Provinces, Tibet, the Eastern Himalayas, the Central Provinces, and even from Upper Burma. Kabir Khan, in particular, has shown himself to be a specially successful and energetic collector, having found several new species, and having ascended to an altitude of 19,000 ft. to obtain some rarities.

SAPEHIN, A. A.—**Ueber das Leuchten der Prothallien von Pteris serrulata.** (Concerning the luminosity of the prothallium of *Pteris serrulata.*)

[The cause of this phenomenon is the same as in the moss *Schistostega osmundacea*, viz. refraction of light by the cells.]

Bull. Jard. Imp. Bot. St. Pétersbourg, vii. (1907) pp. 85–8.

,, ,, **Die Ursachen der Wasserfüllung der Säcke von Lebermoosen.** (The causes which bring about the filling of the sacs of hepaticæ with water.)

[The author raises objections to the experiments of Goebel, and demonstrates that hepaticæ when moistened suck water into their sacs in consequence of the increase in their volume.]

Tom. cit., pp. 113–16 (1 fig.).

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* Rev. Bryolog., xxxv. (1908) pp. 40–55.
† Tom. cit., p. 13.
‡ London: Lovell Reeve and Co, 1906, p. 269.
§ Rev. Bryolog., xxxv. (1908) pp. 14–15.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Marine Algæ of the Channel Islands.*—H. van Heurck has published a marine flora of these islands, founded on his own collections and those of Piquet, White, Cattlow, Bovier-Lapierre, Marquand, and others. After each species is given the list of localities in the islands where it occurs, as well as a rough indication of the part of the French coast from the Belgian frontier to Brest, whence it has been recorded. References to literature, exsiccatæ and illustrations are also given. One new species is described and figured, *Epilithon van Heurckii* Heydrich, which grows on *Aglaosphenia*. Following the enumeration of species is a systematic table of genera, and finally a complete index with a certain number of synonyms. The present work is only an abbreviated form of a more important work on the subject which the author hopes to publish later, containing descriptions and figures, in the style of the Traité des Diatomées. An article dealing with the geology and history of the Channel Islands, by E. T. Nicolle, adds to the interest of the books.

Algæ of Danzig Bay.†—Lakowitz publishes the results of his study of this district during the last twenty years, based mainly on his own collections. Neither Diatoms nor Flagellates are included, and the work deals only with Rhodophyceæ, Phæophyceæ, Chlorophyceæ (including Characeæ), and Cyanophyceæ. Certain new forms are described and one new species, *Goniotrichum simplex*. Keys are given for the genera, and the species are described in German, followed by critical remarks, notes as to habitat, and geographical distribution. Many of the species are figured in the text. The second part of the work deals with the conditions of vegetation in the Bay of Danzig, and describes the district, discussing the limits, conditions at various depths, the geological composition of the substratum, the history of its origin, salinity, and temperature, and the prevailing winds and ocean currents. In a description of the vegetation the author treats of the component parts of the vegetation, its horizontal distribution inside the Bay, distribution in depth, the position of the flora of the Bay as regards geographical distribution, the probable origin of the flora, and the importance of algal vegetation as a factor in marine life.

Fucaceæ of Japan.‡—K. Yendo publishes the complete account of his studies on this subject, a preliminary notice of which appeared in 1905. The author has had considerable difficulty in identifying some of the species from the wholly inadequate descriptions of earlier authors, and out of the thirty-nine species of *Sargassum* hitherto regarded as belonging to the Japanese flora only eighteen seem to him to be valid. In a section of the book devoted to "Distribution of Fucaceous Algæ

* Société Jersiaise, Labey et Blampied, St. Helier (1908) xii. and 120 pp.
† Algenflora der Danziger Bucht. Leipzig: Engelmann (1907), 141 pp., 70 figs.
‡ Journ. Coll. Sci. Imper. Univ. Tokyo, xxi. (1907) 174 pp. (18 pls.).

on the Coast of Japan," the author discusses the two prevailing currents along the Japanese coasts, which may be briefly described as a warm and a cold current. The courses of these are described, and it is shown that they amply account for the remarkable climatic differences at places having the same latitude. The author draws up a table of distribution of all the species of Fucaceæ, showing how fifty-nine species are distributed among forty-six different localities on the Japan Sea, the Ochotsk Sea, and the Pacific. Then follow critical notes to all the species and varieties. The novelties are *Coccophora ? Imperata*, *Sargassum setaceum*, several other species of *Sargassum*, and a new genus, *Ishige*, with species *I. Okamurai*, founded on *Pelvetia Babingtonii* Okam. Eighteen large plates complete this valuable work on the Japanese Fucaceæ.

Nereocystis and Pelagophycus.*—W. A. Setchell has made a study of the two algæ, *N. Luetkeana* and *Pelagophycus giganteus*, and sets forth his results. He discusses the views of Frye as to the length to which the former species may attain, 21 m., and is more inclined to believe Mertens, who gives 90 m. as the extreme length of the thallus. The longest specimen ever seen by the author was 41 m. long. It is often found growing anchored by its holdfasts to other members of Laminariaceæ, particularly to *Pterygophora californica*. Setchell differs from Frye as to the duration of life of the individual plant, and states his opinion that *N. Luetkeana* is an annual plant. The early stages appear in February or March, and the plant passes through its growth and fruiting by November, disappearing in December or January.

The author then turns to *Pelagophycus*, and quotes some extracts from old authors of the eighteenth century alluding to a marine plant called *Porra*. One of these, Le Gentil, in "Voy. dans les Mers de l'Inde," Paris, 1781, gives an excellent drawing of *Porra*, which shows it to be the *Pelagophycus giganteus* Aresch. The name is therefore altered in the present paper to *P. Porra*, and the reasons of the author for maintaining *Pelagophycus* as a separate genus are given.

Colpomenia sinuosa in Britain.†—A. D. Cotton records the first appearance of this alga on the shores of Britain. It has been found by himself at Swanage and by Holmes at Torquay during last year. Up to within the last few years it was not known further north than Cadiz, but since then it has migrated up the French coast, where it causes great anxiety to the oyster cultivators, as it interferes seriously with the oysters in a manner described by various French authors, and noticed in past numbers of this Journal. The present author points out the external likeness between *Colpomenia sinuosa* and *Leathesia difformis*. In structure, however, *C. sinuosa* may be distinguished by the thinner, non-gelatinous walls and by the structure, which is cellular, and not filamentous. *Leathesia* also is usually irregularly lobed, even when quite young, and has a resiliency which is lacking in *Colpomenia*. Figures are given of the structure of both species.

* Bot. Gazette., xlv. (1908) pp. 125–34.
† Kew Bulletin, 1908, No. 2, pp. 73–7 (3 figs.). See also Journ. Bot., xlvi. (1908) pp. 82–3.

Dasycladaceæ of the Danish West Indies.*—F. Börgesen gives an account of the species of Dasycladaceæ collected by him in the Danish West Indies. The first species is *Neomeris annulata* Dickie, of which he describes and figures variations in the form and size of the sporangia. The plant occurs both on sheltered and exposed coasts, and seems to be rather common. *Batophora Oerstedi* is next discussed, and the author agrees with M. A. Howe in considering the name *Batophora* must hold good instead of *Botryophora*. *Acetubalaria caliculus* is fully described and treated of, and its identity with *A. Suhrii* is regarded as fairly established. *A. crenulata* and *Acicularia Schenkii* are also recorded.

Tetmemorus in New England.†—J. A. Cushman records for New England the four species of this genus known from the British Isles. In New England the plants occur mostly in sphagnum pools, and seem to be more common at an elevation, being found very abundantly in certain mountain ponds with sphagnous borders. A description and the corrected synonymy for each species is given and measurements taken from New England specimens. A key to the New England *Tetmemorus* describes shortly the differences between the species.

Lower Chlorophyceæ.‡—R. Gerneck has made cultivations of a considerable number of the lower Chlorophyceæ, which he gathered in ditches, etc., in the neighbourhood of Göttingen. In the introduction to his paper on the subject, he describes in detail the methods he employed in obtaining his cultures, while in the special part which follows he gives the results of his work in connection with each special organism, and describes new genera and species. In the second or general part the author discusses such questions as the influence of light and temperature, that of the substratum of the culture, and of higher concentration of nutritive solutions in connection with his results ; also the influence of the culture medium on the manner of growth and on the formation of gelatin, as well as the production of reserve material. He then describes the transition to resting stages in the older cultures, the formation of involution cells under conditions of exhausted soil, the formation of swarm-spores and the methods of bringing this about, and the occurrence of gametes. Copulation was only observed in two species of *Cystococcus*, and did not take place in *Chlorosarcina minor* nor *Glœocystis vesiculosa*, which possesses zoospores generally regarded as sexual. The author regards the appearance of akinetes and aplanospores as being probably the result of a lack of nutritive salt in the culture substratum. Finally a list is given of the literature consulted.

Diatoms in an Aquarium.§—H. Peragallo has examined the diatoms growing in an aquarium at Banyuls which had been left untouched for five years, and he states that he has rarely met so interesting a collection. Among the 63 species and 9 varieties, only two are surface epiphytes, which were probably introduced at the time of washing, previous to examination. The predominating species in the aquarium vary very

* Bot. Tidssk., xxviii. (1908) pp. 271–83 (9 figs. in text).
† Bull. Torrey Bot. Club, xxxiv. (1907) pp. 599–601.
‡ Beih. Bot. Centralbl., xxi. (1907) pp. 221–90 (2 tables).
§ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 99–100.

much in their mode of life; many of them showing the character of species unattached and influenced by currents. Others are bottom forms, which are sometimes met with in plankton, such as *Coscinodiscus Oculus-Iridis*, *C. gigas*, *Biddulphia membranacea*, and *Auricula insecta*. Other bottom species, such as *Actinoptychus Moelleri*, are rare in this collection, while others, such as *Auricula insecta*, *Navicula dalmatica*, and *Rhoicosigma compactum*, are abundant. One of the most interesting species is *Gephyria media* Arnott, a tropical Californian form, of which three examples were present. The author is of opinion that the diatoms of the original dredging have lived and multiplied during the six years in the aquarium, where the conditions of light and temperature were favourable.

Fossil Diatoms.*—A. Forti gives a list of the species found by him in samples taken from the Miocene deposits of Bergonzano (Reggio d'Emilia). He intends to publish later a full account of the collection, with diagnoses of new species. The present communication mentions only the commoner and more easily recognised species. The most part of the material consists of characteristic fragments of *Coscinodiscus gazellæ* Janisch, few of the specimens being entire.

Rose-colour in Species of Myxophyceæ.†—C. Sauvageau has made some experiments on rose-coloured species of Myxophyceæ, with a view to studying their phycocyanin. Specimens of *Lyngbya sordida* Gom. were obtained at a depth of about 6 to 8 metres, which were as red as *Erythrotrichia* or *Chantransia*; and these were treated with fresh-water, or fresh-water mixed with ether, which caused the cells to increase markedly in length and diminish in width. As a result of his experiments, the author finds that marine species of *Lyngbya*, and probably also of other Myxophyceæ which have a slender rigid sheath, treated with fresh-water and ether, form excellent material for a spectroscopic study of the dissolution of phycocyanin; and the swollen cells, with a non-permeable cell-wall, would be an interesting study from a cytological point of view. The pigment of the rose-coloured Myxophyceæ studied replaces that which gives them their usual colour, and arises from its transformation.

In another note, the author remarks on the red Oscillarieæ observed in an aquarium of the laboratory at Banyuls-sur-mer, and he comes to the conclusion that one of the influences, probably the principal one, which causes their red colour is attenuation of light—in fact, they turn red to save their lives, and the "complementary chromatic adaptation" of Engelmann and Gaidukov has no part in it. They form dwarf individuals, and in an aquarium they keep their red colour as if they were a well characterised race, and prosper. The aquarium in question had been untouched for five years, and the list of algæ found flourishing in it includes species of Chlorophyceæ, Phæophyceæ, and Florideæ.

Pigment of Oscillatoria Cortiana.‡—L. Bocat has made a study of the spectrum of red plants of *O. Cortiana*, comparing it with that of

* Nuov. Notar., xix. (1908) (Reprint).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 95–9.
‡ Tom. cit., pp. 101–2.

phycocyanin and phycoerythrin, and he finds that the spectra of these two substances and that of the pigment of *O. Cortiana* are related but not identical. The normal pigment of that species has not been studied; but the author is of opinion that when the red colour is assumed by the plant, it is no longer able to assimilate in orange radiations, but uses, like Florideæ, green radiations. He comes to this conclusion, while granting that the action of the ether has helped to disperse the absorption band of the orange. Bands i., ii., and iii. of *O. Cortiana* correspond approximately to the third, fourth, and fifth bands of chlorophyll, where assimilation is very feeble.

Plankton of Mofjord.*—E. Jörgensen gives some interesting results of his investigations of the natural conditions of Mofjord, which is the innermost part of a long narrow fjord in the neighbourhood of Bergen. The water reaches a depth of 217 m., and is rather fresh on the surface, varying however from 1–20 mille in salinity, according to the quantity received from streams. The greatest thickness of this sheet of fresh-water is about 10–12 m. Statistics of the salinity and distribution of gases below this sheet are given. The plankton in the upper layers (0–35 m.) is very rich, while below that only empty frustules occur as a rule. The dominant species are: *Chætoceras curvisetum*, *Sceletonema costatum*, and *Ceratium* spp. A few fresh-water forms, *Melosira varians*, *Surirella ovata*, and *Tabellaria flocculosa*, have been noted, more or less scattered.

Indian Ocean Phytoplankton.†—G. Karsten publishes the last part of his account of the phytoplankton collected on the 'Valdivia' Expedition in 1898–9, and the whole work is a valuable and important contribution to the study of those organisms. In the present contribution he gives (1) lists of the species which were found in the different hauls in the Indian Ocean; (2) a systematic part, and (3) a general part. In the systematic part all the species found in the Indian Ocean are described and figured, except such as had been treated in previous contributions. Among the diatoms one genus, 35 species, and 6 varieties are new, and of Peridineæ 15 species and 6 varieties. In the general part all questions relating to the investigation of plankton are discussed in the light of the new results obtained by the 'Valdivia' Expedition. The author regards the Indian Ocean as a more or less compact floral unity, and the differences which he observed he considers as the result of a greater or less intermixing of neritic forms. The vertical distribution of the phytoplankton is not markedly different from that of the Antarctic region. The greater number of the algæ occur above a depth of 200 m., generally between 60–100 m., while below 400 m. only isolated living cells are found. On the surface live the Schizophyceæ and the long-horned light *Ceratia*; then follow *Chætoceras peruvianum* and chains of the lighter species of *Rhizosolenia*, then the more compact *Ceratia amphisolenia*, the large-celled *Rhizosolenia*, and the remaining species of *Chætoceras*. This is the vertical order down to

* Trondjem kgl. norske Vidensk. Selskskrift, 1906, No. 9 (1907) 40 pp.
† Wiss. Ergeb. Deutsch. Tiefsee Exped. 'Valdivia,' 1898–99, ii. 2 (Jena, 1907) pp. 223–548 (20 pls.). See also Bot. Zeit., lxvi. (1908) pp. 87–101.

60, 80, and 100 m. Then the actual mass of organisms is less until the "shade-flora" begins, composed of *Planktoniella*, *Valdiviella*, *Coscinodiscus*, *Antelminellia*, and *Halosphæra*, which forms a fairly dense vegetation to about 150 m., occasionally even to 200 m. From thence downwards to 400 m. there is a gradual decrease of cells, and below that depth there are only colourless cells of *Peridinium*, *Phalacroma*, and *Diplopsalis*. In the lowest depths is found only the rain of dead cells falling to the bottom from the upper strata. The author compares the Indian Ocean phytoplankton with that of the Atlantic, and finds that the warmer regions are characterised by numerous species of diatoms and Peridineæ, which are, however, represented by few individuals. As regards vertical distribution of species and quantity, it is the same as that of the Indian Ocean. Special chapters are devoted to neritic and oceanic phytoplankton; ocean currents and phytoplankton; quantitative distribution, and its dependence on external factors; occurrence of vertical currents and their influence; the different nutritive matters, etc. Other important questions, such as the microspores, the systematic interrelation of centric and pennate diatoms, the phylogeny of *Rhizosolenia*, etc., are discussed.

BÉGUINOT, A., & L. FORMIGGINI—**Ricerche ed osservazioni sopra alcune entitá vicarianti nelle Characee della Flora Italiana.** (Researches and observations on certain vicarious entities in the Characeæ of the Italian flora.]
Bull. Soc. Bot. Ital., 1907, pp. 100–16.

HERNANDEZ-PACHECHO, E.—**Consideraciones respecto à la organización, género de vida y manera de fosilizarse algunos organismos dudosos de la época silúrica y estudio de las especies de algas y huellas de gusanos arenicolas del silúrico inferior de Alcuéscar (Cáceres).** (Considerations respecting the organisation, mode of life, and manner of fossilisation of some doubtful organisms of the Silurian period, and a study of the species of algæ and casts of arenicolous worms of the Lower Silurian of Alcuescar in the province of Cáceres.]
Bol. R. Soc. Española Hist. Nat., viii. (1908) pp. 75–91 (4 pls.).

MAZZA, A.—**Saggio di Algologia oceanica.** (A study of oceanic algology.)
[A continuation.] *Nuov. Notar.*, xix. (1908) pp. 1–24.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

New Species of Achlya.*—J. D. Pemberton describes this new fungus, which was found in a culture of *Saprolegnia*, etc., taken from a small brook. It is characterised by the presence of antheridia, which arise immediately below the oogonium; the fertilising tube rises from the septa that divides the oogonium from the antheridium. Cultures of the new species were made on small gnats in hanging drops, and the whole development was followed with ease.

Hydnocystis Thwaitesii.†—T. Petch has collected a number of specimens of this rare fungus, and gives a revised and full account of it. The species looks somewhat like a *Peziza*, and grows on decaying wood. It is a *Peziza* without a disk: there is a thick wall only, of a cup-like

* Bot. Gazette, xlv. (1908) pp. 194–6 (6 figs.).
† Ann. Mycol., v. (1907) p. 473–5 (1 fig.).

shape; the wall is of three parts; outer and inner of varying thickness, and, inclosed in a cavity between them, the fertile layer of asci and hyaline, elliptic, smooth spores. The author considers this species to belong to *Genea*, one of the Tuberineæ.

Pyronema confluens.*—P. Claussen has had occasion to examine this Ascomycete, and he has come to the conclusion that there is no fusion of nuclei in the ascogonium such as Harper described. The male nuclei pass from the antheridium to the ascogonium, but do not fuse; they lie side by side until the ascus stage is reached, and the fusion of nuclei there, considered to be a second fusion, is really the first fusion of the conjugate nuclei. Claussen thinks that this will prove to be the case in all of the ascomycetous forms, and that fusion in the ascus is a belated sexual fusion between male and female nuclei. He cites cases of delayed fusion to illustrate his discovery.

Fruit-development in Aspergillus Fischeri.†—M. Domaradsky has undertaken an examination of this species, and publishes some preliminary notes. He was able from the ascospore to grow the mycelium and conidiophores in a hanging-drop culture. Mycelium and conidiophores are white; the fruit is slightly yellowish. Following the development of the ascus fruit, he found on one of the hyphæ a twisted branch, occasionally forming a perfect screw, multinucleate, and at first non-septate, becoming septate at a later stage. No organ corresponding to an antheridium was detected, and he concludes that some kind of sexual act has taken place in the twisted hypha, resulting in the association of two nuclei. The enveloping hyphæ in this species do not arise from the hyphæ nearest to the "screw": from those at some distance fine branches arise that grow towards the "screw," and finally form the peridium.

Notes on some Species of Erysiphaceæ from India.‡—E. S. Salmon describes some infection experiments made with *Erysiphe graminis* from India. The host-plant was *Triticum vulgare*, and plants of the same species and of *Hordeum vulgare* were inoculated with the oidiospores and with the ascospores. The infection was successful only with the *Triticum* plants. Salmon was successful in slightly infecting some plants of *Hordeum silvaticum* with the same oidiospores; but the experiments proved that *Erysiphe graminis* occurring in India on wheat is a biologic form, as it is in Europe. He describes a new species of *Uncinula*, growing on teak.

Seuratia and Capnodium.§—Paul Vuillemin draws a comparison between these two genera of fungi, species of which were found growing together. They are both Ascomycetes; the former is rather of the nature of a Discomycete; the species *S. coffeicola* was found in Java along with *Capnodium*, on leaves of the coffee-plant; the two fungi

* Ber. Deutsch. Bot. Gesell., xxv. (1907) pp. 586–90 (1 fig.).
† Op. cit., xxvi. (1908) pp. 14–16.
‡ Ann. Mycol., v. (1907) pp. 476–9.
§ Comptes Rendus, cxlvi. (1908) pp. 307–8.

were so closely associated that it was difficult to assign to each its own developmental stages. The author compares the association to that found in lichens between alga and fungus.

Origin of Yeasts.*—Following Viala and Pacottet, G. Bonnier has cultivated *Glœosporium nervisequum* to try and reproduce, as they did, a yeast-form. He succeeded, after various failures, in securing a pure culture, and the characteristic conidia and pycnidia already observed by Klebahn; but after eight months' continual growth on various substances, he has never found any yeast torulation nor any endospore formation. He is thus forced to conclude that Viala and Pacottet must have had some impurity in their culture, and that yeast, as before, must be regarded as an autonomous plant.

Biological Study of Glœosporium.†—E. Lasnier selected for experiment two saprophytic species of this genus, *G. Cattleyæ*, which grows on decaying leaves of the orchid *Cattleya*, and *G. Musarum*, which attacks bananas. He grew the mycelium and spores in different media, and records the effect produced in each case. He found that forms of fructification were developed that are unknown in natural conditions: conidia of a hyphomycetous type were produced at the tips of mycelial branches at the extremities of closely-packed tufts of hyphæ, or perithecia were formed. These variations were entirely due to the medium in which they were grown. Sugars were found to favour spore formation; yeasts were not observed; alkalies in small quantities did not affect the growth of the fungus, but acids retarded, or in stronger quantities completely checked, development.

Hyphomycetes.‡—The part just issued by G. Lindau is largely occupied by the description of species of the parasitic genus *Cercospora*. Other genera with brown septate spores are dealt with, and the curious genus *Sporochisma*, which forms its spores inside the hyphæ. The Phæodictyæ have been commenced, and one genus, *Coniothecium*, has been described. As before, there are many illustrations, especially of *Cercosporæ*.

Uredineæ.—W. Tranzschel § gives results of twelve series of experiments. He has been able in several cases to associate different forms of the life-cycle. He contrasts *Puccinia obtusata* and *P. Isiacæ*; with the spores of the latter he infected a large number of plants in different natural orders, producing the *Æcidium* form.

J. C. Arthur || publishes diagnoses of fifteen new species of Uredineæ, all of them from the American continent or neighbouring islands.

B. Pole Evans ¶ has undertaken a study of the histology of the "cereal rusts," *P. graminis*, *P. rubigo-vera*, and *P. coronata*, and the first paper deals with the mycelium of the uredo form, which in an early

* Comptes Rendus, clxvi. (1908) pp. 704–7.
† Bull. Soc. Mycol. France, xxiv. (1908) pp. 17–43 (3 pls.).
‡ Rabenhorst's Kryptogamen-Flora, i. Abt. 9, lief 107 (Leipzig, 1908) pp. 113–76.
§ Trav. Mus. Bot. Acad. Sci. St. Pétersbourg, iii. (1907) pp. 37–55. See also Hedwigia, Beibl., xlvii. (1908) pp. 126–8.
|| Bull. Torrey Bot. Club, xxxiv. (1907) pp. 583–92.
¶ Ann. Bot., xxi. (1907) pp. 441–66 (3 pls.).

stage shows distinctive morphologica characters, the substomatal vesicle and the haustoria differing according to the hosts. The work is being carried out at the Transvaal Department of Agriculture.

Rudolf Bock* has made an exhaustive study of several species of Uredineæ to test the existence of biological forms. In *Puccinia Gentianæ* he failed to prove specialisation, though several species of *Gentiana* were immune to the fungus; also some species that were free from rust in the open were easily induced to grow the fungus. With *Uromyces Geranii* he found that there were several of the hosts recorded that could not be infected by the spores he was cultivating, indicating probable specialisation; the rusts found on all of the hosts were morphologically identical. *Puccinia violæ* was also studied, and it was found that another species, *P. depauperans*, also grew on *Viola lutea*, *V. tricolor*, and *V. cornuta*, which are thus collective hosts. Experiments were made with *P. obtusata*, which is very similar to *P. Isiacæ*, as already noted by Tranzschel, but probably forms its *Æcidia* on a much more restricted range of hosts.

Infection by Smut Fungi.†—There are two methods of infection described for *Ustilago*: in one the seedling plants are infected, in another it is the flower that is attacked. Ludwig Hecke finds that there is a third method by which the fungus enters the host, which he calls "shoot" infection. In perennial plants the old stump can be infected, and the new shoots in time produce smutted heads: this was proved in *Urocystis occulata* on *Secale cereale*.

Poisoning due to Amanita Phalloides.‡—M. Ménier describes two cases of poisoning caused by eating this fungus, one of them fatal. He publishes a complete account of the remedies used to counteract the poison, which were successful in one case, though the patient was more or less indisposed for a month thereafter. A note is added from C. B. Plowright on the poisoning of a family at Ipswich in the autumn of 1907.

Polymorphism of Hymenomycetes.§—G. F. Lyman has made a large series of artificial cultures of some of the larger fungi, many of which possess some secondary method of reproduction. He proved that *Ægerita candida* is the conidial form of an undescribed *Peniophora*, to which he gives the name *P. candida*, and *Michenera artocreas* a secondary growth of *Corticium subgiganteum*. Incidentally he proved the autonomy of *Lentodium squamulosum*, considered by some to be an abnormal form of *Lentinus tigrinus*. He grew the fungus from the spore, the mature fruiting body reproducing all the characters of *Lentodium*. In many of the cultures he found that the first mycelium grown from the spores was composed of slender hyphæ without clamp connections and bearing conidiophores; at a later stage stouter hyphæ with clamp connections and no condiophores were formed.

* Centralbl. Bakt., xx. (1908) pp. 564–92.
† Zeitschr. landw. Versuch. Oesterr., 1907, pp. 572–4. See also Centralbl. Bakt., xx. (1908) p. 625.
‡ Bull. Soc. Mycol. France, xxiv. (1908) pp. 68–72.
§ Proc. Bost. Soc. Nat. Hist., xxxiii. (1907) pp. 125–209. See also Bot. Gazette, xlv. (1908) p. 207.

Phalloids.—C. G. Lloyd* has given an account so far as yet known of the genera and species of this group of fungi in Australia. They include species of eight genera, and photographs are reproduced of plates already published. He classifies them under sections, with (1) simple stem, (2) lobed, (3) columnar, and (4) clathrate, each section containing two or more genera. An account is given of the species in the different herbaria, where and by whom they were collected. In Mycological Notes † Lloyd publishes various critical remarks on *Mutinus*, *Phallus*, *Lysurus*, *Clathrus*, etc., with figures either from nature or from authentic drawings. Lloyd has gathered together much information that is interesting and useful about these plants.

Witches' Brooms of the South Midlands.‡—J. Saunders finds that in most cases the exciting cause of brooms on trees is a parasitic fungus. The phenomena associated therewith are, usually, crumpling of the foliage and barrenness and brevity of life of the twigs: the leaves fall early, the twigs live for only one or two seasons, so that a full-grown broom contains numerous dead twigs entangled with the new growth. A list of trees is given on which brooms have been observed; the exciting fungus in spruce fir was a species of *Puccinia*, in all the other cases a species of *Exoascus*. On hornbeam and birch, brooms are caused by *Exoascus* and also by a mite, but on the latter tree he states that the brooms due to the mite are diminutive in size and are outgrowths from diseased buds; the large well-known birch broom is caused by *Exoascus*.

Action of Fungi on Cellulose.§—H. C. Schellenberg has made a prolonged study of this subject by growing selected fungi, parasites or semi-parasites, on various plant substances. Two kinds of cellulose had been distinguished: true cellulose which is only soluble in boiling acid, and hemicellulose, which yields to more or less weak acid solutions. The author explains how he grew the fungi, and describes the substances with which he experimented. Among grasses he selected *Molinia cœrulea*, as rich in hemicellulose; seeds of *Lupinus hirsutus*, with less soluble hemicellulose; date-kernels still more resistant to acids, and seeds of *Impatiens* and *Cyclamen*, which contain amyloids. The selected fungi were several species of *Mucor*, *Rhizopus nigricans*, *Thamnidium elegans*, *Penicillium*, *Botrytis*, *Nectria*, *Cladosporium*, etc. These fungi, though very different in their action, were capable of dissolving the hemicellulose in one or another of the plants presented to them, though they showed a quite remarkable specialisation in this respect. Vuillemin distinguishes four different ferments: *Molinia*-, *Lupinus*-, *Phœnix*-, and *Impatiens*-cytase, by means of which the fungi attack and destroy the different kinds of hemicellulose. True cellulose remained intact, and this he considers due to its chemical constitution. He also discusses the action of bacteria on cellulose and their ferments. Incidentally he draws a distinction between the behaviour of *Botrytis cinerea* and *B. vulgaris*, the latter being more active: he thinks this decides that they

* Cincinnati, U.S.A., July 1907, 24 pp., 25 figs.
† Mycological Notes, No. 28 (Cincinnati, U.S.A., Oct. 1907) pp. 349–64 (19 figs.).
‡ Journ. Bot., xlvi. (1908) pp. 116–19.
§ Flora, xcviii. (1908) pp. 257–308.

represent two distinct species. The conclusion is drawn that fungi are more active in the breaking-up of plant remains than we had realised, and that the different fungi are not able to attack plants indiscriminately, but are strongly specialised in this respect.

Sexuality in Fungi.—I. Gallaud * brings to an end his review of work done on this subject. In the present contribution he describes Blackman's and Christman's work on Uredineæ, and contrasts their results with Maire's work on the Basidiomycetes. Dangeard and Sapin-Trouffy consider the fusion of nuclei in the basidium and the teleutospore to be fertilisation, analogous with that of the higher plants. Maire, on the contrary, considers that this fusion is comparable to chromatic reduction, and is in no sense sexual fusion.

A. Guilliermond † begins a review of recent work on the same subject in the Ascomycetes. Among the hemiasci he quotes from work done by Mlle. Popta on *Protomyces* and *Ascoidea*; the latter she retains among the hemiasci, the former belongs rather to the Phycomycetes. The results and theories of Dangeard, Juel, Barker, Ikeno, and Kuyper are also considered. They studied different members of this troublesome group, the point in dispute being the nature of the spore capsule, whether it is to be regarded as a sporangium or an ascus. Dangeard connects the hemiasci with the Chytridiaceæ, which he regards as the ancestors of the Ascomycetes, the latter being derived from the sexual sporangium, while the hemiasci have arisen from the asexual sporangium. Juel removes *Taphridium* from the Exoasceæ, and places it also among the hemiasci; the so-called ascus of this genus develops similarly to the sporangium of *Protomyces*. *Monascus*, an allied genus, has been placed by Kuyper in a new group of Endoasceæ on account of the formation of asci in the interior of the oogonium.

Notes on American Fungi.‡—W. G. Farlow found growing in Vermont, and now describes as *Tremella reticulata*, a fungus previously published as a *Corticium*. From a solid gelatinous base there rose to the height of 3 inches or more masses of white jelly; branches arose from a common base, anastomosing below, reticulated, and becoming free upwards; he found in it the typical *Tremella* basidia and spores. Further notes are given on *Synchytrium pluriannulatum* and *Pucciniastrum arcticum*.

Mycological Notes.§—C. G. Lloyd has recently issued a number of papers bearing on the larger fungi. In Nos. 29 and 30 he discusses some Phalloids and some of the Polyporeæ, notably *Fomes nigricans*, as he finds that two plants are included under that name. The second paper deals with further examples of Phalloids and Lycoperdons. A third paper is devoted to a consideration of the Nidulariaceæ, with plates 102–11; descriptions of the genera and species are given. A beginning has been made with the study of the Polyporeæ, and Lloyd gives us "Polyporoid issue, No. 1," containing a number of forms of

* Rev. Gén. Bot., xix. (1907) pp. 556–9 (6 figs.).
† Op. cit., xx. (1908) pp. 32–9 (12 figs.).
‡ Contrib. Crypt. Lab. Harvard Univ., lxv. (1907) 17 pp.
§ Mycological Notes, Cincinnati, Jan. and Feb. 1908.

Polystictus of the *perennis* group and an account of *Polyporus Schweinitzii*, and again a note on *Fomes nigricans*, with photographic reproductions of the two forms in question. There are many figures throughout these works, of which the numbers are continuous with previous issues, though a new pagination of the text begins with the Polyporoid issue.

Mycological Fragments: iii.*—Franz von Höhnel continues his work on systematic mycology, passing under review many published forms, and examining new material. In these notes he publishes four new genera: *Protodontia* (Tremellaceæ); *Wettsteinina* (Dothiæaceæ), with a single 8-spored ascus, which he places in a new family, Pseudosphæriaceæ; *Pseudospharia*, also with one ascus, but with muriform spores; and *Sphærodermella*. He describes a large number of new species from the neighbourhood of Vienna, and a second series from Samoa. He gives also critical notes of various known forms: *Bombardia fasciculata* is placed by him among the Sordarieæ, and these he divides into two groups, according to the thickness of the perithecial wall. *Dædalia quercina* he has decided must be included in *Lenzites quercina*, the former name having been given to a less developed form.

Diseases of Plants.—Attention is called † to Gooseberry Black-Knot, a fungus that attacks the stems and larger branches of the gooseberry and red and black currant. The first indication of the disease is the wilting and yellowing of the leaves, which fall early in the season. The fungus *Plowrightia ribesia* is a wound parasite, and cannot pierce an uninjured surface.

D. V. Hegyi ‡ describes cases of crumpling and distortion in wheat, caused sometimes by an insect, and sometimes by the fungus *Helminthosporium gramineum*, or by unfavourable weather conditions.

Claude W. Egerton § has investigated an anthracnose of the blackberry *Rubus nigrobaceus*, and found that it was due to a pyrenomycete, *Gnomonia Rubi*. He cultivated the ascospores on bean agar, and reproduced the perithecia in about ten to fourteen days. He also carried out inoculation experiments with success, the fungus spread rapidly in branches infected, and though blackberry fruit set, most of it dried up before it matured.

P. Voglino ‖ has given an account of a troublesome fungus on *Solanum Melongena*. Brown spots of varying size are formed on the leaves, later on the fruits, very rarely on the stems. Small perithecia of *Ascochyta hortorum* appear scattered over the spots, and spores are produced in great numbers. Favoured by the excessive humidity of a wet season, these germinated on other leaves and penetrated to the interior tissues through the pores of the stomata, and the brown spots were again formed. Vogliano found that several other plants were

* SB. k. Akad. Wiss. Wien, Math.-Nat. Kl., cxvi. 1 (1907) pp. 83–162 (1 pl.) See also Hedwigia, Beibl., xlvii. (1908) pp. 117–22.

† Journ. Board Agric., 1908, pp. 680–1 (4 figs.).

‡ Zeitschr. Pflanzenkr., xvii. (1907) pp. 334–6.

§ Bull. Torrey Bot. Club, xxxiv. (1907) pp. 593–7 (3 figs.).

‖ Malpighia, xxi. (1907) pp. 353–63 (1 pl.).

liable to infection from the same fungus: *S. Lycopersicum*, *S. nigrum*, *S. dulcamara*, *Physalis Alkekengi*, *Datura Mètel*, and *Atropa Belladonna*.

R. E. Smith * publishes his examination of the California peach blight, which is found wherever peaches are cultivated in California, and which is increasingly hurtful. It is caused by the fungus *Coryneum Beijerinkii*, which attacks the leaves and young shoots, causing spots and finally killing the parts attacked. The spores alight on the young twigs, and with sufficient moisture they germinate and penetrate the bark. Gum is exuded copiously from the injured twigs.

BROCKMAN-JEROSCH & R. MAIRE—**Contributions à l'étude de la flore mycologique de l'Autriche.** (Contributions to the study of the mycological flora of Austria.)
[A list of fungi collected during a botanical excursion to the Eastern Alps by the Vienna Congress. Several new species are recorded of microfungi.] *Oesterr. Bot. Zeitschr.*, lvii. (1907) pp. 271–80, 328–38, 421–4 (4 figs.).
See also *Ann. Mycol.*, v. (1907) p. 556.

BOUDIER, E.—**Icones Mycologicæ, ser. iv. livr. 18.**
[The issue comprises 20 plates of Basidiomycetes and Ascomycetes.]
Paris: Klinksieck, 1908.

FERDINANDSEN, C., & O. WINGE—**Mycological Notes.**
[Includes notes on the spores of *Pseudovalsa aucta* and *Fenestella fenestrata*, and on the conidial form of *Helotium herbarum*. Some new species for Denmark are recorded.] *Bot. Tidsskr.*, xxviii. pp. 249–56 (8 figs.).
See also *Ann. Mycol.*, v. (1907) p. 357.

GÜSSOW, H. T.—**Ascochyta Quercus-Ilicis sp. n.**
[Found on the under side of the leaves of *Quercus Ilicis*.]
Journ. Bot., xlvi. (1908) p. 123.

HÖHNEL, FR. V.—**Mycologisches, xviii.–xxi.**
[Notes on four different species of microfungi.]
Oesterr. Bot. Zeitschr., lvii. (1907) pp. 321–4.
See also *Hedwigia*, Beibl., xlvii. (1908) pp. 122–3.

MURRILL, W. A.—**Polyporaceæ.** (Concluded.)
[The species are arranged under Murrill's new classification. There are keys to all the genera.] *North American Flora*, ix., pt. 2., pp. 73–131.
See also *New York Bot. Gard.*, 1908.

PATOUILLARD, N., & P. HARIOT—**Fungorum novorum Decas tertia.**
[Third decade of new fungi.]
Bull. Soc. Mycol. France, xxiv. (1908) pp. 13–16.

PATOUILLARD, N.—**Champignons nouveaux ou peu connus.** (New or little known fungi.)
[Many new species are described, mostly from the Southern States or from South America.]
Bull. Soc. Mycol. France, xxiv. (1908) pp. 1–12 (3 figs.)

ROSTRUP, E.—**Lieutenant Olufen's Second Pamir Expedition. V. Fungi.**
[Plants collected in Central Asia and Persia by Ove Paulsen. Several species are new.] *Journ. Bot. Copenhagen*, xxviii. 2 (1907).
See also *Hedwigia*, Beibl., xlvii. (1908) p. 124.

REHM, H.—**Ascomyceten excs., Fasc. 40.**
[Descriptions or notes on 25 species, several of them new.]
Ann. Mycol., v. (1907) pp. 465–73.

* Agri. Exper. Stat. California, Bull. No. 191 (1907). See also Bot. Gazette, xiv. (1908) pp. 208–9.

Rehm, H.—**Ascomycetes novi.**
[A large number of new species from different parts of the world.]
Tom. cit., pp. 516–46.

Sartory & Jourde—**Pathologie Expérimentale. Caractères biologiques et pouvoir pathogène de Sterigmatocystis lutea.** (Biological characters and pathogenic power of *S. lutea.*)
[Describes the growth of the fungus, and the fatal effect of infection.]
Comptes Rendus, cxlvi. (1908) pp. 548–9.

Sydow, H. & P., & E. J. Butler—**Fungi Indiæ Orientalis.**
[A large number of microscopic fungi from India are listed. Many new species are described in the Ustilagineæ and Uredineæ.
Ann. Mycol., v. (1907) pp. 485–515 (5 figs.).

Tranzschel, W. von—**Diagnosen einiger Uredineen.**
[Diagnoses of some Uredineæ from Asia and Russian territories.]
Tom. cit., pp. 547–51.

Lichens.

(By A. Lorrain Smith, F.L.S.)

American Lichens.*—Bruce Fink publishes his last paper on *Cladonia*, giving an account of several species with red fruits, *C. digitata*, *C. deformis*, and *C. bellidiflora*. The first of these grows usually on trunks or on decaying wood in forests, the two latter on soil: *C. deformis* in woods, *C. bellidiflora* on high open places; detailed descriptions are given of each. A. S. Foster † describes the lichens that are to be found growing on *Alnus Oregana*, a tree that occupies any area that has been burned over; it is a favourite habitat and a large number are recorded. R. Heber Howe, jun.,‡ has been examining the lichens of the Monadnock region that had been collected by G. A. Wheelock. He publishes a first list of 27 species of *Ramalina*, *Cetraria*, *Usnea*, and *Alectoria*, with some few notes appended.

Oswald, L., & F. Quelle—**Beiträge zu einer Flechtenflora des Harzes und Nordthuringens.** (Contributions to a lichen flora of the Harz and North Thuringia.) *Mitt. Thür. Bot. Ver.*, n.f. xxii. (1907) pp. 8–25.
See also *Hedwigia*, Beibl., xlvii. (1908) p. 128.

Steiner, J.—**Lichenes Austro-Africani.**
[A list of lichens from South Africa; a number of them are new.]
Bull. Herb. Boiss., vii. (1907) pp. 637–46.

Vereitinow, J. A.—**Excursions lichénologiques dans le gouvernment Grodno.** (Lichenological excursions in Grodno.]
[The lichen formation of the woods described.]
Bull. Jard. Imp. Bot. St. Pétersbourg, vii. (1907) pp. 89–98.
See also *Hedwigia*, Beibl., xlvii. (1908) p. 129.

Wasmuth, P.—**Verzichniss der Strauch und Blattflechten der Umgebung Revals.** (List of shrub and leaf lichens from the neighbourhood of Reval.)
Naturf. Ver. Rigi, l. (1907) pp. 211–21.
See also *Hedwigia*, Beibl., xlvii. (1908) p. 130.

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* Bryologist, xi. (1908) pp. 21–4 (1 pl.).
† Tom. cit., pp. 34–5. ‡ Tom. cit., pp. 35–8.

Schizophyta.

Schizomycetes.

Bactridium lipolyticum: Fat-splitting Bacterium.* — H. Huss examined some unpleasant-tasting milk obtained from "Montavoner" cows. The samples were treated in two portions, that were allowed to stand on ice and at room temperature respectively for two days. In the first case the sample was not curdled, and had a sweet, rancid taste; but the other portion was curdled, and had a sour, rancid taste, and smelt of butyric acid. In both cocci were found microscopically, either singly or in pairs, but in the second portion there was an abundance of *B. güntheri*. On agar and gelatin plates prepared from both portions there were obtained colonies of *Pseudomonas coli*, *B. ærogenes*, yeasts, *Penicillium*, *B. güntheri*, and gelatin-liquefying rods of *Bactridium lipolyticum*. Pasteurised cream was inoculated with these various organisms, but the *B. lipolyticum* alone produced the peculiar rancid taste of the affected milk sample.

B. lipolyticum, which produces the fat-splitting enzyme, is a small coccal-shaped rod with peritrichal flagella. The coccal shape is especially marked with gelatin cultures, and streptococcal-like chains are formed, the gelatin being rapidly liquefied. The rods show active motility; they stain well with carbol-fuchsin, and also by Gram's method; growth is not good in an atmosphere of nitrogen; optimum temperature is from 30° to 35° C.

Broth is clouded, and shows a sandy deposit; milk is curdled after three days, the upper layers being peptonised and of a brown-grey colour, the medium having a strong alkaline reaction; at the end of three weeks the casein is completely dissolved, and the liquid becomes viscid, of a dirty yellow colour, and smelling of nuts; there is gas production in all cultures, also a slight formation of indol, and reduction of nitrates to nitrites.

Glycerin, mannite, dextrose, saccharose, raffinose, and xylose are fermented with the production of acid, but lactose is unaffected. The fat-splitting property was demonstrated by employing the diffusion method of Eijkman.

Intestinal Flora of Infants.† — H. Tissier finds that the intestinal flora of infants from one to five years of age changes as the diet becomes more varied. There is a "fundamental flora" (*B. bifidus*, enterococcus, *B. coli*, *B. acidophilus*, *B. exilis*, and *B. iii* of Rodella) which has survived from the suckling period, and which is fixed and constant and of physiological importance, and an "additional flora" of variable composition which is responsible for pathological effects. The author advocates a diet that will maintain a preponderance of the "fundamental flora"; a vegetable diet favours the growth of *B. bifidus* in the lower portion of the large bowel, where by virtue of its acid-producing property it will excite peristaltic action and evacuation of the bowel content,

* Centralbl. Bakt., 2te Abt. xx. (1908) p. 474.
† Ann. Inst. Pasteur, xxii. (1908) p. 189.

and will also exercise an opposing action on the injurious bacteria and other members of the "additional flora."

The author gives descriptions of the morphology and biology of the new species *Coccobacillus præacutus*, *Coccobacillus oviformis*, *Diplococcus orbiculus*, *B. ventriosus*, and *B. capillosus* that were isolated among the "additional flora."

Comparative Study of Spirochætes.*—v. Prowazek has described various forms of spirochætes. (*a*) Spirochæte of tropical abscess; in the contents of the swelling, besides pyogenic micro-organisms were found large spirochætes, resembling in form and movement those of balanitis, though generally more slender, the terminal periplast was more delicate and flagella-like; longitudinal division was frequently observed; resting stages occur as with other spirochætes, the parasite being twisted up into a tangle of deeply stained fragments; taurocholate of soda (1 : 10) dissolves the spirochæte.

(*b*) Spirochæte of stomatitis (*S. buccalis*). In a case of stomatitis the author found a number of mouth spirochætes of large dimensions; the undulating membrane was well shown in macerated preparation, the elementary fibrillæ being sometimes split up and resembling peritrichal flagella; resting phases were also seen. Besides *S. buccalis* and *S. dentium*, the author found a third spirochæte, which he regarded as intermediate.

(*c*) Frambœsia spirochætes (*S. pallidula*), is stouter than *S. pallida*, the undulations are not so stiff and regular; the body is not so elastic, and the ends are often bent into hooks, and a terminal flagellum is seldom shown; there is frequent longitudinal division.

(*d*) Spirochætes of syphilis (*S. pallida*). In monkey syphilis the spirochætes are generally fewer than in human syphilis. The resting stage probably accounts for the long latent period of the disease. Taurocholate of sodium dissolves the spirochætes; syphilitic material mixed with taurocholate of sodium for half an hour is no longer infectious; but if syphilitic material is injected simultaneously with taurocholate of soda, infection is not prevented.

(*e*) *Spirochæte lutræ* occurred in the blood of the otter as broad, band-like organisms with blunted ends, and showing in the blue stained protoplasm four various sized chromatin fragments.

The author concludes that spirochætes are distinguished from bacteria by their behaviour with taurocholate of soda and saponin, by their morphology, by their multiplication by longitudinal division, and by their characteristic resting stage.

Bacillus Endothrix.†—F. Guéguen isolated on two occasions an organism from the hair of a patient suffering from alopecia. The interior of the hairs exhibited a number of fine discontinuous longitudinal striæ; staining with violet-dahlia and differentiating with alcohol or Gram's method showed that these striæ were formed of short bacilli. When planted on gelatin these bacilli developed chrome-yellow colonies, composed of non-motile, short, round-ended rods in thin capsules; no spore-production was noted, though the body content was

* Centralbl. Bakt., 1te Abt. Ref., xl. (1908) p. 822.

† Comptes Rendus, cxlvi. (1908) p. 199.

often collected into ovoid masses resembling spores; pepton-broth is clouded after three days, and has a viscid yellow deposit; gelatin is not liquefied; growth on potato is visible after 24 hours, and develops into a citron-yellow band, smooth at the centre, but granular and irregular at the edges; in pepton-water nitrates are reduced to nitrites, and in broth there is a slight production of gas; indol is not formed; urea is unaltered, and there is no fermentation of glucose, maltose, or lactose; milk is peptonised to a clear yellow liquid with sediment.

The organism is distinct from the "bacille séborrhéique" and from the *Coccus butyricus* of Sabouraud, though it resembles Ascobacterium of Babes.

Etiology of Mycetoma.*—W. E. Musgrave and M. T. Clegg have isolated from a case of Mycetoma a *Streptothrix* organism (*S. freeri*). It is an essential aerobe and grows on ordinary media, but especially well on those containing sugar, and on potato at 37° C.; on alkaline litmus milk growth occurs on the surface as dry, flat particles, which become confluent and form a heaped-up yellow mass, a tenacious sediment being deposited; the milk is not coagulated, and there is no formation of acid, but the medium is slowly decolorised; the growth on potato has a pink to yellow colour; when grown on gelatin the medium is not liquefied. The organism stains by the ordinary dyes, and also by the methods of Gram-Weigert and Ziehl-Nielsen-Gabbet; some specimens show fragmentation, and when stained by the last named method they present a close resemblance to the tubercle bacillus. A number of animals developed the lesions of *Mycetoma* after intra-peritoneal inoculation; three typical examples of Madura foot developed in monkeys after injection of the organism into the foot. The authors consider this organism to be distinct both from the *S. maduræ* of Vincent and from the organism described by Wright, and conclude that Madura foot is probably produced by any one of several species of *Streptothrix*.

"La Graisse" in Wines.†—E. Kayser and E. Manceau recognise two ferments as the cause of "La graisse." The microbes that produce the one have been previously described: they multiply readily on peptonised sugar media, they are resistant to acids, and attack lævulose more rapidly than other sugars; those of the second group are also short bacilli, arranged in long and twisted chains; peptonised liquids are not suitable for their growth, they are less resistant to acids, and they act more vigorously on glucose than on the other sugars. The authors find that certain aerobes play an important role in the diseases of wine, not only by facilitating the development of the anaerobic organisms of "la graisse," but also because they form true associations with these germs, and can thereby modify the preference of the ferments for certain sugars. Among these aerobes were found yeasts, mycoderma, a bacillus, two varieties of cocci, and a sarcina, which have already been described as causing the "bleu" of champagnes.

* Philippine Journ. Sci., ii. (1907) p. 477.
† Comptes Rendus, cxlvi. (1908) p. 92.

Action of Absolute Alcohol on Bacteria and on Yeasts.*—E. C. Hansen experimented on the action of ethyl alcohol on yeasts and on certain bacteria, viz., *B. coli* and *B. pasteurianus*. The organisms were collected on a platinum wire and thoroughly spread in a fine layer over the inside of a sterile flask, and after standing 24 to 48 hours in the dark at room temperature, the cells were regarded as dried; these were then treated with absolute alcohol, and it was found on every occasion that after one minute the cells still lived and could be cultured in broth, and in two cases the cells survived the action for eight minutes. By using 60 p.c. to 50 p.c. alcohol all the cells were killed within one minute, and the same result was obtained when undried cells were treated with absolute alcohol. From these results it is shown that bacteria in a moist state have a less resistance to absolute alcohol than when they are dried; the dried wall of the cell must take up water before the alcohol can penetrate the cell substance. Referring to the different results obtained by other observers, the author accounts for these by the methods employed, and lays stress on the proper drying of the cells by thoroughly spreading in thin layers. In some cases a surrounding mucus capsule will protect the organism from the action of the alcohol.

Blue Pigment produced both by a Diphtheroid Bacillus and by a Streptothrix.†—R. Müller isolated from a serum plate culture, made from a swab from a tonsil, a diphtheroid bacillus which produced a light blue colour on potato and in milk, but not on agar or on gelatin. The organism presented most of the characters of the diphtheria bacillus, but was not pathogenic for guinea-pigs. The author has named it *B. cœlicolor*. A year later the author found on an unused potato-tube a *Streptothrix* colony, surrounded by an intense blue-coloured area. Grown on thin layers of medium beautiful concentric rings were formed, and are represented in a number of illustrations accompanying the description of the organism. These ring colonies are formed by zones of growth with aerial hyphæ alternating with zones where the hyphæ are absent. The author has named this organism *Streptothrix cœlicolor*. It grows well at room temperature and at 36° C.; it is an obligate aerobe; it has a characteristic earthy smell; gelatin is liquefied without production of the pigment; milk is peptonised without the formation of acid or pigment. The author considers the blue pigment is identical in these two organisms; it is only formed at temperatures below 30° C., and in the presence of oxygen; its formation is apparently caused by the action of the organism on the starch of the potato, and on some molecular complex nearly allied to the starch molecule that may be present in the media in which this pigment appears. The author has named this pigment amylocyanin; it is soluble only in water; spectrum examination shows a strong absorption of light between the D line and the green, and a fainter absorption at either side extending to the C and E lines respectively.

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) p. 466.
† Op. cit., xlvi. (1908) p. 195.

Velocity of Progression and the Movement Curves of certain Bacteria.*—R. Stigell has studied the various forms and measured the velocities of movement of different bacteria. By using a magnification of 1500 and an ocular micrometer, ten estimations of the distances travelled in definite intervals of time were made, and an average of these velocities was taken for each organism examined. It was shown that whereas *B. subtilis* travelled $3 \cdot 41 \mu$ per second, the average velocity of *B. typhosus* was only $1 \cdot 15 \mu$ per second, and of *Vibrio aquatilis* only $0 \cdot 79 \mu$ per second.

By means of an Abbe drawing apparatus the forms of movement were traced on paper; those of *B. subtilis* and *B. megatherium* were almost straight lines, but *B. pyocyaneus* moved in irregular excentric curves. The author supplies a number of interesting reproductions of these tracings.

Bacterial Disease of Green Malt.†—H. Schnegg remarks that in wet years green malt is liable to a disease which causes the death of the rootlet and, at the same time, increases the number of sinkers. The bacteria which cause this disease are located in the embryo of the barley-corn, and spread thence to the growing rootlet. The organisms first attack the epidermis cells of the rootlet, and subsequently the interior cells lying between the epidermis and the endodermis; they appear, however, to be incapable of attacking the endodermis, and the vascular bundles are thus protected from their action. The author has isolated the bacterium by placing small portions of barley embryos (suspected to be affected with the disease) and small pieces of diseased rootlets in sterile wort and preparing gelatin-plate cultures from the wort cultures. The appearance of the organism indicates that it belongs to the group known as *Termo bacteria*, and it appears to be very similar to, if not identical with, *Bacterium coli*. In sugar-containing nutrient liquids it causes fermentation and a considerable degree of acidity. By addition of disinfectants to the steep-water the bacteria may be destroyed, but such treatment injures the germinating power of the barley. The danger of bacterial attack may be lessened, however, by adding to the steep-water agents which cause an increase of the germinating power of the grain. The bacterium (either as a result of enzyme-secretion or of a stimulation to enzyme-secretion in the corn) accelerates the modification of the corns, and hence it may be that its action is beneficial rather than injurious. Kilned malt, prepared from green malt affected with the disease, is of good quality in every respect.

New Bacillus of Dysentery.‡—F. B. Bowman describes a new bacillus which was isolated from the dejecta of cases of infantile dysentery prevailing in Manila in July and August of 1907. The organism, named *Bacillus* "*S*," was characterised by small, deep-blue colonies, which were first detected after 48 hours' incubation on agar. *B.* "*S*"

* Centralbl. Bakt., 1te Abt. Orig., xlv. (1907) p. 289.
† Zeitschr. Gesell. Brauw., xxx. (1907) pp. 537 et seq. See also Journ. Inst. Brewing, xiv. (1908) pp. 194–5.
‡ Philippine Journ. Sci., iii. (1908) pp. 31–8.

is distinguished from *B. coli* by being smaller and more delicate. Its motility is very marked. Coagulation of milk is delayed, and the litmus present is completely reduced. It forms no gas in lactose-litmus, and grows freely therein. Indol reaction is negative. Thus culturally and morphologically *B.* "*S*" resembled in some ways *B. dysenteriæ*, in others *B. coli* and *B. typhosus*.

The specific agglutinins developed in animals from this bacillus did not react with *B. dysenteriæ*, *B. coli*, and *B. typhosus*. Serum from one patient agglutinated the bacillus isolated from this patient, but did not react with other organisms from the same source. The author claims that this bacillus, *B.* "*S*," has not hitherto been described, and was the cause of the epidemic alluded to.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

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

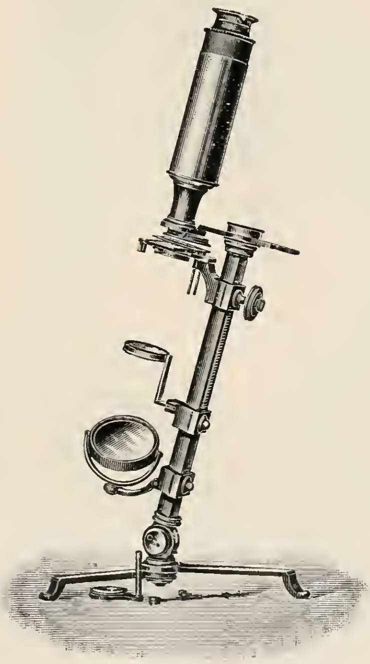
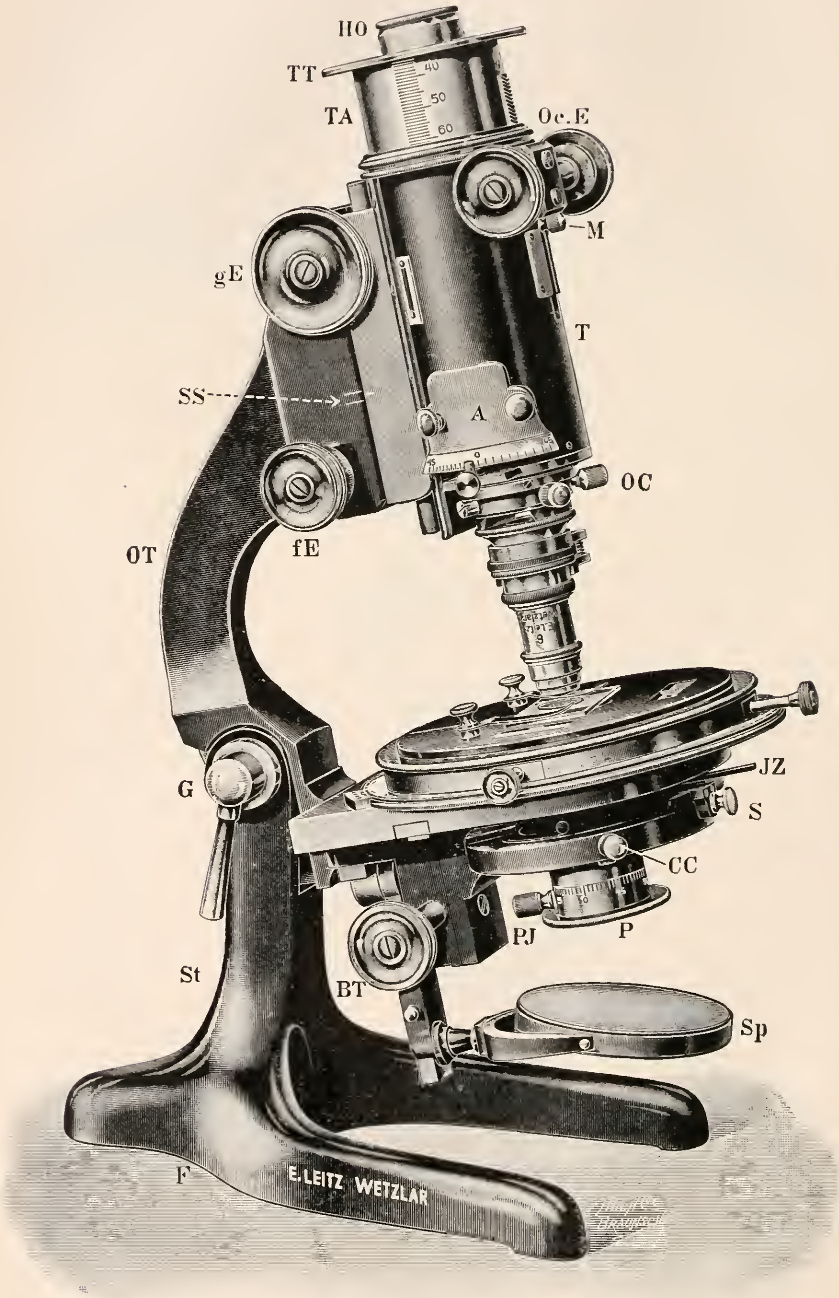


FIG. 86.

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

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

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

Fig. 87.

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

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

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

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

† 1907, p. 479.

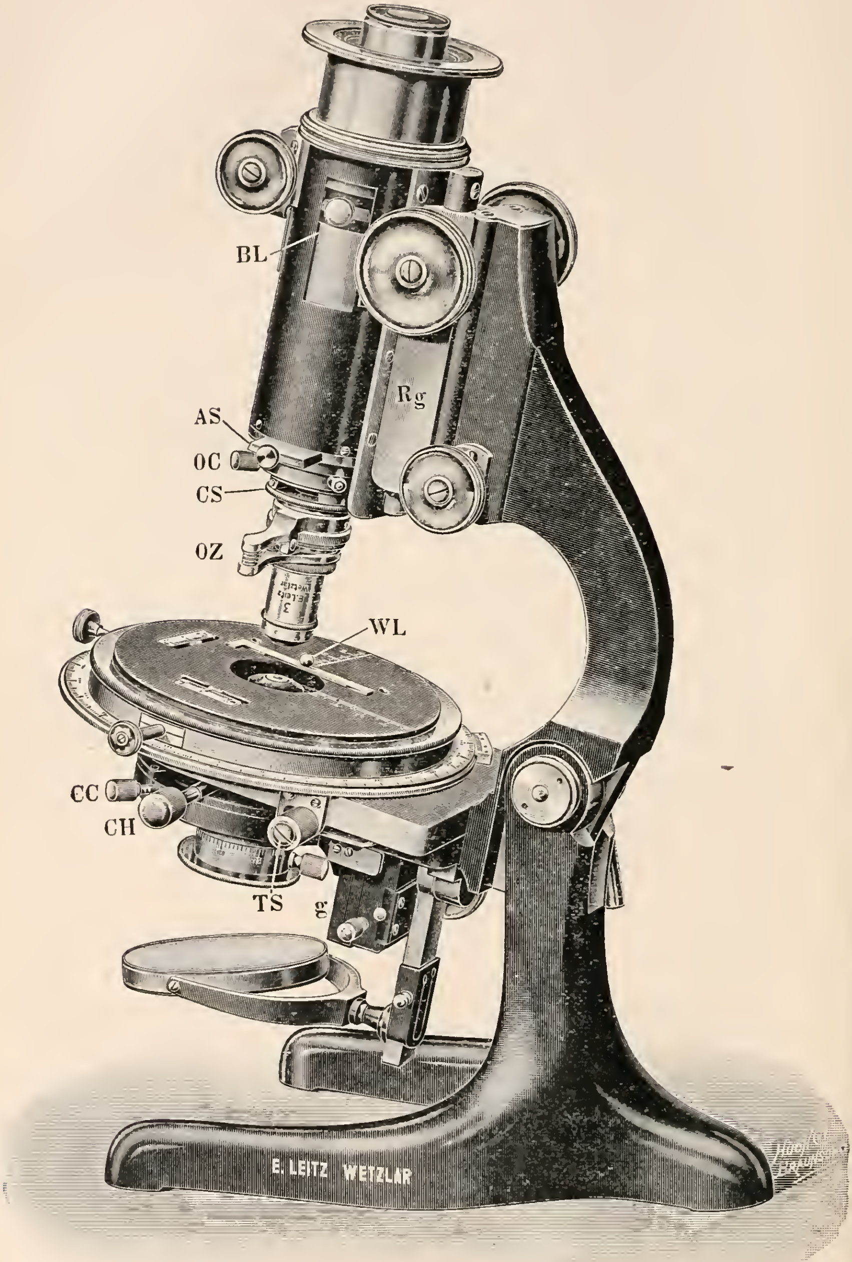

FIG. 88.

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

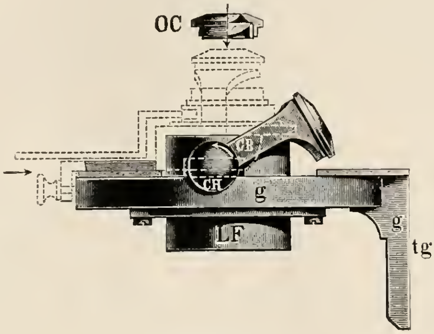

FIG. 89.

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

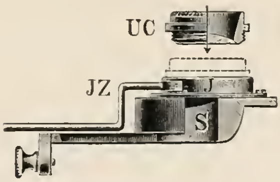

FIG. 90.

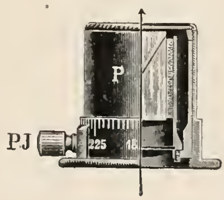

FIG. 91.

diaphragm, as followed by the lower condenser lens U C, which yield an approximately parallel beam of light. Both are carried by the slider S. The iris diaphragm is placed above the polariser so as to render it possible to limit at will the pencil of plane-polarised light. It is used in conjunction with the polariser, e.g. for determining after Becke's method the difference of refraction in minerals, twin laminæ, etc. The essentially novel feature of the illuminating apparatus is the upper condenser O C (fig. 89). This is so mounted that it may be tilted back by a lever C H and bridge C B, and that it may be thrown in and out of action at any elevation of the illuminating apparatus. This hinged condenser may be supplied in two forms, one of the customary aperture of 120°, the other having an aperture corresponding to that of a wide-angle lens of N.A. 1·48. As the apertures of the objectives advance it will be found necessary to centre the hinged condenser after the interchange, if the available polarised field is to be fully used. This adjustment is effected by a horizontal ring recessed into the disk *g* and carrying the hinged condenser, whilst two screws, C C (figs. 87 and 88), and a copper spring serve to centre it accurately with respect to the axis of the Microscope. The movement of the hinged condenser is limited by a screw. In all, there are six methods of illumination attainable. 1. After removal of the entire illuminating apparatus the object may be illuminated either direct or with the aid of the mirror, according to the inclination of the body. 2. Illumination may be produced by means of the iris diaphragm and the rack-and-pinion only. 3. Illumination with the iris diaphragm, the lower condenser and the rack-and-pinion motion. 4. Illumination, after folding back the upper condenser, removing the slider S and substituting for the polariser a wide-angle Abbe condenser. In this case the rack motion serves for focusing this condenser, the angle of the illuminating pencil being adjustable either by a vertical movement of the condenser or by means of a wheel diaphragm, which may be attached to the lower end of the condenser mount. The wheel diaphragm forms part of a simple apparatus provided for the production of oblique illumination, such as is employed in determining refraction by Schroeder v. d. Kolk's method of envelopment. 5. Illumination by parallel polarised light in conjunction with the entire illuminating apparatus, excepting the hinged condenser ; and (6) finally, illumination by convergent polarised light with the assistance of the hinged condenser.

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

To render the Microscope available as a focimeter, a vertical scale divided into $\frac{1}{2}$ mm. is attached to the left of the tube, so as to slide along a vernier on the intermediate fitting R *g* (fig. 88), above the milled-head of the coarse-adjustment, which renders it possible to read to $\frac{1}{20}$ mm.

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

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

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

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

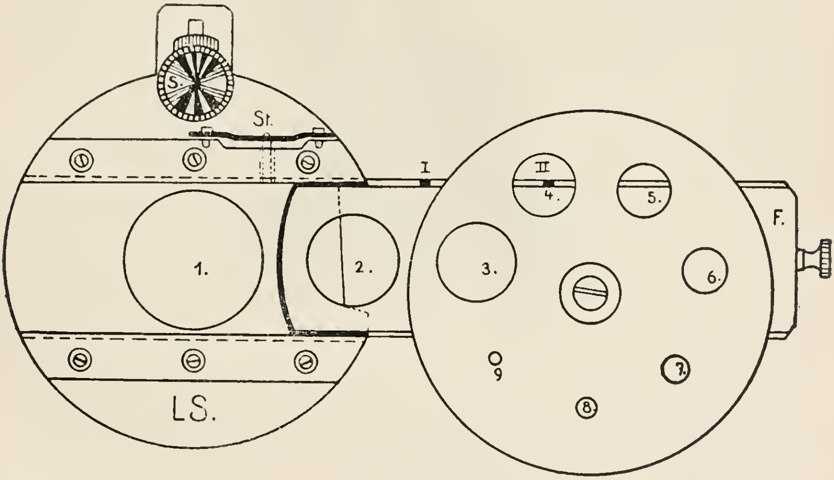

Fig. 92.

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

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

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

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

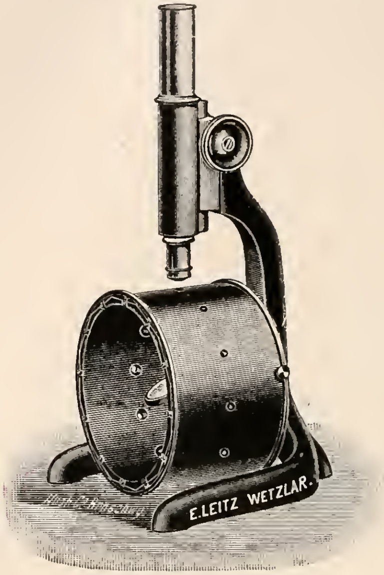

FIG. 93.

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

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

(3) Illuminating and other Apparatus.

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

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

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

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

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

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

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

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

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

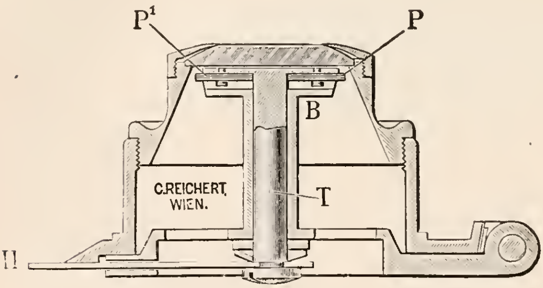

Fig. 94.

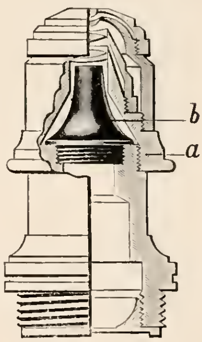

Fig. 95.

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

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

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

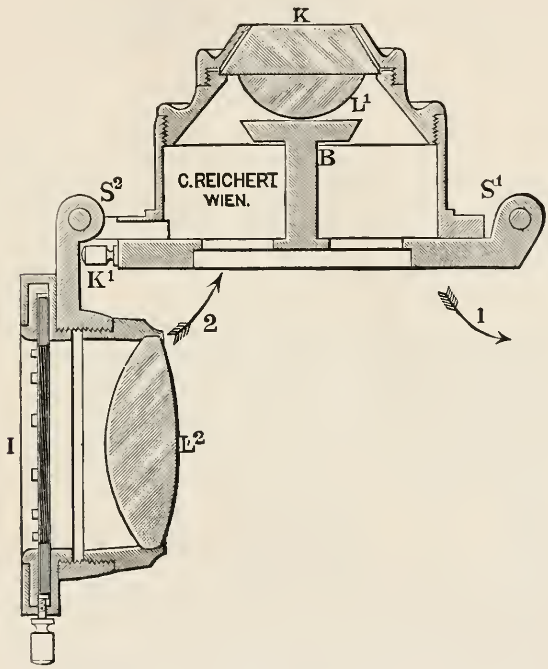

FIG. 96.

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

Plate-Condensers.—Figs. 97–101 illustrate an entirely new class of ultra-microscopical illuminators, and derive their name from the fact that they (especially the simpler forms) bear some resemblance to a glass plate. They have the advantage of being completely independent of the illuminating apparatus of the Microscope, and their application only requires the existence of the Microscope mirror and of a sufficiently large stage-aperture. They could therefore be used with the simplest stand. Fig. 97 shows the most primitive form of such a condenser, the whole arrangement resembling an object-slide on whose lower surface a conical mirror K has been cemented by its smaller end. A metal plate B is cemented on to the large end of the frustum *k*, so as to keep the direct rays back from the preparation. This frustum lies, as shown, in the stage aperture, and as its lower diameter is 14·6 mm., the stage

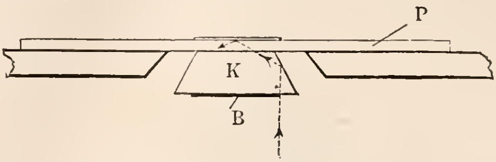

Fig. 97.

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

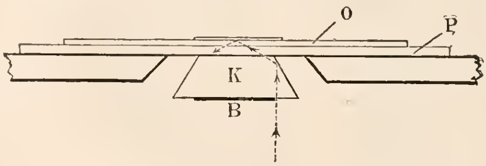

Fig. 98.

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

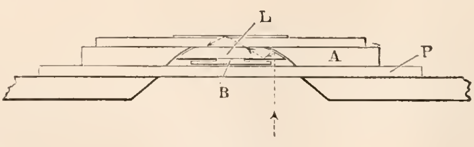

Fig. 99.

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

Fig. 99 represents another very simple arrangement for ultramicroscopical purposes. The conical mirror is now replaced by a spherically ground mirror-lens L, whose silvered surface is protected from injury by being cemented on to a glass block A, provided with a suitable recess. The stop B, T-shaped in cross-section, shuts out the direct rays, and those of N.A. less than 1·0; it is cemented centrally on the under surface of the mirror-lens. The glass plate P serves to protect the whole arrangement from external effects: its ends are made to project somewhat beyond A, so as to receive the stage-clamps. This instrument,

FIG. 100.

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

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

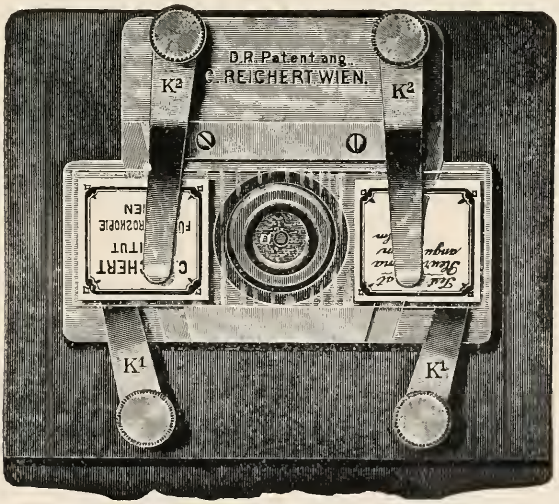

FIG. 101.

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

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

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

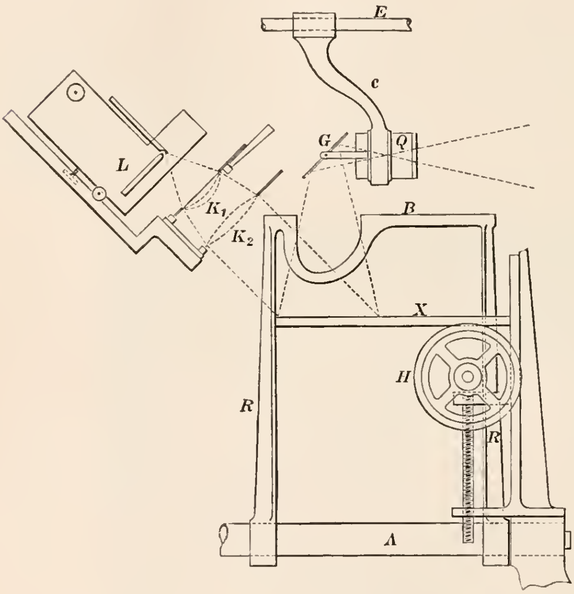

Fig. 102.

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

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

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

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

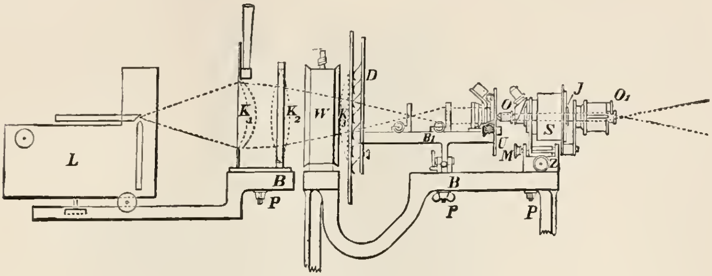

Fig. 103.

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

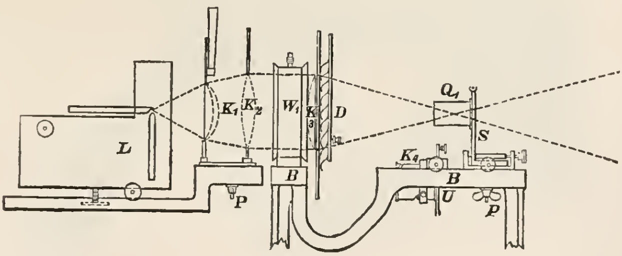

Fig. 104.

once, one above the other, the lower one being that which appears on the screen. The latter is removed in a downward direction, whilst the upper one glides into its place so as to be projected in turn. The succeeding lantern slide is introduced from above, and the process repeated as often as required. To facilitate the removal of the lower slide, the optical bench is provided with an arched gap, so as not to impede the motion of the hand, as may be seen from the figure. The holder of the lantern slides is adjustable in all directions, so as to render it available for use with plates of various sizes, and the largest plate which it projects is 12 by 9 cm., casting an image 230 by 172 cm. (90 by 68 inches) on a screen at 4 metres distance with a lens of 200 mm. focus.

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

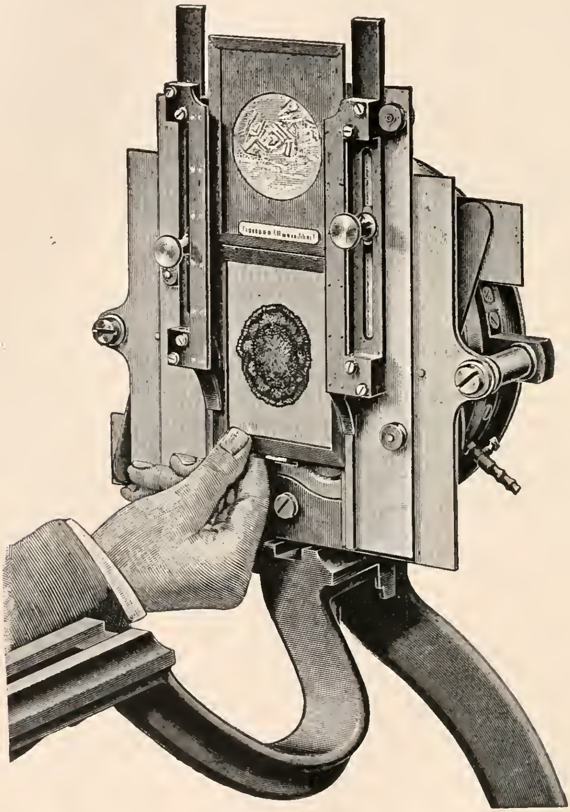

FIG. 105.

of the lens, this being greatly facilitated by the pressure of a spring catch. The lamp is tilted at 45° by the handle fitted at the back until the quadrant fixes its position. The mirror G, being silvered on its outer worked surface, should not be touched, and should not be cleaned otherwise than with a soft camel-hair brush; after use the mirror should always be covered with its protecting cap. The illuminated area is of the form of an ellipse, measuring 28 by 20 cm. in the extreme case. By withdrawing the lamp from the lens the light may be concentrated upon a smaller area. Fig. 102 shows diagrammatically the path of episcopically projected rays, and fig. 106 shows the optical bench as seen from the front when thrown out of action.

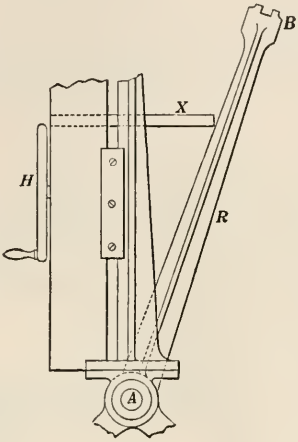

FIG. 106.

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

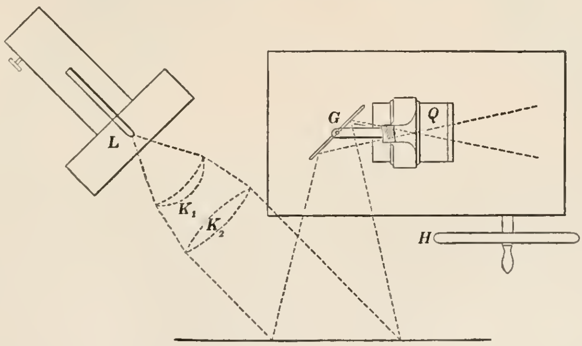

FIG. 107.

to project on the screen part of a living being, the subject is so placed at the side of the apparatus that the part in question may be illuminated by the lamp and completely reflected by the mirror. In this case the lamp is returned to its horizontal position and turned through 45° about its vertical axis. The mirror G should be turned about the axis of the objective Q of 400 mm. focus. Fig. 107 represents this mode of projection, and shows the path of the rays.

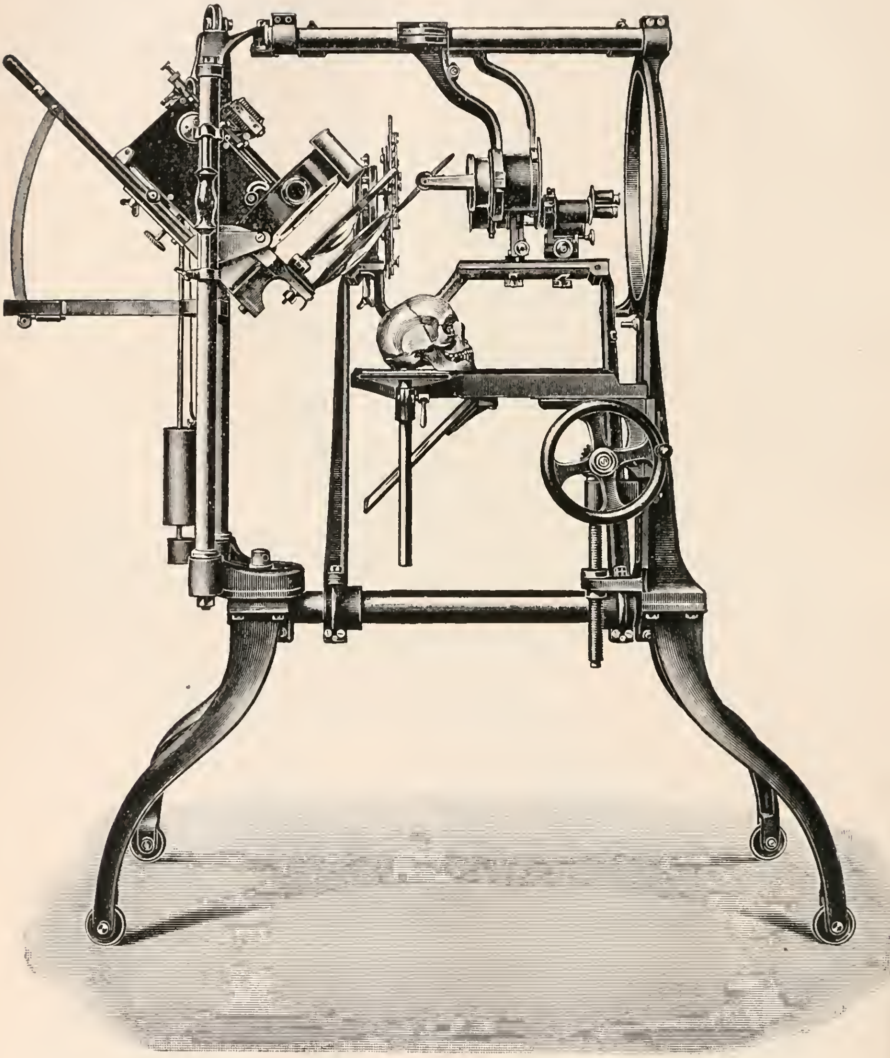

Fig. 108.

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

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

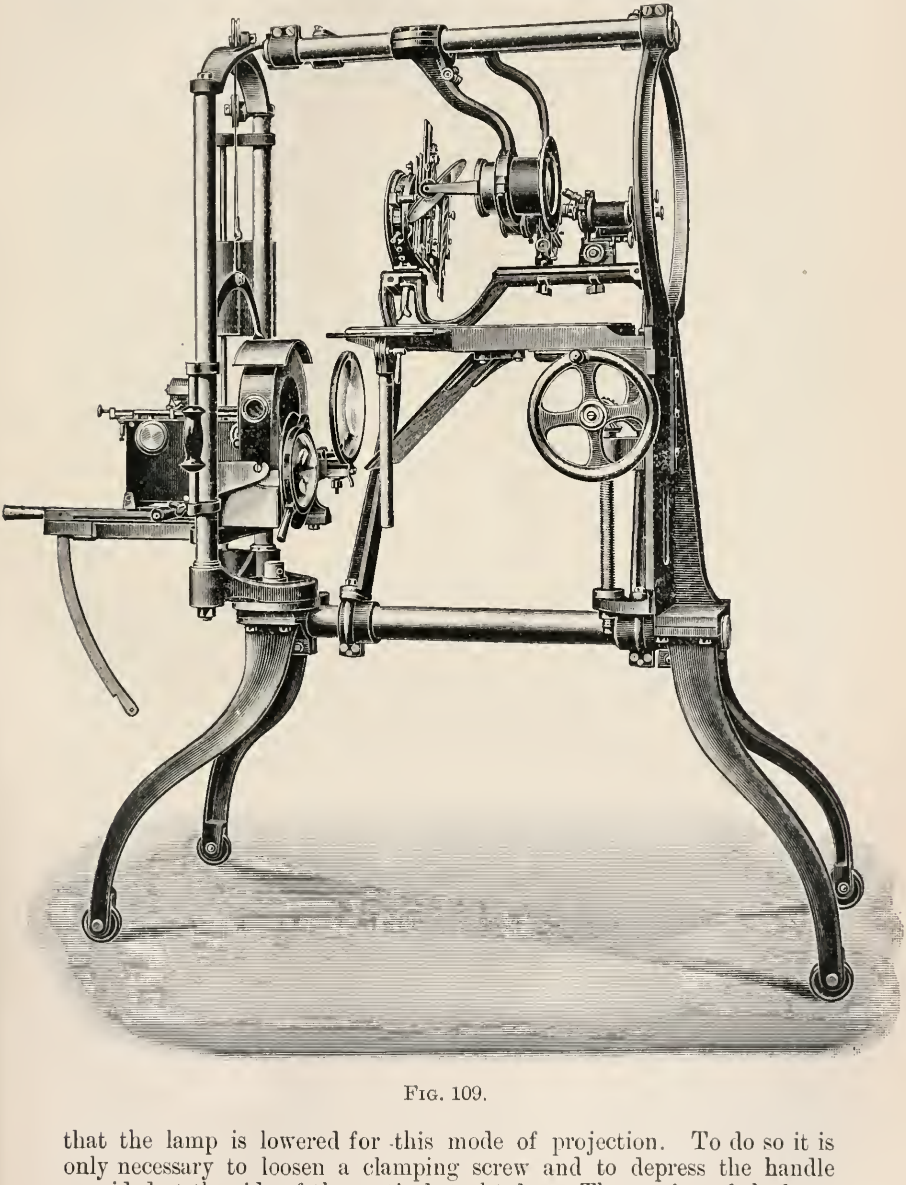

Fig. 109.

that the lamp is lowered for this mode of projection. To do so it is only necessary to loosen a clamping screw and to depress the handle provided at the side of the vertical steel tubes. The motion of the lamp is facilitated by a counterpoise. After lowering the lamp lens K_1 should be thrown out of action, and the lamp placed at such a distance from lens K_2 that the pencil of rays emerging from the latter, after reflection at the inclined mirror placed below the stage, may entirely fill the lens let into the stage. The reversing mirror G sends the light through objective Q, whereby an image is formed on the screen.

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

(4) Photomicrography.

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

FIG. 110.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(5) Microscopical Optics and Manipulation.

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

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

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

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

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

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

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

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

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

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

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

(6) Miscellaneous.

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

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

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

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

B. Technique.‡

(3) Cutting, including Imbedding and Microtomes.

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

* English Mechanic, lxxxvii. (1908) p. 112.
† See this Journal, 1905, pp. 412–13.
‡ This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, etc.; (6) Miscellaneous.
§ Zeitschr. wiss. Mikr., xxiv. (1907) pp. 274–7 (2 figs.).

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

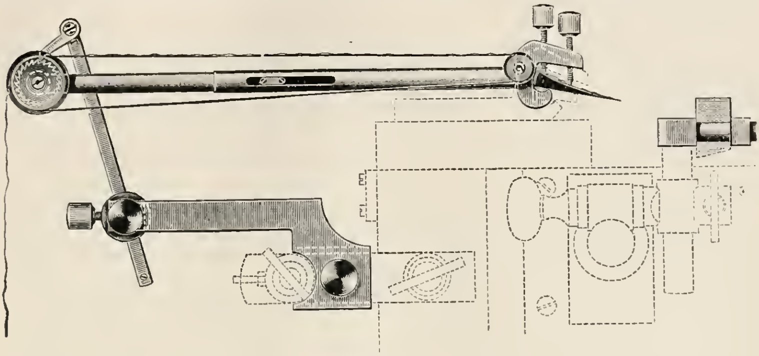

FIG. 111.

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

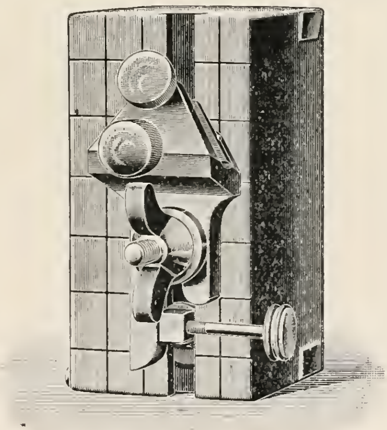

FIG. 112.

screws are set behind one another, not sidewise, so that it is possible to arrange the band horizontally or oblique. The roller is thus close behind the knife-back. In the axis of the other roller there is a toothed-wheel. An angle-piece carrying a clutch is fastened on to the arm which bears the chain-wheel. This clutch projects from the end of a staff which is adjustable in its length, and at its place of attachment is rotatory about the angle-piece. The clutch when set engages downwards in the toothed-wheel of the rear roller. When the apparatus is in action the band in the case of every section travels just as much forwards as the movement in length of a section of the object under treatment. As soon as the serial sections have commenced formation their free ends are placed by a paint-brush on the band and then left: while the cutting is continued the sections unfold and arrange themselves ribbon-like on the band till they have reached the free end, where they are removed in their entirety. The movement of the knife-block insures the automatic action of the band-gear. The teeth of the wheel are so cut that the clutch slides downwards over them in the back stroke, and engages in them in the forward stroke.

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

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

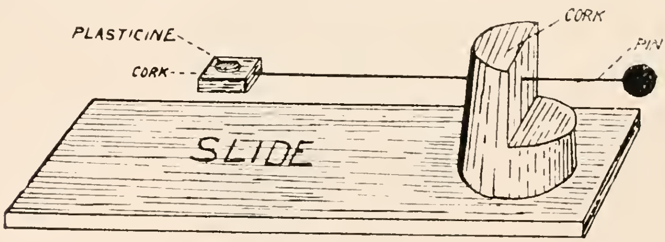

Fig. 113.

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

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

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

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

* Original communication.

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

(4) Staining and Injecting.

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

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

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

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

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

(6) Miscellaneous.

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

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

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

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

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

MOYSEY, L.—**Method of Splitting Ironstone Nodules by means of an Artificial Freezing Mixture.**
[Method of freeing fossils without damage; though not strictly microscopical, the method is indirectly useful if slices or sections of a fossil be required.] *Geological Mag.*, v. (1908) pp. 220–2.

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* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 92.
† Op. cit. 1te Abt. Ref., xl. (1908) p. 850.

Metallography, etc.

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

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

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

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

‡ See this Journal, 1905, p. 534.

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

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

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

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

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

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

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

* Phil. Trans. Roy. Soc., Series A, ccviii. (1908) pp. 21–109 (31 figs.).
† Journ. Soc. Chem. Ind., xxvii. (1908) p. 229. See also Bull. Inst. Min. and Metallurgy, 1908.
‡ Comptes Rendus, cxlvi. (1908) pp. 820–2. § Tom. cit., pp. 822–6.

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

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

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

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

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

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

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

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

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

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

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

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

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

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 15th of April, 1908, at 20 Hanover Square, W.
Conrad Beck, Esq., Vice-President, in the Chair.

The Minutes of the Meeting of the 18th of March, 1908, were read and confirmed.

A Donation of an Old Microscope (made by Shuttleworth about 1786) from Mr. W. E. Baxter was announced, the instrument being exhibited in the room, and described by Mr. C. F. Rousselet.

The Chairman said he was quite sure that the Fellows present would pass a very hearty vote of thanks to Mr. Baxter for this addition to their collection of instruments, which was now becoming an important and interesting one.

The thanks of the Meeting were unanimously voted for this donation.

Messrs. Watson and Sons exhibited a new form of Museum Microscope which had been designed by Mr. C. O. Waterhouse, of the Natural History Museum at South Kensington. The instrument was entirely inclosed in a glass case, excepting the eye-piece, by turning which an alteration of focus could be made. All the working parts of the instrument were secured against interference or removal by the public, who could make use of the instrument when once it had been adjusted, and an object placed upon the stage by an attendant. A drum-shaped stage for twelve objects, mounted on the ordinary 3 in. by 1 in. slides, could be rotated from the exterior of the case.

The thanks of the Society were voted to Messrs. Watson for sending this Microscope to the Meeting for exhibition.

Mr. Pigg, in reply to an inquiry from the Chairman as to a specimen of Microscopic Writing which he was exhibiting, said that the slide was a specimen of Webb's diamond writing. The Lord's Prayer, containing 227 letters, had been written in the space of $\frac{1}{237000}$ sq. in., which was in the ratio of 15 bibles to the square inch. A $\frac{1}{12}$ in. objective was necessary to decipher the writing. The size of the space occupied by the writing is $\frac{1}{447}$ in. by $\frac{1}{531}$ in. The ratio of letters to the square inch is 53,880,000.

The Chairman asked where Mr. Webb's writing machine was at the present time.

Mr. Pigg said he did not know.

Mr. C. L. Curties said that Mr. Webb destroyed it before his death.

Mr. F. Shillington Scales read a number of extracts from a paper contributed by Mr. James Strachan, "On Dendritic Growths of Copper Oxide on Paper," the subject being illustrated by a large number of examples exhibited under Microscopes in the room. Lantern slides of some of these were subsequently shown upon the screen.

Mr. Strachan verified previous investigations showing that these dendrites originated in minute particles of copper, their branching being due to the direction of the fibres in the paper, and showed further that they were not peculiar to any particular kind of fibre, that they formed a coating outside and not inside the fibre, that they were found in quite recent papers, and that they might be formed in as short a time as twelve months. He advanced various suggestions with regard to the chemical process which took place.

Mr. Scales being called upon by the Chairman for an expression of his own opinion on the subject, said that he should not wish to indorse all the theories which Mr. Strachan had put forward in this very interesting paper, but there was no doubt he was right as to the fact that these forms arose from the oxidation of particles of copper derived from portions of the machinery during the process of manufacture of the paper that they branched along the fibres of the paper, and that this process took a much shorter time than had hitherto been thought possible, but when he came to the reasons why they branched out in this remarkable manner, and the chemical changes which caused them to do this, he was getting upon rather more controversial ground. The copper must necessarily have an intermediate stage of solution of some kind, but what was the exact nature of the process by which it was dissolved and re-crystallised was not yet set beyond question.

The Chairman said they were much indebted to Mr. Scales for bringing the subject before them in the absence of the author of the paper.

The thanks of the Society were unanimously voted to Mr. Strachan for his paper, and to Mr. Scales for reading it.

Mr. F. Enock then gave a very interesting exhibition of lantern slides in illustration of his remarks on "Nature's Protection of Insect Life"—all the slides having been taken by the Sanger-Shepherd three-colour process. Mr. Enock prefaced his description of the pictures by a brief accouut of the process which he had employed in their production, by transferring the red and yellow prints to the blue plate, so as to avoid the necessity of transmitting the light of the lantern through the thickness of three films—with the result that a much brighter picture was produced without in any way impairing the fidelity of the coloration. The difficulties experienced in taking photographs of living subjects, which were likely to move during the time needed for three exposures, were also mentioned. The series exhibited comprised a number of illustrations of so-called mimicry on the part of moths and caterpillars, some of which had settled themselves on bark and other objects so nearly of the same colour as themselves that it was extremely difficult to determine their whereabouts. The exhibition concluded with a few slides of flowers, etc., to demonstrate the fidelity of the process in the reproduction of the natural colours.

On the motion of the Chairman, a very hearty vote of thanks was passed to Mr. Enock for his very beautiful and interesting exhibition.

Notice was given that the rooms of the Society would be closed from Thursday evening, April 17, to Tuesday morning, April 21.

Also that at the next meeting of the Society, on May 20, there would be a special exhibition of Pond-life.

The following Instruments, Objects, etc., were exhibited :—

The Society :—An Old Microscope by Shuttleworth, presented by Mr. Wynne E. Baxter.

Messrs. Watson and Sons :—New form of Museum Microscope.

Mr. J. Inderwick Pigg :—Microscopic writing by Webb, the Lord's Prayer being written within an area of $\frac{1}{237000}$ sq. in.

Mr. F. Shillington Scales:—16 micro-slides of dendrites from paper. Lantern slides shown on the screen and various specimens in illustration of Mr. Strachan's paper.

Mr. W. J. Marshall :—Dendritic crystals on old ledger paper.

MEETING

HELD ON THE 20TH OF MAY, 1908, AT 20 HANOVER SQUARE, W.
A. N. DISNEY, ESQ., M.A., B.SC., IN THE CHAIR.

The Chairman said they had received a letter from the President expressing his regret at not being able to be present, as he was detained by important business at the House of Lords; he hoped, however, to be able to join them later in the evening.

The Minutes of the Meeting of April 15, 1908, were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last Meeting, was read, and the thanks of the Society were voted to the donors.

	From
C. F. O. Nordstedt, Index Desmidiacearum, Supplementum. (4to, Berolini, 1908)	*L'Académie Royale Suédoise des Sciences Stockholm.*
H. & M. Peragallo, Les Diatomées Marines de France. (8vo, Grez-sur-Loing, 1908)	*M. J. Tempère.*
Cornelius Varley, A Treatise on Optical Drawing Instruments. (8vo, London, 1845)	*Mr. J. E. Ingpen.*
Direct-reading Micrometer Gauge	*Mr. J. Ciceri Smith.*

Mr. C. F. Rousselet said that the Society were going to exhibit in the Biological Section of the Franco-British Exhibition a collection of instruments illustrative of the history of the Microscope. The collection would consist of twenty-eight old Microscopes, most of which were taken from the Society's own collection, several others being lent for the purpose by Sir Frank Crisp and Mr. Nelson. As the Fellows present would no doubt be interested in what would be shown, lantern slides of the various instruments had been prepared, which were then exhibited on the screen—a brief description being given of each, and the parts referred to being indicated where necessary by Mr. J. W. Gordon with a pointer. The series included models by Leeuwenhoek, Wilson (screw barrel form), Lieberkuhn, Marshall, Culpeper, Jones, Benjamin Martin, Shuttleworth, Cuthbert, Chevalier, Hugh Powell (early form 1839), James Smith, Andrew Ross; and finished with Powell and Lealand's of 1848.

The Chairman felt sure that the Fellows of the Society had been greatly interested by this exhibition, and would return a very hearty vote of thanks to Mr. Rousselet and Mr. Gordon for bringing the matter before them. The thanks of the Society were unanimously voted to these gentlemen accordingly.

Mr. J. E. Barnard exhibited an old Photomicrographic Apparatus, which was designed by Dr. Maddox for Dr. Lionel S. Beale. There were two points about it which were worth notice; the first of which was, that the objective was connected up to the stage by a light-excluding appliance; the other being that the sub-stage condenser, and other illuminating apparatus, were carried on a triangular bar, which was inverted. He should be very pleased to place the apparatus at the disposal of the Society if it was considered of sufficient value to be worth adding to their collection.

The Chairman expressed the thanks of the Society to Mr. Barnard for his exhibit, and for the present to them of the apparatus described, which they would be very pleased to accept and to place amongst the other objects of interest in their collection.

The Chairman called attention to the large number of examples of pond-life exhibited in the room, and asked for a very hearty vote of thanks to those Members of the Quekett Club and Fellows of their own Society who had brought their Microscopes and objects for exhibition.

The following Instruments, Objects, etc., were exhibited:—

The Society:—Lantern Slides of Microscopes to be exhibited at the Franco-British Exhibition.

Mr. J. E. Barnard:—An Old Photomicrographic Apparatus.

Specimens of Pond-life, as follows:—

Mr. F. W. Watson Baker:—*Plumatella* emerging from statoblasts.

Mr. James Burton:—*Draparnaldia* sp., *Stentor* sp. Illuminated with Rheinberg's colour disks.

Mr. Thomas N. Cox:—*Anacharis*.

Mr. D. Davies:—*Œcistes crystallinus*.

Mr. Th. A. Delcomyn :—Desmids, Diatoms, etc.
Mr. A. Downs :—*Hydra fusca*, *Volvox globator*.
Mr. F. W. Eyre :—*Melicerta ringens*.
Mr. A. E. Hilton :—*Spongilla lacustris* (?) × 20.
Mr. E. Hinton :—Bladderwort, showing captured *Entomostraca*.
Mr. J. T. Holder :—Water-mite.
Mr. H. S. Martin :—*Actinosphærium eichhorni*.
J. I. Pigg :—Circulation of blood in tail of Tadpole.
F. J. W. Plaskett :—Fresh-water Diatoms, *Navicula*, *Surirella*, etc.
Mr. Thomas H. Powell :—Cyclosis in *Vallisneria*.
Mr. G. H. J. Rogers :—*Lophopus crystallinus*.
Mr. C. F. Rousselet :—*Fredericella sultana*, *Lophopus crystallinus*, Rotifera, various, *Melicerta ringens*, *Stephanoceros eichhorni*, *Volvox globator*.
Mr. J. Pledge :—*Actinosphærium eichhorni* ($\frac{1}{4}$ in. objective).
Mr. D. J. Scourfield :—Ditto ($\frac{1}{12}$ in. objective).
Mr. C. J. J. Sidwell :—Ditto (1 in. objective dark ground).
Mr. T. J. Smith :—Diptera, *Mochlonyx* (male).
Mr. Charles D. Soar :—Water-mites.
Mr. H. Taverner :—Water-mites.
Mr. George Tilling :—*Melicerta ringens*, shown with Rheinberg's colour disks.
Mr. W. R. Traviss :—Circulation in *Nitella*.
Mr. Charles Turner :—Head of Water-beetle, *Gyrinus natata*, showing the two pairs of eyes.
Mr. J. C. Webb :—*Daphnia*.

W. Wesché, del.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

AUGUST, 1908.

TRANSACTIONS OF THE SOCIETY.

XII.—*On the Microscope as an Aid to the Study of Biology in Entomology, with particular reference to the Food of Insects.*

By W. Wesché, F.R.M.S.

(*Read January* 15, 1908.)

Plates V. to X.

Entomologists are generally satisfied with the identification and classification of their specimens; connected with this work are many points of the greatest interest, such as variation and mimicry, and in the phylogeny new points are constantly arising and give little leisure for other work. So the large majority of the life-histories still remain unstudied, and the habits of many well known species

EXPLANATION OF PLATE V.

Fig. 1.—Fore leg of *Chrysops cæcutiens* L. ♀. To illustrate the simple type of limb. This insect belongs to the family of the Tabanidæ, and is a well known and keen blood-sucker. It is met with in our English woods and meadows.

Fig. 2.—Middle leg of *Chrysopilus aureus* Mg. ♀. Simple type. Belongs to the Leptidæ, and is not uncommon in long grass and meadows.

Fig. 3.—Hind leg of *Beris vallata* Forst. ♀. Simple type. Belongs to the Stratiomyidæ; is very common, and found on the hedges.

Fig. 4.—Fore leg of *Hydrophorus*; species undetermined (♂). To illustrate the raptorial or predaceous type. Belongs to the Dolichopodidæ, and resembles *Aphrosylus* in the structure of the legs, but has dissimilar mouth-parts. It is a small Australian insect, which I captured at Geelong, Vic.

Fig. 5.—Fore leg of *Notiphila cinerea* Fln. ♀. Raptorial type. It has the remarkable saw-like process on the femur, found also in many of the Hydrellinæ. It is placed in the Ephydridæ, is an inhabitant of damp places, and is rare in my experience.

Fig. 6.—Middle leg of *Caricea tigrina* F. ♂. Raptorial type. Placed in the Anthomyidæ, but is fiercely predaceous. Common in damp meadows.

are yet a matter of conjecture; indeed, the amount of care and patience required for the working out of these are sufficient to deter all but the most enthusiastic. I do not think that the work of the field naturalist, the accurate and minute noting of habit and life-history, can be overvalued, but I would point out another method, which, while it cannot supersede, can absolutely confirm as well as suggest further observation, and by its unaided use show a great number of structures, that on account of their minuteness are visible by no other means. This method I have applied mainly to the insect in the imaginal stage, which, owing to the quickness of movement in life, is the most difficult of observation, but it can be used with advantage in the study of the more simple larva. It has often been my experience to hear speakers depreciate the method of those who mount whole insects with pressure, the softer parts being dissolved and the object cleared in caustic potash. Their objections are good from many points of view, but the fact remains, that this method is the only one that will enable the student to use the higher powers of the Microscope; and it is just this use of the high powers that is absolutely necessary for a complete study of a preparation, which when well mounted, exhibits all points of structure, and of difference other than colour, that the examination of a pinned specimen can show, and multitudes of detail that are beyond the powers of resolution of the simple lens. It is true that allowances have to be made for altered shapes and relations, but experience and study will give an idea of the changes undergone, and enable the student to reconstruct the original form of his subject in a mental image.

I shall endeavour to show that it is possible to take a preparation of an insect that may be quite unfamiliar, and sitting by a comfortable fireside, with a Microscope conveniently arranged, study it: (1) place it in its particular order, family and genus; (2) ascertain its sex; (3) describe its habits, whether blood-sucking, predaceous, or otherwise; (4) show how it obtains its food or attacks its prey; (5) tell what that food is, sometimes naming the animal, plant, or insect, that serves as such; (6) know if it crawls on the earth, flies in the air, swims in or skates on the water, or is parasitic; (7) see how the insect smells, tastes, hears and feels; (8) trace the differences that shade from species to species; (9) see the remains of the organs of the past, examining their minute remnants; (10) see that there is nothing in Nature that is not logical and has not a "why and a wherefore"; (11) and be convinced that all these observations strengthen and fit in with that great fact of Evolution, which has so altered, for the man who thinks, the aspect of the earth as well as that of the heavens. But the field of inquiry is so large and the mass of detail so bewildering, that the student of "life-history" must use method in his investigations, and it appears to me that he will best obtain data bearing on his inquiry by a separate study of the parts. They may be divided thus:—

I.—General Structure. This includes, in addition to the insect as a whole, (*a*) the limbs; (*b*) the finer bristles; (*c*) the sense-organs.

II.—The Armature of the Mouth.

III.—The Contents of the Abdomen: (*a*) food; (*b*) structure.

IV.—The Genitalia.

I.—General Structure.

This may be regarded from several points of view, as it is (A) Utilitarian; (B) Sensorial; (C) Raptorial; (D) Secondary sexual.

A. *Utilitarian.*—A study of the wings and their nervation affords information as to the character of the flight, but also is in a measure a guide that will tell something of the evolution of the species. The openings of the tracheæ on the thorax and the abdomen show us how sounds are made, and how the insect oxygenates the blood. The immense importance of keeping the antennæ clean is shown by the contrivances on the fore limbs, such as the brush on the metatarsi of the Muscidæ, or the comb on the tibiæ of the Hymenoptera. The Microscope will show how it is possible for an insect to skate on the surface of smooth water, and parasitism can be recognised by the flattened form of the body and the character of the legs, particularly the claws.

B. *Sensorial.*—This section requires almost exclusively high-power work, and will in some cases necessitate the cutting of sections. All or most of the many modifications, such as "taste hairs," or "olfactory pits," and other structures so clearly brought before us in "Senses of Animals," * can be seen on preparations mounted with pressure: they must be looked for on the antennæ and mouth-parts.† On the legs will be found some sense-organs, particularly in Diptera, which are comparatively rare, and which I have described in a former paper: those on the coxæ are more frequently met with than the organs on the tibiæ.‡

C. *Raptorial.*—Under this heading I include all modifications that are used in holding prey. The most usual characteristic is an enlargement of the femur to contain the much-developed muscles, and the legs and often the fore coxæ have rows of strong sharp spines. But strong spines are equally characteristic, and the arrangement is apt to alter in different families. This type is usually easily recognisable, as it is found in both of the sexes, but there are a number of genera in the Syrphidæ which, from the

* Senses of Animals, 1889, Sir John Lubbock.

† Sopra certi organi di senso nelle antenne dei Ditteri. Dr. Paul Mayer, Reale Accademia dei Lincei, 1878–79.

‡ Some New Sense Organs in Diptera. Journ. Quekett Micr. Club, 1904.

general appearance and detail of some of their limbs, as well as the armature of the mouth, might be thought to be raptorial, were it not that the convincing evidence afforded by the contents of their stomachs exonerates them—(*Ascia, Erystalis, Heliophilus, Mallota, Xylota,* and *Syritta*). In some of the genera of the Ephydridæ, there is a serrated fore femur, the chitin itself being drawn out into a number of sharp teeth, exactly like those of a saw; this is unusual, most of these contrivances consisting of strong hairs in sockets.

D. *Secondary sexual.*—These structures are more strikingly developed, and more commonly found in the male sex; they mostly consist of an extraordinary variety of modification of the legs, usually of one particular pair, and often of the abdomen.

Setæ are altered in shape and grouped in rows; they are, as a rule, blunter than those found on the raptorial limb, and occasionally take the form of bunches or pads of quite soft hair. Sometimes a seta is provided with a round head, not unlike that of the ordinary pin. In many cases the shapes of the tibiæ are modified, and more often the tarsi are greatly enlarged, spatulated

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EXPLANATION OF PLATE VI.

Fig. 7.—Hind leg of *Leptogaster cylindrica* Deg. ♀. Raptorial type. Belongs to the Asilidæ, the most predaceous family in Diptera.

Fig. 8.—Fore leg of *Hilara clypeata* Mg. ♂. To illustrate the secondary sexual type. The extraordinarily enlarged metatarsus is used in holding the female, whose fore leg is quite simple. The *Hilaridæ* mate while flying, belong to the predaceous Empidæ, and are found over streams or brooks.

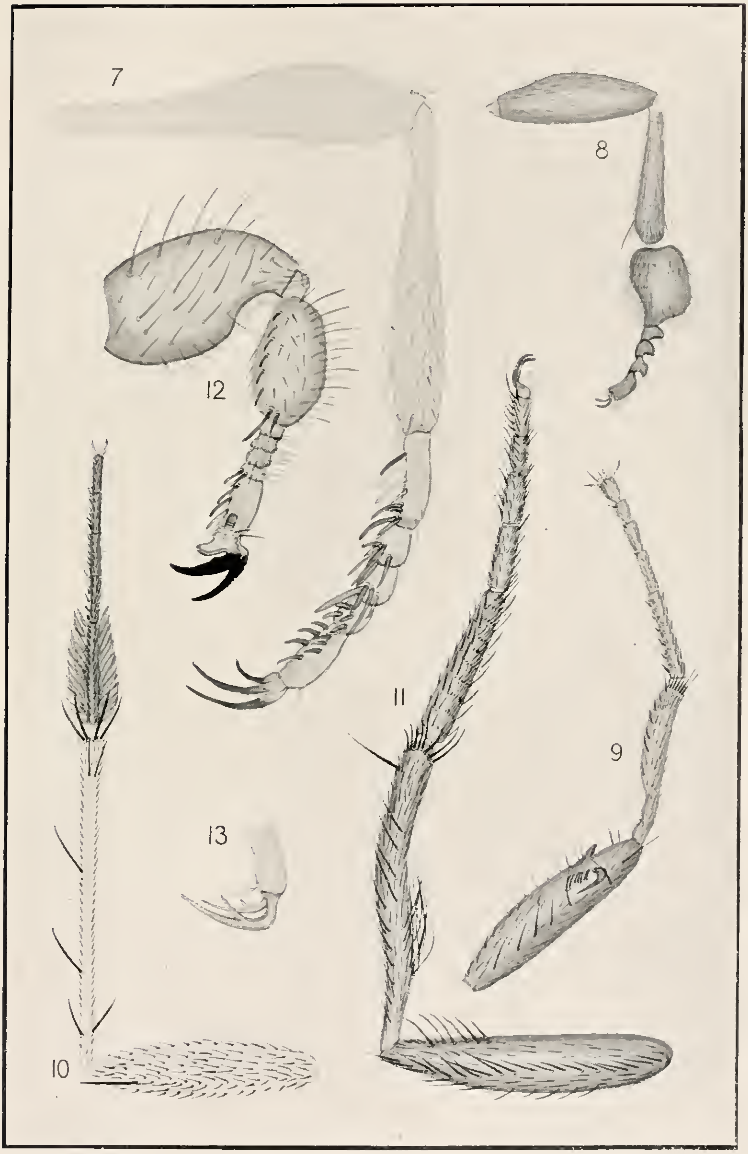
Fig. 9.—Fore leg of *Hydrotea parva* Mde. ♂. Secondary sexual type. The males of this genus of the Anthomyidæ, are easily recognised by the remarkable modifications of the fore femora and tibiæ. In the Hydrellinæ the fore femora of both sexes is elaborated for predatory purposes. In *Hydrotea* only that of the male, and for sexual advantage. These insects are found in gardens and on hedges, and appear to be general feeders like the Blow-fly.

Fig. 10.—Middle leg of *Dolichopus plumipes* Scop. ♂. Secondary sexual type. Belongs to the family of the same name, and is predaceous. The fine tomentum on the tarsi of many genera enables the insect to glide on the surface film of shallow undisturbed water. This particular species is however met with on damp herbage.

Fig. 11.—Hind leg of *Ophyra leucostoma* W. ♂. Secondary sexual type. Belongs to the Anthomyidæ, and from the venation of wing, the shortness of the labium, and the marked remains of the maxillary palpi, may be thought to be of a far more primitive form than any of the Muscidæ proper, except the Cyrtoneura group. Every joint of this leg is modified for sexual purposes. The femur has numerous hairs and stiff bristles; the tibia is curved and ciliated with a soft pad or brush of hair, and the inner sides of the tarsi are clothed with delicate pubescence. The food consists of pollen and minute vegetable organisms.

Fig. 12.—Fore leg of *Melophagus ovinus* L. ♀. Parasitic type. This insect is found on sheep, and is sometimes wrongly called the "sheep tick." The claw is characteristic of the family, the Hippoboscidæ, and is well adapted for fastening on to the fleece of the host; so much so that I have had, on occasion, some trouble in detaching hair from it.

Fig. 13.—Fore claw of *Culex pipiens* L. ♂. This is a secondary sexual character. A comparison of the claws figured will give an idea of the habits of the insects.



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or feathered, to enable the male to maintain a firm hold of the female. In the Culicidæ even the claws of one pair of legs are altered, and have an extra barb. On the under side of the abdomen are bunches of hair, tubercles, and spined areas in regions of contact.

As in the raptorial Ephydridæ, so in a few insects in this section, the femur itself is modified into teeth and hooks. The genera *Hydrotca* and *Borborus nitidus* Mg. among the flies, are of this rarer type. Even the sucker has been used, and most microscopists are familiar with the beautiful apparatus on the fore legs of the Dytiscus Beetle. The stridulating organs used in calling the sexes together, would come under this head also.

In the female, secondary sexual characters are comparatively rare, and mostly consist of arrangements of spines on contact areas.

I only know of one modification of the limbs, and that consists of enlargement of the last joint of the hind tarsi, and I would feel inclined to place this in another section, were it not for the fact that the males are without this character.*

As this division of the subject has had but little attention, I will give an account of my observations, which, however, are confined, as will be most of my remarks, to insects of the order Diptera.

Secondary Sexual Characters in the Female Insect.

BIBIONIDÆ. *Dilophus febrilis* L. has two hairy tubercles on the posterior ends of the eighth segment, laterally placed. The male also has two on the ventral side of the abdomen. Both sexes have two rows of teeth, or strong hairs modified into teeth, across the thorax. Their presence in the female is easy to understand; in the male, especially as they seem nearly as well developed as in the female, difficult.

CHIRONOMYIDÆ.—*Chironomus plumosus* L. is provided with two patches of soft hair on the dorsal sides of the last segment.

EMPIDÆ.—In *Hilara cilipes* Mg. there is a notched guide for the flagellum of the male on the ovipositor of the female.

DOLICHOPODIDÆ.—A large number of species in the Dolichopodidæ have a strong blunt fringe of spines on the end of the ovipositor. This is a character that so far I have only found in this family, which is so remarkable for the development of primary characters in the male. The antennæ are also often smaller than those of the male: the reason is obvious.

* The late Dr. Meade in his British Anthomyidæ, p. 47, gives *Chortophila billbergi* Ztt. as another example, the female having the second and third joints of the front tarsi dilated. Drs. Schiner and Zetterstedt are mentioned as having wrongly ascribed this character to the male. I am not acquainted with the insect, and cannot say which doctor is right.

Syrphidæ.—*Sphærophoria scripta* L. has the outer edges of the abdomen decidedly more thickly haired than the same part in the male.

Conopodæ.—*C. quadrifasciata* Deg. has a remarkable organ which protrudes from the ventral side of the abdomen, and hangs down anteriorly to the opening of the vagina. A microscopic preparation shows an even more remarkable complexity; posteriorly to the opening of the vagina are two very powerful teeth with levers attached to their bases. Opposite are two lobes studded with blunt spines, and with sensory hairs on the extremities. More anterior to this, and on the ventral part, is an area also studded with blunt spines, but more densely, and arranged in rows of 2, 3, 5, and 6. From this point begins the descent of the organ alluded to, which is seen to be a hairy unpaired lobe, furnished on the posterior side with short blunt spines more sparsely distributed, and on the anterior surface with sharp hairs (plate VII. figs. 14, 15).

In *C. flavipes* L. an even more striking appearance is seen, as the "unpaired lobe" appears to have quite a point. In a prepared specimen the vagina is found to be even more armed than in *C. quadrifasciata*, as is also the posterior surface of the lobe and the ventral space between. Posterior to the male genitalia of the last-named species is a little shiny black knob; this is a paired organ homologous with the "forcipes superiores" of the ordinary genitalia. This knob, when the whole hypopygium is turned in under the abdomen of the female, comes in contact with the serrated posterior surface of the "lobe" and is kept in position by it. That being so, effective fertilisation would be greatly helped by the "unpaired lobe," and it is easy to see that females possessing it, or tending to vary in the direction of greater development, would have an advantage over the simpler females, and, passing on the character to their female offspring, produce these extraordinary complications (plate VII. figs. 16, 17).

Anthomyidæ. *Pegomyia latitarsis* Ztt. has the last joint of the posterior tarsi enlarged, while the males are normal; the advantage of this to the possessor is not obvious. *Pegomyia bicolor* W. has two very thickly haired patches, placed one behind the other on the ventral side of the abdomen, close to the aperture of the ovipositor. There are also two groups of eight spines disposed laterally on each side of the posterior patches.

Cordyluridæ. *Norellia spinimana* Fln. has a number of blunt spines on the ventral side of the abdomen and below the ovipositor.

Sapromyzidæ. *S. fasciata* Fln. has on each side of the fourth segment a patch of very fine bristles, highly chitinised and seated on a curious corrugation of membrane; *S. apicalis* Lw. has the fine hair of the membrane, laterally on the lower part of the abdomen, modified into sharp hooks. *Lauxanea aenea* Fln. has the same. These structures are peculiar, as usually the chitinous plates are altered. They are undoubtedly "secondary sexual," and present degrees of development in those species observed; They are very marked in *S. fasciata*, might easily escape notice in *S. apicalis* and *L. ænea*, while they are absent in *S. lupulina* F. and *Lauxanea bilineata* Hutton (N. Zealand) and *L. decora* Schiner (S.E. Australia).

Borboridæ. The membrane of the abdomen in *B. equinus* L. is studded with short sharp spines, but not close to each other in the contact areas, as in the Sapromyzidæ; the corresponding part in the male is nearly bare, though the plates on the ventral side of the abdomen are thickly covered with setæ. *Sphærocera subsultans* F. has similar modifications.

Hippoboscidæ. *H. equina* L. has large lateral spined tubercles on each side of the vagina, as well as two spiny patches on the dorsal side, near the posterior end of the abdomen; the whole of this part is much more sharply spined than in the male.

Olfersia tasmanica Wesché, a Tasmanian insect, parasitic on the Wallaby, has tubercles in the same places, but they are armed with long delicate spines.

II.—The Mouth-parts.

The majority of insects are provided with a strong pair of biting or crushing jaws (mandibles), which break up their food and enable the smaller jaws (maxillæ) to seize it, and with the aid of the labium transmit it down the gullet till it reaches the gizzard. The three principal orders whose trophi most markedly differ from this scheme are the Hemiptera, Lepidoptera and Diptera, and the microscopist who is familiar with these four types can already do much in classifying his preparations. The Hemiptera can be easily recognised by their "beak": a sharp case (labium) which contains fine delicate lancets (mandibles and maxillæ) and is usually turned in under the thorax. The Lepidoptera have their maxillæ modified into a long double tube, which is carried curled up like a watch-spring. The Diptera are distinguished by the presence of tracheæ on the labium. In the Culicidæ (gnats) and certain parasitic forms this character may fail, but high powers will show traces of their presence, or of their presence in the past. Mandibles that bite or crush will never be found, though their representatives are present in certain families; but in the trophi there is such a wide range of variation, and such alteration of detail, that from a study of this part alone a judgment can be formed of the habits and food, and in the majority of cases of the place in the scheme of classification. I have treated this subject at some length in a paper published in the Journal of this Society,* but will supplement those observations by a few general rules, that will, I hope, enable the student to glean facts from his preparations.

1. When the mandibles and maxillæ are present the insect is a blood-sucker, as *Culex, Tabanus,* or *Simulium.*

2. When the labium is without teeth and has only a *simple arrangement of tracheæ,* and the mouth is armed with maxillæ and with maxillary palpi, the insect is predaceous, as in *Empis.*

3. When the labium is without teeth, but has *well developed tracheæ,* and the mouth is armed with maxillæ and with maxillary palpi, the insect feeds on the pollen of flowers, as in *Syrphus.*

4. When the labium is without teeth or maxillæ, and the palpi present (well developed) are labial, the insect feeds on the juices or the smaller pollen of flowers, as in *Trypeta,* or *Pipunculus.*

N.B.—The palpus is labial when unattached to the stipes or cardo of the maxilla—in *Calliphora* labial, in *Syrphus* or *Culex* maxillary.

5. When the mouth-parts are as in Rule 4, except that the labella or paraglossæ of the labium have strongly chitinised teeth

* "The Mouth-parts of the Nemocera and their Relation to the other Families in Diptera," January 1904.

EXPLANATION OF PLATE VII.

Fig. 14.—Part of the abdomen of *Conops quadrifasciata* Deg. ♂. This and the next two figures are drawn from pinned specimens to show the ordinary appearance as seen when examined with a simple lens.

Fig. 15.—Part of the abdomen of *C. quadrifasciata* ♀ to show the curious unpaired organ that is appended to this part in the female.

Fig. 16.—Part of the abdomen of *C. flavipes* L. ♀, to show an even more remarkable development of the appended lobe.

Fig. 17.—Part of the abdomen of *C. flavipes* L. ♀, drawn from a prepared specimen, to show the complicated spinose armature of the part.

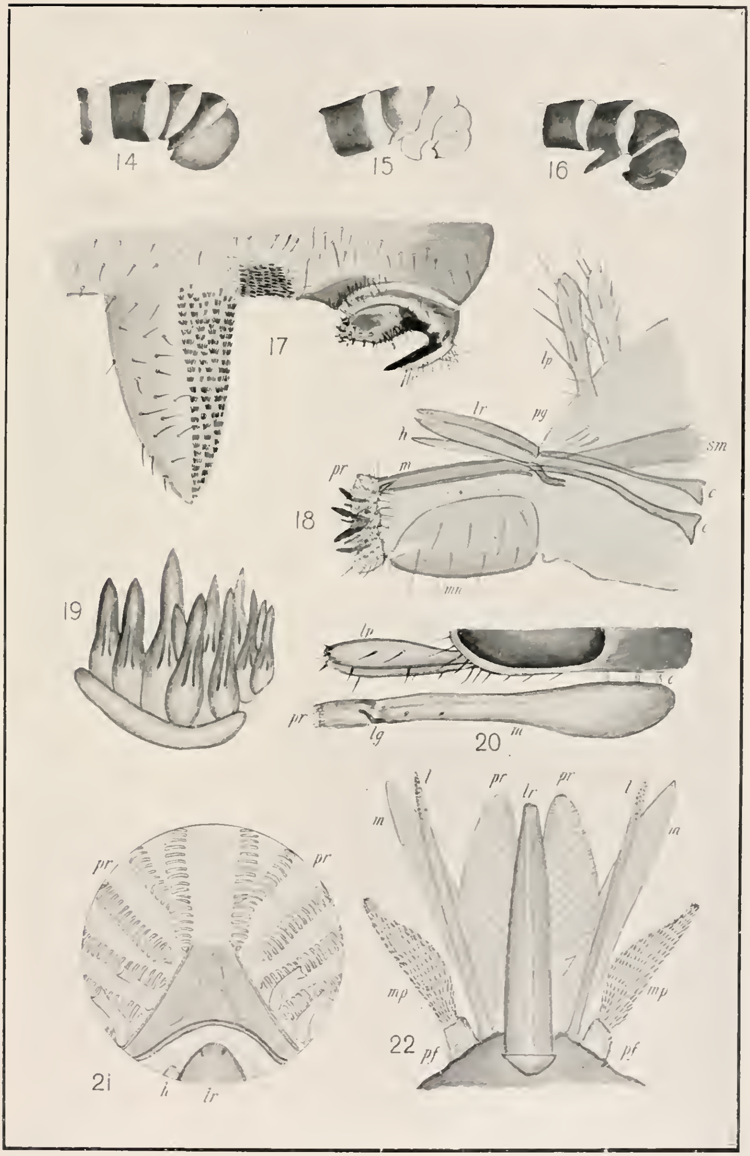
Fig. 18.—Trophi of *Norrellia spinimana* Fln. ♀. (The mouth does not differ in the sexes.) Raptorial type, to illustrate Rule 5. This insect is placed in the Cordyluridæ, and a lateral view is given of the trophi.

Fig. 19.—The teeth of *N. spinimana* drawn from a higher magnification. They are very strong and highly chitinised, and may be compared with those on the paraglossæ (labella) of the blow-fly (*Calliphora erythrocephala* Mg.).

Fig. 20.—Trophi of *Lyperosa* (?) ♀. This is a Sinhalese insect, and is, though much smaller, closely allied to our blood-sucking *Stomoxys,* the chief point of difference being the larger relative size of the palpi in *Lyperosa*; the male armature does not differ from that of the female. Blood-sucking Muscid type, to illustrate Rule 8. Lateral view.

Fig. 21.—Part of the paraglossæ of *Hydrotea occulta* Mg. ♂, highly magnified, to show the situation and character of the teeth characteristic of the general feeder. Armature identical in both sexes. To illustrate Rule 6. This insect belongs to the Anthomyia family, and the preparation shows the dorsal side uppermost.

Fig. 22.—Trophi of *Tabanus sudeticus* Zlr. ♀. The males are without the mandibles. A blood-sucker of the most pronounced type. To illustrate Rule 1. Dorsal view.



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at their bases, the insect is predaceous, as in *Scatophaga*, *Caricea*, and many of the Cordyluridæ.

6. When the mouth-parts are as in Rule 5, except that the teeth are transparent and less developed, the insect is a general feeder, but is not predaceous, as in *Calliphora*, *Musca*, or *Lucilia*.

7. When the labium is hardened into a style, or is geniculated, and tracheæ or traces of tracheæ can be made out, but no vestiges of teeth, the insect feeds on the juices or nectar of flowers, as in *Prosena* or *Siphona*.

8. When the labium is hardened into a style with no tracheæ, but more or less developed teeth, the insect is a blood-sucker, as in *Stomoxys*, *Glossina*, or *Melophagus*.

9. When special teeth or spines are found on the labrum or hypopharynx the insect is predaceous, as in *Dolichopus* or *Phora*.

N.B.—The mouth-parts differ in the sexes of the last-named family in several species that I have examined, but I do not commit myself to the statement that it is so in all the species, or that the females are predaceous and the males general feeders. So far as my observations go I have taken a small acalyptrate Muscid out of the mouth of *P. concinna* (?) Mg. ♂ and have found the mouth of *P. incrassata* Mg. ♂ simple, and armed as in Rule 9, in the female.

III.—The Contents of the Abdomen and the Food of Insects.

a. *Food.*—Most preparations of the whole insect will show food, or traces of food. When it is present in quantities, it is often forced, by the pressure necessary in mounting, back into the mouth, or through the weak membranes that are between the plates of the abdomen, through the ovipositor, or through the anus, giving an opportunity for examination better than that through the chitinous segments of the body. Also the membrane alluded to is often quite transparent, and permits a good view of detail, even with an oil-immersion. My attention was first drawn to this subject by a preparation of the female of the earwig (*Forficula auricularia* L.), which happened to have had a very full meal before being killed. The abdomen was filled with a confused mass of shreds of chitin, long-jointed stalks, and round reniform objects which were pierced with a number of holes. I had made some preparations of the aphides that I found in my garden, which also was the place of capture of the earwig, and I recognised the "jointed stalks" as the antennæ and the reniform masses as the eyes. I then looked for the tubes, characteristic of these insects, which exude the "honey dew," dear to the Formicidæ, and after careful search I found a number. I examined other *Forficulæ*, and in all I found this tube; I could then say with certainty that though the earwigs might damage our dahlias, they certainly helped our roses. Another earwig is full of debris, and scales of Lepidoptera can be recognised.

The food of the mandibulate insects is comparatively easy to identify, as the prey is broken up into large fragments, recognisable by comparison or experience. Before describing my observations of Diptera, I shall make some discursive remarks on a few other Orders. In all these insects the food is in various stages of digestion; the last stage seems marked by the presence of a black, finely-granular mass (occasionly only traces) in the abdomen, staining the intestine, and in some cases, the mouth. This colour is possibly a chemical reaction of the digestive fluids, with the various chemicals through which the preparation has been passed. I think, from my observations on this point, that it is highly probable that the process of digestion in all insects, whatever the nature of the food, is identical.

Remarks on Various Mandibulate Insects.

A mole cricket, *Gryllotalpa americana*, that came flying at the lights in a hotel at Cairns, North Queensland, has the abdomen full of shreds of neatly bitten vegetable, probably grass.

The larvæ of *Myrmeleon*, which had made their sandy traps on the borders of the Burdeken river, in the same part of Australia, show reddish masses, which our knowledge of the food of these creatures enables me to say is probably the digested blood or juice of insects.

In the Coleoptera, I am able to say that *Pterostichus cupreus* was decidedly carnivorous, as I found six antennæ of a Neuropteron, probably a Sialid, in its stomach.

One of the smaller water-beetles of genus *Rhantus* has half the head of a fly in the thorax, just before the gizzard, which I recognise as that of a *Chironomus*. That *Scolopendra* (centipede) is carnivorous is known, and I have a specimen which contains the antenna of a Coleopterous insect, probably one of the clavicorn beetles.

Cockroaches (*Periplaneta orientalis* L.), are, I believe, supposed to keep houses clear of other insect pests. I have a preparation of a female which has the remains of other cockroaches inside. These can be recognised by the peculiar sculpturing of the chitin, though broken up into minute pieces. This insect was one of a number kept in a trap all night. The person who caught them remarked that by the morning all the small ones had disappeared.

Of the Hymenoptera, a saw-fly (*Nematus* ♀) has the black stain alluded to as characteristic of the last stage of digestion.

A worker bee (*Apis mellifica* L.), of the Ligurian variety, had the abdomen full of several species of pollen.

Our common wild bee (*Bombus pratorum* ♀ ?), has some very large pollen granules inside, which are probably from the flower of the hollyhock (*Althæa*).

Hallictus leucozonus ♀, another wild bee, has made a meal of pollen, which, however, is partially digested.

The food of a wasp (*Vespa vulgaris*) was less easy to determine; it was a fine reddish, granular mass, which had cracked across. This is the way that albumen behaves when mounted in xylol and Canada balsam, and I conclude that some juices of animal or insect have been the staple part of its meal. There was also some debris in the thorax.

Of all insects the Odonata (dragon-flies) are the most voracious, and as they only partially break up their prey, it is comparatively easy to identify fragments; for example I recognised many portions of the wings of Diptera. This is a part that is often rejected; it is not an unusual sight to see a dragon-fly capture a moth, immediately followed by the slow flutter of the four wings to the earth, bitten off by the captor. I have a few preparations of these insects, which are from all parts of the globe; from an examination of the abdomen of these (there is not one that is not full of undigested food), I should think that the favourite meal is that on some dipterous insect, particularly the haunter of streams.

In *Orthetrum cœrulescens* F. I have seen some minute tarsi and claws that probably belong to small Ephydridæ, and I can recognise a tarsal joint, a base of an antenna, the characteristic interior tubes of the head, several parts of the wings, and part of an eye of an unfortunate *Chironomus*.

An *Archibassis*, from Borneo, has made a meal of a fly; I am able to say, from the character of one of the receptacula seminis, that the prey was a female, one of the large Muscid family, probably an Anthomyid; a part of the tracheæ of the labium, and several pieces of the eye are also recognisable.

An American insect from Indiana, U.S.A., *Enallagma civilis*, was very thorough, and, as might be expected from an inhabitant of the Great Republic, exhaustive in his method. He began the day on a *Chironomus*, then devoured a large larva of Lepidoptera (this last was interesting, as usually the prey is caught on the wing); and completed the third course of his meal with another fly. The caterpillar was easily identified by the claws of the prolegs, but the presence of pollen granules in the abdomen of the dragon-fly rather baffled me, till I saw that they must be the food of the larva, which, like its captor, was overtaken by fate soon after a meal.

I now turn to the more difficult part of my subject, the Diptera, though in this order I can offer a more comprehensive survey, as in my study of this branch over 1500 slides were examined with high powers, and often with a magnification of over 1000 diameters. The general appearance varies, but not more so than in other orders, and the fine black granule already alluded to, is present in the very large majority of cases.

In the Culicidæ, Tabanidæ, Glossinidæ, and Stomoxidæ, that are known blood-suckers, and whose mouth-parts are so modified that it is scarcely possible for them to obtain other food, that food, when digested, presents a certain character, rather like that of albumen, cracked and shrivelled up, and resembles in some degree that seen in *Vespa*. I found a similar appearance in one of my preparations of the house-fly (*Musca domestica* L.) caught inside the house, and concluded that she (it was a female) had been sucking the juices of raw meat, a highly probable occurrence. The pollen-feeders present no difficulties; their food is mostly undigested, the insects being caught on the flowers, and sometimes the plant on which the insect was feeding can be recognised by the characters of the pollen.

There is a group consisting of such flies as the house-fly, the blow-fly (*Calliphora erithrocephala* Mg.), and the green bottle-fly (*Lucilia*), which seem to feed on anything and everything, and the contents of their abdomens are baffling.

Repeatedly in certain flies, mostly inhabitants of fields or gardens, in the midst of the amorphous mass of digested food, little dark brown, semi-transparent, cellular organisms are seen. These, from a comparison with plates and descriptions, I should think are the spores of some of the "rusts" or "mildews."

Owing to the small size of the openings in the mouth, no large fragments can reach the stomach; I have, however, four

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EXPLANATION OF PLATE VIII.

Fig. 23.—Trophi of *Empis livida* L. ♀. The mouth-parts do not differ, and both sexes are predaceous. To illustrate Rule 2. Lateral view.

Fig. 24.—Trophi of *Platychirus manicatus* Mg. ♂. The mouth does not differ in the sexes. A pollen feeder, like all the Syrphidæ. To illustrate Rule 3. Lateral view.

Fig. 25.—Trophi of *Helomyza rufa* Fln. ♀. The mouth does not differ in the sexes. This insect is placed in the somewhat anomalous group of Heliomyzidæ, and is only representative of the flower feeders, and illustrative of Rule 4 as regards itself; some species of the genus differ in type. Dorsal view, and rather diagrammatically drawn.

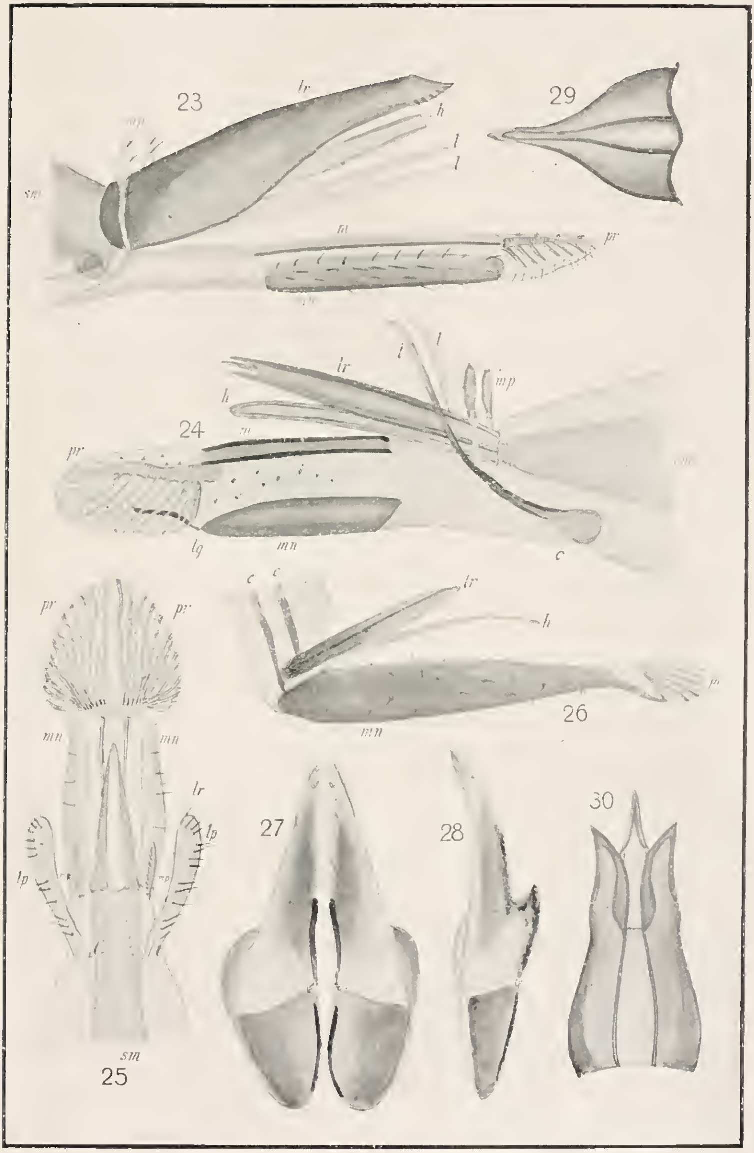
Fig. 26.—Trophi of *Conops quadrifasciata* Deg. ♂. The mouth does not differ in the sexes. The labium, chiefly by a modification of the mentum, has undergone changes, which have made it into a hard style, fitted to probe the nectaries and cavities of flowers. To illustrate Rule 7, and for comparison with Fig. 20 (*Lypcrosa*), which has undergone similar changes. Lateral view.

Fig. 27.—Labrum of *Pœcilobothrus nobilitatus* L. ♀. Dorsal view.

Fig. 28.—Labrum of *P. nobilitatus* ♀. Lateral view.

Fig. 29.—Hypopharynx of *P. nobilitatus* ♀. The mouth-parts do not differ in the sexes. *Pœcilobothrus* is a genus of the Dolichopodidæ, is predaceous, and is often seen on shallow brooks and streams, skating on the surface film. To illustrate Rule 9. Dorsal view.

Fig. 30.—Labrum of *Phora incrassata* Mg. ♀. This part is quite simple in the male, and without the sharp processes. To illustrate Rule 9. Dorsal view.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preparations of predaceous flies, *Empis livida* L., the Dolichopid *Medeterus truncorum* Mg., and the Cordylurid *Norellia spinimana* Mg., which contain the hairs and scales of gnats (*Culex*).

What will appeal to a section of my fellow microscopists is the fact that two of my preparations show that when alive they had a taste for the Diatomaceæ.

An unnamed Cænosid from Geelong, Vic., has three small *Naviculæ* inside; while *Scatophila despecta* Hal., a minute Ephydrid, has a whole collection, and is like a slide spread with *Pinnuliaræ* and *Naviculæ.* We may infer that they found their food in marshy spots, which, however, is already known of these two genera.

Remarks on the Food of Diptera.

MYCETOPHILIDÆ.—In *Glaphyroptera fascipennis* Mg. I find some digested pollen and the usual black granular stain.

BIBIONIDÆ.—In *Bibio hortulanus* L. ♀, the digested food appears to contain some very fine earthy debris, some of it quite crystalline. This is an appearance often met with.

In the male of the same species I can distinguish some pollen.

Dilophus (?), an undetermined or unnamed insect from New Zealand, shows spores of mould or mildew.

SIMULIDÆ.—In *S. reptans* L. the food is much cracked, yet not clearly characteristic of the blood-suckers.

CHIRONOMYIDÆ.—The abdomens of several species of *Chironomus* are full of pollen; the colouring in some species is affected by it. Another shows short fine rods of dark colour: these adhere in small bundles, and are unique in my observations.

In the intervening families, Ornephilidæ, Psychodidæ, Culicidæ, Dixidæ, Ptychopteridæ, Limnobidæ, Tipulidæ, and Rhyphidæ, my observations call for no record; traces of "black granule" can be seen in most.

STRATIOMYIDÆ.—*Beris vallata* Forst. ♀ and *Chloromyia formosa* Scop. ♂ show a dark, amorphous mass, of which little can be made, though the "black granule" is very marked.

CYRTIDÆ.—In two females of *Oncodes gibbosus* L. I find the intestine full of a dark mass; in two males, empty. Both sexes are absolutely without mouth-parts, the cavity being covered over with a membrane. This mass in the female is probably larval food, necessary to sustain her through the stages of maternity. The male I would expect to die soon after coitus.

EMPIDÆ.—*Rhamphomyia pennata* Mg. ♀ has some fine sediment with the black granule, and another female shows a minute spore of fungus or mildew. One preparation of *Empis chioptera* Fln. ♂ shows the intestines full of a very minute reddish, or reddish brown granule, rather dried up in appearance; this, by experience, I associate with the food of the predaceous insect; this observation is, however, contradicted by that on the next preparation in the point of colour, the granules being white and shining, and reflecting the light in the manner of starch. An almost identical appearance is seen on a preparation of *E. brunipennis* Mg.

A female of *E. livida* L. affords valuable data, as it contains digested and undigested food; the hairs and scales of a gnat (*Culex*), and a joint (probably of the palpus of a male) are quite recognisable, and the digested food has a reddish brown appearance of a finely granular texture; where the hairs and scales are thickest, the black colour is also present, combined with a more digested portion.

Dolichopodidæ.—The black stain in most of my preparations is very strongly marked. *Psilopa wiedemanni* Fln. ♀ shows pollen and spores of fungi. Another preparation has minute rods, also probably fungoid. The contents of the stomach contradict the character of the mouth, which has sharp teeth on the labrum, and is, on that character, raptorial, though the tracheæ of the labium are singular, and unlike that part in all other insects of the family.

Gymnopternus assimilis Staeg. ♂ has pollen in the stomach. The labium of these insects is longer than is usually found in the Dolichopodidæ, and they seem to have more of the characters of flower feeders than is the rule in the species of this family. Their mouth-parts appear to be intermediate between the ordinary and a specialised type. There is one species—*Orthochile nigrocœrulea* Ltr.—that has quite a long labium, obviously modified to enable the insect to reach the nectary of flowers.

Medeterus truncorum Mg. ♀ has, like *E. livida*, hair and scales of *Culex* inside.

Another species contains a greenish mass, which, however, seems to be mixed with albumen.

Two preparations of *Campsicnemus curvipes* Fln., male and female, show a somewhat similar appearance to *E. livida* in the digested part.

Lonchopteridæ.—*L. flavicauda* Mg. ♂ is quite full of transparent, structureless filaments, long, cone-shaped, and tapering, which I have not met with in other insects, and are probably the mycelium of some fungus or mould; the other specimens of the same insect only show the black granule.

Platypezidæ and Pipunculidæ.—I cannot arrive at definite conclusions as to what I find in my preparations of these insects.

Syrphidæ.—*S. balteatus* Deg. and *S. ribesii* L., like most of my preparations of the insects of this family, show an immense mass of undigested pollen.

S. ortas Wk., a New Zealand fly, has the same, with much the same size in the granules, but a careful inspection shows an unfamiliar detail in the sculpturing.

There are some pollen granules of willow-herb (*Epilobium*), mixed with a greater number of that of other flowers, in the abdomen of *Syritta pipiens* L. ♀.

Two preparations of *Erystalis arbustorum* L. show a mass of partially digested pollen and also a great number of black debris, broken up into large pieces, and occasionally somewhat crystalline forms.

CONOPODÆ.—Most of my preparations only show digested food, but *Myopa buccata* L. shows some pollen granules.

ŒSTRIDÆ.—I find nothing in the abdomen of *Gastrophilus equi* L. ♂, as might be expected from the fact that in this insect the mouth-parts are nearly totally absent.

TACHINIDÆ.—*Oliviera lateralis* F. ♀ shows a unicellular growth of low type—it may be a fungus that grows in the balsam, defying caustic potash and acetic acid. Another ♀ shows a few pollen-grains, and the jaws of larvæ, showing her to be viviparous.

As might be expected from the trophi, which are modified into long styles for probing the nectaries of flowers, the abdomens of *Prosena* and *Siphona* show nothing.

MUSCIDÆ.—I have a preparation of *Stomoxys calcitrans* L. ♂ which gives a good example of digested blood; very often the abdomen is empty. A female bit me on the ankle, through a merino sock, in September last. I drove her off, but she returned to the same spot, and I placed the cyanide bottle over her. The short labium of this insect is scarcely fitted for penetrating through clothing.

One preparation of *M. domestica* ♀ shows the appearance of having fed on the juices of meat, and has already been alluded to; another ♀ shows an amorphous mass, which has some angular fragments of a dark colour; while a third, ♂, shows a conglomerate of circular dark bodies, which are probably partially digested pollen-granules.

Calliphora graenlandica Ztt. shows the usual dark granular mass.

Lucilia (?) has a number of angular black bodies, and a fewer number of fragments of what appears to be chitin, mixed with the usual mass.

Morellia curvipes Mcq. Both sexes of this insect show a mass of pollen, one or two black pieces, as in *Lucilia* above, and a reddish mass of digested food. These were captured in a hayfield in June.

ANTHOMYIDÆ.—*Polietes lardaria* F. contains a granular dirty mass and very minute shining granules of pollen (?). Captured in Epping Forest, where all the flies were covered with it.

Hyetodesia læta Fln. ♀ shows a peculiar yellowish mass, which contains an immense number of objects, chitinous in colour and transparency; some are boat-shaped, others round, many appear to be cells joined to each other—they have not the form of the mould or mildew alluded to before. They may be the spores of fungus.

H. obscurata Mg. ♀ shows a dark red cracked mass.

H. perdita Mg. ♀ shows usual dark mass.

H. pallida F. ♀ shows the same, with the black stain, a number of large angular black pieces, several spores, and one scale of Lepidoptera.

A curious male fly from New Zealand, with pubescent eyes but *Cœnosia* teeth on the labella, and claws and legs resembling *Caricea tigrina* F., has red cracked flocculent matter in the stomach, and is probably predaceous.

Two preparations of males of *Spilogaster communis* Dsv. show a number of unicellular rod-like spores; one also the larva or pupa of a parasite.

S. flagripes Rnd. ♀, among a large mass of the usual type, shows four large pollen-granules.

S. uliginosa Fln. ♂ contains a number of minute granules, quite reniform in appearance, shining, and having the appearance of starch.

S. notata Fln. ♀ shows separate pollen-granules of large size. The very strong chitinous teeth, the long hypopharynx, the spined fore femora, and the situation where I captured this insect (a marshy spot), all point to its being similar in habits to *Caricea tigrina*; as I shall show later, I also find pollen in that insect, and on the whole I think *S. notata*, unlike the other species in the genus that I have studied, is predaceous—at all events, occasionally so.

A male of *Hydrotea meteorica* L., from Jersey, shows reddish masses of semi-digested food; a higher power resolves and separates these into minute circles with a dot in the middle.

Three preparations of *H. irritans* Fln., a male and two females, all show digested food and pollen. What the object of the females is in buzzing round man on hot days is not at all obvious. The male is, as far as my experience goes, never in these crowds.

H. dentipes F. ♀ is of interest, as it shows pollen and digested material, the usual granular mass, with broken up black fragments, and, in addition to these, some unicellular vegetation similar to that in *Oliviera*.

EXPLANATION OF PLATE IX.

Fig. 31.—Photograph of part of abdomen of *Forficula auricularia* (Earwig), showing the fragments of *Aphides* (plant lice) in the stomach.

Fig. 32.—Photograph of part of abdomen of Odonata (Dragon fly), *Enallagma civilis*, showing the fragments of a fly (*Chironomus*) in the stomach.

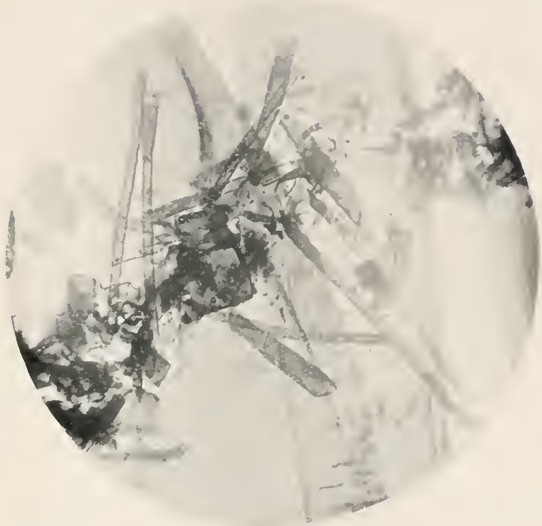


Fig. 31.

Fig. 32.

W. Imboden, photo.

Ophyra leucostoma W. ♂ shows dark reddish lobular masses, some of which seem to be made up of the same material as that in the intestine of *H. meteorica.*

Drymia hamata Fln., as I would expect from the character of the mouth, shows pollen. In these flies the paraglossæ of the labium have been elongated, and the tracheæ simplified, but not so much modified as in *Siphona.*

Hylemia strigosa F. ♀ is quite full of spores of fungus.

Lasiops ctenoctema Kow. ♂ has the abdomen full of a dark mass, with black angular fragments similar to that in *H. dentipes* ♀ and others.

The two sexes of *Anthomyia pluvialis* L. show pollen and the black stain.

The food in *A. radicum* is very quickly digested, as, out of twenty preparations, in only two was the food present in any quantity; the black granular stain was very constant, and in the abdomens of four I found black angular debris, and one single spore.

Homalomyia scalaris ♂ shows masses of minute pollen.

H. canicularis L. ♂ shows a fine yellowish granule. This insect was caught inside a house in Maida Vale, and the contents of his stomach are not without traces of albumen.

H. incisatura Ztt. ♀.—Many black fragments, and digested food in nodules.

Caricea tigrina F. ♀ shows digested food which seems albuminous, but also a number of rather large pollen-granules. Two males from the borders of the New Forest have no pollen, and what little food is present is of the appearance seen in *E. livida.*

Hoplogaster mollicula Fln., a male from Jersey, shows an intestine, or rather stomach, as it is swollen into a large bulb, full of transparent, long filaments, of a low vegetable nature (mycelium of a fungus ?). A female from the same place has well-digested food of a dark colour, and a few separate filaments, which appear to be a series of minute cells, and probably are spores of a fungus. A second female has obviously been feeding on the same food as the male. A male from the New Forest is, unfortunately, quite empty. Another female shows some hairs, which suggests that this species is occasionally predaceous.

A Cænosid from Kineton, Victoria, shows pollen-granules and some semi-lunate bodies that are strange to me.

Another, from Geelong, Victoria, shows a scattered mass of debris, with some small crystals and one or two diatoms.

Cordiluridæ.—*Scatophaga stercoraria* L. var. *Merdaria* F. ♂, and all the Scatophagidæ, show digested food much like in appearance to that found in *Empis livida*; this particular male has also a minute cluster of reniform, shining cells, and a spore of fungus or mildew.

Four preparations, two of *S. lutaria* F. and two of *S. stercoraria* L., show what, by comparison, I consider the digested juice or blood of insects. These insects are fiercely predaceous, but I have found them in numbers on the blossom of the Ivy (*Hedera*) in the autumn, but whether to feed, or from their interest in the other flies, who are even more numerous, I am not absolutely certain.

I think I can distinguish a little animal debris, hair, etc., in the excreta of a *S. lutaria* that I collected in Jersey.

A male and female of *Fucellia fucorum* Fln. both show an appearance similar to that seen in the Scatophagidæ. Another shows some curious minute circles with a dot in the middle when the thinner parts of the intestine are examined with the higher power.

A female of *Norellia spinimana* Mg. shows a few hairs clustered into a bunch, while a male of the same species has the abdomen full of masses of hair and a great number of scales of a gnat (*Culex*) or gnats. These are in greater number than in *E. livida*, already described, and in masses, while in the female and in *E. livida* they seem to be in pellets. It is interesting that in Prof. Poulton's paper,* there is no mention of Culicidæ as prey, or of *N. spinimana* as predaceous, though there are twenty records of different insects, mostly Diptera, being captured in the grasp of *E. livida*.

HELIOMYZIDÆ.—*Helomyza rufa* Fln. has been feeding on small-sized pollen, while *H. similis* shows a preference for larger. Of a female of this genus, I can reconstruct the following history:—She was very young, as not only are the wings perfect, but the insect is virgin, not having been impregnated; this can be seen by the receptacula seminis, which are quite clear and empty. While feeding, or possibly immediately after emerging from the pupa case, she had been attacked by a small ichneumon, which

* Predaceous Insects and their Prey. Prof. E. B. Poulton, F.R.S., Trans Entom. Soc., London, Jan. 23, 1907.

EXPLANATION OF PLATE X.

Fig. 33.—Photograph of another part of the abdomen of Odonata (Dragon-fly). *E. civilis*, showing fragments, particularly the jaws of Lepidopterous larva.

Fig. 34.—Photograph of part of the abdomen of a Hawk or Hover fly, *Syrphus balteatus* Deg. ♂, showing pollen-grains in stomach.

Note.—The following letters are used in the mouth-parts throughout the plates.

m.	Mandible.			
l.	Lacinia.	Maxilla.		
g.	Galea.	Maxilla.		
mp.	Maxillary palpus.	Maxilla.		
pf.	Palpifer.	Maxilla.		
s.	Stipes.	Maxilla.		
c.	Cardo.	Maxilla.		
pr.	Paraglossa.	Labium.		
lg.	Ligula.	Labium.		
lp.	Labial palpus.	Labium.		
pg.	Palpiger.	Labium.		
mn.	Mentum.	Labium.		
sm.	Submentum.	Labium.		
lr.	Labrum.	Labium.		
h.	Hypopharynx.	Labium.		

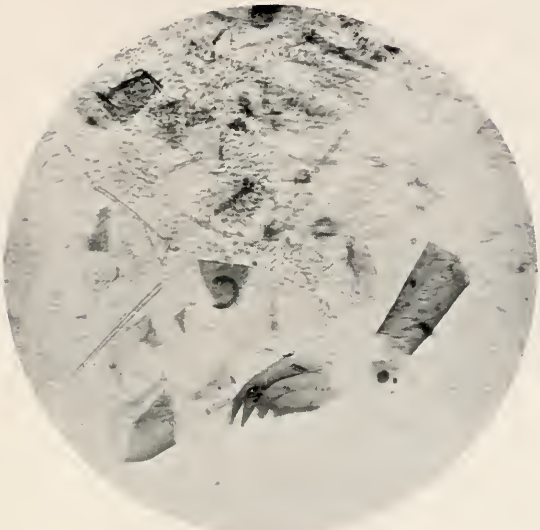


Fig. 33.

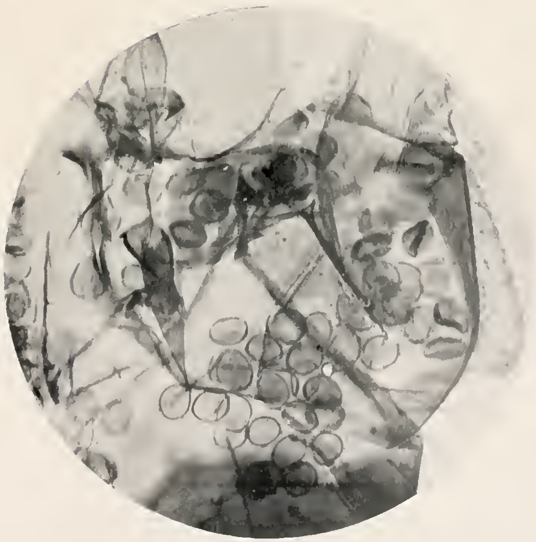


Fig. 34.

W. Imboden, photo.

laid eight eggs in the thorax, where they can still be seen *in situ.*

SCIOMYZIDÆ.—*Tetanocera lævifrons* Lw. is quite filled with digested food, and the lower part of the intestine shows much black stain.

ORTALIDÆ.—*Pteropæctria nigrina* Mg., *Seoptera vibrans* L., and *Ulidia nigripennis* Lw., show the black granular remains, but no undigested food.

TRYPETIDÆ.—*Acidia lychnidis* F. shows pollen, and the intestine is much stained with black.

Tephritis formosa Lw. ♂ has a particularly long intestine, much coiled, and full of nearly digested food.

LONCHÆIDÆ.—*Lonchæa nigrimana* Mg. is full of pollen, and all the members of this small family are flower haunters.

SAPROMYZIDÆ.—The flies of this family are mostly full of debris of various kinds, with large fragments of black or chitinous-looking material. It is interesting that a *Lauxania* from New Zealand has an identical appearance.

In addition to this, *Sapromyza fasciata* Fln. shows the spores so often met with. Another undetermined *Sapromyza* also shows a number of spores.

The debris in *Lauxanea ænea* Fln. is large, and there are some crystals.

L. bilineata Hutton (N.Z.) also shows a similar type of digested food. Some of the crystals in *L. decora* Schiner (S. Australia) are green.

SEPSIDÆ.—*Sepsis cynipsea* L. shows the usual black granular stain and some digested food.

EPHYDRIDÆ.—*Parhydra coarctata* Fln. has varying appearances; one shows a very fine mass of conglomerate, with larger pieces of chitin (?), and others black in colour and angular in form. Another quite different, rather like dried blood. A third with the intestine full of conglomerate.

Scatophila despecta Hal. shows many diatoms, *Pinnuliaria* and *Navicula.*

BORBORIDÆ.—*Borboras equinus* L., male and female, both show a large granule and reddish nodules in the intestine.

B. geniculatus (?) Mg. ♂ shows some very minute reniform granules, besides the usual mass.

Limnosina fuscipennis Hal. has all the abdomen full of larger, milky white, kidney-shaped pollen.

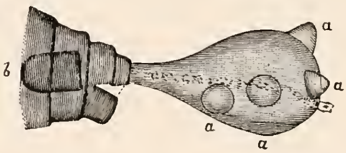
PHORIDÆ.—*Phora rufipes* Mg. ♀ shows the cracked dried-up appearance that I associate with albumen. There is little doubt that some of these flies are predaceous. An undetermined *Phora* from New Zealand also shows this appearance in both sexes.

HIPPOBOSCIDÆ.—A Nycteribid shows blood in quite an undigested state (*N. Hermanni* Leach).

The Contents of the Abdomen.

B. *Structure.*—I shall now make some remarks on the structure found in the abdomen, regarded more especially from the point of view of the microscopist. The containing membranes of the intestines, and of the various complicated glands that surround the stomach, are so soluble that they seldom or never show in preparations fitted for high powers. However, the following parts are often visible :—(1) the gizzard, or crop ; (2) the rectal papillæ ; (3) the breathing tracheæ and the stigmata ; (4) the eggs or larvæ or pupa ; and (5) receptacula seminis or spermathecæ.

1. The gizzard is an elaborate and interesting structure in many insects. In our large grasshoppers it is scarcely a microscopic organ ; in the earwig (*Forficula*) it consists of two arms studded with rows of sharp hooks ; in the cockroach (*Periplaneta*) it is, though chitinous, more muscular and is adapted for crushing, not tearing. All can be easily found in preparations. Nothing similar exists in the flies, but an organ composed of a number of



a. Papilla. *b*. Receptaculum.

FIG. 114.—Rectal papillæ of *Hydrellia griseola* Fln. ♀. The delicate membrane is the anal extremity of the intestine. In the process of dissection it has been forced out of the anus, and consequently reversed ; normally, the apices of the cones of the papillæ are on the inner side, but I have drawn it just as I saw it. This figure also shows the single receptaculum seminis that is found in this fly, which, moreover, is remarkable, as the mouth contains a complete maxilla.

filaments, springing from a central tube, is often met with in the calyptrate Muscidæ. This is the chyle stomach. The crop or gizzard can be differentiated in the blow-fly (*Calliphora*), though to see it special dissection is necessary ; it is not likely to appear in preparations, such as the other observations can be made from. A somewhat similar organ is found in the abdomen of the fleas (Pulicidæ).

2. The rectal papillæ will often be met with pressed out of the anus. In some Diptera they have minute scales ; this is most marked in the *Dolichopodidæ*, the "fan-tailed flies," where microscopists will find them mostly in the abdomen or in the ovipositor. I give a figure of them as they are found in a minute Ephydrid, *Hydrellia griseola* Fln. This was drawn from a dissection : it is seldom these organs appear so clearly.

3. The tracheæ are often dissolved away by the potash, but

good preparations can be secured by careful watching, taking the insect out of the solution immediately the chitin is thoroughly softened and will not crack with pressure. They are beautiful symmetrical objects, and can be easily traced to their openings, the stigmata, particularly in the longer ovipositors, where the membrane is transparent. The stigma has a minute apodeme or lever to control its aperture; this lever in the flies undergoes great changes in appearance, so that it is occasionally possible to find the place of an insect in the classification by a sight of this part alone.

4. Eggs will often be met with in various stages of development. In *Periplaneta* the capsule that contains them can be seen, but certainly not recognised, as it appears as a mass of folded chitin.

When eggs are present in the flies, the abdomen is full of them; the receptacula seminis in some species are egg-shaped, but are usually only three in number and can thus be distinguished, but the beginner is very likely to take them for eggs.

5. Larvæ when present will always show, as their jaws will

Fig. 115.—Jaws of the larva of *Lucilia sericata* Mg. These larvæ infest the fleeces of sheep. Most of the larvæ in the Muscidæ have the trophi of this type.

not dissolve. There are many species of the large Muscid family that are viviparous, and a slide with the jaws of the larvæ showing in the abdomen will absolutely settle this point in the life-history. I have preparations of *Oliviera lateralis* F., *Plagia trepida* Mg. and *Phorocera serriventris* Rnd., showing these jaws. In the latter case a problem at once presents itself. The female has a remarkable ovipositor, of which the principal part is a curved hook turned in under the abdomen. (Not at all resembling in arrangement this part as found in the Pipunculidæ.) The question arises, to what use does an insect put an ovipositor when that insect does not lay eggs?

One day a field naturalist will notice this fly boring holes in something that will contain food, or abraiding with the under surface of the abdomen some leaf or plant and depositing larvæ. The edges of the plates on the under side of the abdomen are spined (hence Rondani's name). This elaboration exists for some very specific purpose, but here the limitations of what I may call the "arm-chair method" come in, and we must wait for the field naturalist to solve the problem. Even here the Microscope affords a clue that may suggest a solution. The "scent pits" on the antennæ of the female are unusually numerous and well developed —far more so than in those of the male.

The "scent pits" on the antennæ of many of the Ichneumonidæ are very large and regularly disposed on each of the numerous joints. Mr. C. O. Waterhouse, Pres.E.S., told me that he has watched the females of certain species using the antennæ to detect the presence of larvæ living under the bark of the smaller branches of shrubs; this was obviously done by scent, and when the insect was satisfied of the presence of its prey the ovipositor was brought into play and eggs laid in or near the unfortunate host. It is well known that the larvæ of the Tachinidæ in which family *Phorocera* is placed, live on the larvæ of other orders, and even on the larvæ of a species of fly (*Sciara mali* Fitch). It therefore appears probable that the host of *P. serriventris* is some insect that burrows into wood or other substance, and the ovipositor and the highly specialised scent-organs (dependent on each other for successful

Fig. 116.

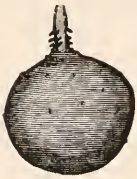


Fig. 117. Fig. 118.

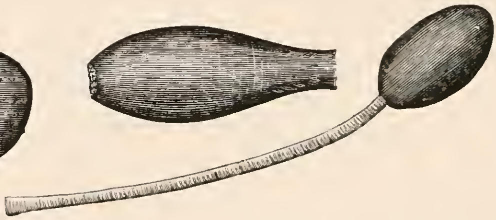


Fig. 116.—Receptaculum seminis of *Conops flavipes* L. Four are found in this insect; actual size, circa 200 μ.

Fig. 117.—Receptaculum of *Chrysopillus aureus* Mg. Three are present in this insect; actual size, 130 μ.

Fig. 118.—Receptaculum of *Beris vallata* Forst. Three are found in this insect, and each have the long tubular attachment figured; these organs in the Tabanidæ and Asilidæ have similar appendages. Actual size of bulb, 100 μ.

application) have developed, giving *Phorocera* particular advantages, possibly the monopoly of a species, for the food of its larvæ.

These flies were quite common in a garden in South Hampstead in the month of June.

6. The pupa will be found in the abdomen of the Hippoboscidæ, those remarkable flies which have been so modified that they pass through the larval stage in the abdomen; it is but seldom that a specimen shows this.

7. The receptacula seminis may be regarded as part of the female genitalia, but for convenience I will make what few remarks I have to make here. I am only acquainted with these organs in Diptera. They vary remarkably and inexplicably, not only in number (from one to four) but in sculpturing and shape, species differing from species. In groups like the Anthomyidæ, where

sexual dimorphism is commonly found, the females are very difficult to distinguish, and I have been able to separate female insects by a comparison of this part.

When I say "inexplicably" I do so advisedly, as in what manner the various setæ, points, tubercles, folds and differences in shape can influence any particular species is at present an enigma; variations in genitalia are a check on hybridism, but how do these modifications further that end?

IV.—The Genitalia.

I have treated this subject at some length in a former paper,* to which I refer those who wish to pursue this difficult subject.

The study of these organs is of great use in the separation of species. The microscopist who has seen that the genitalia are identical, is not confused by the variability in colours, however remarkable, or deceived by the similarity of appearance so perplexing in the Sarcophagidæ or the Lucilidæ, and in so many Lepidoptera.

Summary.

I have several times mentioned facts that may be very ancient history to the entomologist, but are useful to the microscopist of average experience. But besides this, I have collected a number of observations that I submit are, at all events, out of the beaten track, and I shall enumerate these in the order in which they occur in the paper.

1. Modifications in the general structure that are guides as to the habits of insects are discussed. Figures of various types of limbs are given in the plates.

2. A number of the comparatively rare secondary sexual characters in the female are given, confined however, to the Order of Diptera.

3. General rules are formulated for finding the nature of the food from the characters of the mouth-parts, also confined to the same Order. Figures of the various types to illustrate the rules are given in the plates.

4. A number of observations of the food of various mandibulate insects belonging to other Orders are given, and illustrated by photography in the plates.

5. The appearance of digested food in various insects is discussed, and suggests that an identical process of digestion occurs in all Orders, and in all habits (predaceous or otherwise).

* "The Genitalia of Both Sexes of Diptera." Trans. Linn. Soc. Ser. 2 (Zool.) ix., Part 10, July 1906.

6. Recognisable remains of prey are found in a number of mandibulate insects.

7. Also in a few Diptera.

8. Remains identified as scales and hairs of *Culex.*

9. The food of non-predaceous flies is discussed, and in one or two cases the pollen is recognised.

10. Food which must have been eaten in the larval stage is found in the abdomen of the female imago of *Oncodes gibbosus* L., and not in that of the male.

11. Spores of rust or mould, or mildew, are found in the intestines of many Diptera, from New Zealand as well as England.

12. Larvæ are found in the abdomens of several viviparous flies—*Phorocera, Olivicra,* and *Plagia.*

13. Differences are noted in the armature of the mouth of the males and females of some Phoridæ.

Methods of Work.—I use a $\frac{2}{3}$ in. for general, and a $\frac{1}{7}$ in. capable of working at a long distance, for particular examination. With them I use a powerful substage condenser (the ordinary Abbe is not sufficiently powerful). A $\frac{1}{10}$ oil-immersion, with a tube-length of 25 mm., is occasionally employed.

Examination through the slip is sometimes necessary, when the part desired to be seen is on the under side of the preparation; an eye-piece of high magnification is used with the $\frac{2}{3}$ in., and answers very fairly well. The satisfactory working of these objectives entirely depends on the substage illumination; the condenser must be powerful, and the iris diaphragm carefully used, as the objects focused are often on the surface, or even between plates of only semi-transparent chitin.

In conclusion, I have to express my great obligations to Mr. Walter Imboden, F.R.M.S., for his most valuable assistance in so kindly photographing the abdomens of various insects.

XIII.—*Illuminating Apparatus for the Microscope.*

By J. W. Gordon.

(*Read June* 17, 1908.)

The illuminating apparatus which is this evening exhibited has been designed as the result of experience gained in working with very high powers. But it is believed that it will be found to comprise several material improvements upon present forms of apparatus even for use with ordinary magnifying powers.

For successful illumination of the stage of a Microscope it is necessary that the operator should have control over (1) the brilliancy of the light; (2) the form of the luminous disk which constitutes the source of light; and (3) the angle under which the light is incident upon the object. It is further important that the light source, when in focus, should be a featureless disk, and that all the adjustments relating to the points above enumerated should be susceptible of being independently made.

These points may best be illustrated by taking notice of the defects exhibited by the various sources of illumination in common use.

To take, first of all, the ordinary paraffin lamp. The great defect of this light source is that it is too feeble for use with very high magnifying powers. With ordinary magnifications, however, its brilliancy is abundantly sufficient. But here its shape is faulty. The side of the flame is unsuitable for use, because its luminosity and colour vary in different parts of its area. This defect may, indeed, be made good by placing a perforated diaphragm in front of the flame, and using only a selected part as the effective source of light. In that case, however, if a uniform source of light is to be obtained, it is necessary to limit the exposed surface to such a small area that an equal breadth of light-source can be obtained by placing the flame end-on to the Microscope—and this, in fact, is the plan adopted in practice by all experienced microscopists. It has the additional advantage of presenting the flame with its long axis in line with the optical axis of the instrument, with the result that the light is concentrated, since to some extent the remoter parts of the flame shine through the nearer parts, which are not entirely opaque to the flame-light.

For use with high powers a source of light having an elongated form is, however, very unsuitable, for a reason which will be easily understood by reference to the annexed diagram (fig. 119). Here the optical system of the Microscope is represented by its Gauss planes. Now let us suppose that for the due delineation of a particular feature in the object it is necessary to throw the light-source slightly out of focus with the object. Then, the image of the light-source being focused, say at P_1 $\frac{1}{20}$ in. short of the object, another image, conjugate to this, will be formed at the point marked P_2 in the diagram, which lies at about $\frac{1}{400}$ in.* behind the eye-point R of the instrument, it being assumed that the Microscope as a whole has a magnifying power of 1000. It will, of course, follow that this image of the source of light will be interposed between the eye-lens of the Microscope and the retina of the observer; and therefore, upon the principle first explained by Helmholtz, the effect upon the image, so far as diffraction is concerned, will be the same as if a diaphragm were interposed at that point in front of the observer's eye, having an aperture of the same form and dimensions as the image of the flame. Those

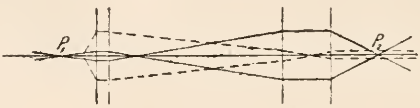


Fig. 119.

dimensions are easily calculable. But as it is only the breadth which now concerns us, it will suffice to obtain a notion of the breadth of this post-ocular image of the lamp-flame. Assuming the original lamp-flame to have a breadth of $\frac{1}{16}$ in., its image at P_1 would, with a $\frac{1}{4}$-in. condenser, have a breadth of about one-thirtieth of that quantity, amounting, say, to $\frac{1}{500}$ in. The second image, formed at P_2, may be supposed to have a breadth of about one-quarter of this amount, so that the image of the lamp-flame formed over the eye-lens of the instrument would have a diameter of about $\frac{1}{2000}$ in. It is well known that the diffraction produced by an aperture of such dimensions is very serious, and in fact it is found quite impossible to obtain a well-resolved image of fine detail under these conditions. Experience has shown that what is known as "critical illumination" is necessary; that is to say, the edge of the flame must be accurately focused in the plane of the object, so that its image may everywhere coincide with the image of the object and there may be no diffracting aperture interposed between the eye-lens and the observer's retina. Hence it is in practice found impossible to use a lamp-flame for critical

* This, perhaps, is stated too rigorously, the position and dimensions of the image being variable within comparatively wide limits in different optical systems. But as the case actually put is one that might very well occur in practice, it may serve the purpose of illustration.

work under other conditions than those of precise focusing on the stage of the instrument; and the very considerable advantage of being able independently to control the brightness of the illumination and the angle at which the light shall be incident upon the object, is lost. This is, in fact, a more serious difficulty than is commonly supposed in the way of high-power microscopic work; and what has here been stated in reference to the lamp-flame applies, of course, with added force to such sources of light as electric lamp filaments or Welsbach mantles. The diffraction which they produce when thrown slightly out of focus makes them wholly useless under those conditions of working, and the contraction of the illuminated field when they are in focus makes them entirely unsuitable for the purposes of critical illumination.

This difficulty has in practice been met by placing ground-glass between the source of light and the condenser. So long as the ground-glass remains out of focus it forms a most excellent light source. But if it is brought into the position in which it yields

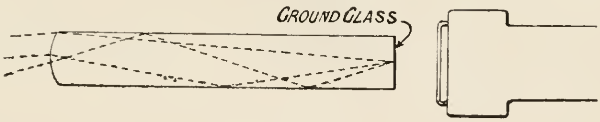


Fig. 120.

the brightest field its grain becomes conspicuous, and of course destroys the image. For this reason a flame or filament covered with ground-glass, in the usual way of employing that medium, has only a very limited application in microscopy.

The two great difficulties, then, against which provision has to be made in devising a source of light for the Microscope are (1) diffraction due to the post-ocular image of the filament when a glowing filament is used; and (2) the loss of light and intrusion of the grain when a diaphanous screen is employed to diffuse the light from the primary light source.

Both these difficulties are met by the use of the speculum exhibited this evening. The apparatus consists, as shown in fig. 120, of a glass rod, one end of which is cut to a plane surface and finely ground. Such a surface can be very strongly illuminated, for it will bear exposure to very intense radiant heat. The small size and symmetrical form of the exposed surface render it singularly tolerant of this particular kind of hard usage, and the very considerable conducting power of the glass rod prevents it from being easily heated to fusing-point. It may thus be placed with perfect safety within $\frac{1}{8}$ in. of a Nernst filament, and in that way it can be made to receive a very intense illumination. In the illuminating apparatus now under description this ground-glass surface becomes the effective source of light. It is a very convenient light source, because its brilliancy can be varied within wide limits, and very simply. By varying the distance between the filament and the ground-glass surface, the luminosity of the latter can be rapidly and greatly altered, since it varies inversely with the square of the distance between the filament and the ground-glass film. The light which in this way enters the glass speculum is transmitted almost intact by total internal reflection along the length of the glass rod. If a glass be chosen which has low absorbent power and is free from optical defects, the illumination is almost constant at all points of the speculum. The optical system of such a speculum presents some very interesting features, but its discussion would demand more space than can be allotted to it in this paper. It may suffice here to say that these internal reflections give rise to a figure in which a central disk of light is seen surrounded by a succession of luminous rings concentric with it, the illumination falling off gradually towards the edges of the pattern. The diameter of the central disk and of its concentric rings is, of course, determined primarily by the diameter of the rod. Its appearance, however, is dependent equally upon the magnifying power under which it is viewed. A rod of about ½ in. diameter yields a disk of very serviceable size.

The glass speculum, which is conveniently made about 6 in. in length, but may be of any required dimensions, is mounted in a carrier which holds it in a horizontal position, and is provided at the end opposite to the ground-glass already described with a polished surface, flat or lenticular in form, according to the user's requirements. The use of a lens, when the end of the rod is shaped to a lenticular form, is to focus the condenser short of the ground-glass at some point in the rod where the speculum pattern is of a convenient size. By speculum pattern I mean the appearance of the light source when some plane in the interior of the speculum is chosen as the source of light. The speculum pattern has the same general character of a luminous central disk surrounded by bright rings, as the ground-glass seen with the aid of the speculum. But in the speculum pattern itself there is no visible grain of the ground-glass. This results from the circumstance that the light at any point within the speculum is supplied by rays coming from various points upon the ground-glass. The features of various points of origin therefore are combined, with the result that the luminous patch is as structureless as is the flame of an oil lamp. We have, in fact, a diffusion similar to that which results from throwing the ground-glass out of focus; but the use of a cylindrical reflector secures at the same time that there shall be no corresponding loss of light or loss of angle, since the light which would, if unreflected, have become diffused over a broad wave-front, is here condensed by reflection into the original and unvarying area.

We thus obtain a light source which is structureless, and which, as we have already seen, can be made to vary indefinitely in intensity.

The rest of the apparatus can be very briefly described. To the polished end of the speculum are fitted stops of various forms and sizes for the purpose of giving any required shape and dimensions to the light source. The fittings in which the burner and speculum are carried are made adjustable in height for the purpose of collimation, and the whole is placed upon a convenient stand adapted to hold the various parts in due relation to one another, while permitting the requisite freedom of motion.

It will, of course, be understood that this speculum can be used not only with a Nernst lamp, but with any form of illuminant. Filamentous lamps, like the Osram and Tantalum lamps, which burn with very high brilliancy, are equally available, although, as these lamps are ordinarily made, their filaments, being inclosed in a glass envelope, cannot be brought into such close proximity to the ground-glass end of the speculum as the Nernst lamp, which burns in the open. Whatever the form of the primary source of light, the speculum pattern retains its even illumination and symmetrical figure, with the result that, whether focused in the plane of the object—that is to say, under the conditions of what is commonly called "critical illumination"—or not, the diffracting aperture is of circular form, and therefore yields a symmetrical antipoint, producing the best image which any Microscope with which it may be used is capable of yielding.

XIV.—*Corethron eriophilum* Castr.

By Edward M. Nelson.

(*Read June* 17*th*, 1908.)

During the examination of a strewn slide this diatom was found. Critical examination showed that the "awns," or bristles of the "broom," had minute secondary spines arranged spirally round them. These secondary spines, though quite conspicuous in other varieties of this and kindred species, have not been previously observed on this variety. These secondary spines are not like the short thorns upon a *Bacteriastrum*,* but they more resemble the spines upon the hair of a *Polyxenus Lagurus*. They are minute, being much about the size of a flagellum of a bacterium.

It is not on account of the insignificant biological importance of the discovery of these small secondary spines that this note is brought before you this evening—nevertheless, it is as well that an organism should be figured as correctly as possible—but from a microscopist's point of view this diatomic structure does possess some importance, for not only is it an excellent test object, but it will, better than almost any other object, enable a microscopist to discriminate between the various competing methods of illumination. There can in this case be no doubt about the structure: no question can possibly arise as to whether it is a hole or a boss, a puncta or a pearl.

In this object the focus for the white dot image is longer than that for the black dot. The thickness of the "awns" is 0·000006 inch plus 0·000003 for antipoint correction = 0·000009 inch, or 0·23 μ. It is then an interesting question if this structure can be better seen with a small or large axial cone of transmitted light, or upon a dark ground obtained, by the lately revived oil immersion paraboloid, by Mr. Gordon's top-stop arrangement,or by some other method.

Apart from these considerations, questions upon the theory of microscopic vision are opened up, for at the present time it is held that a self-luminous bright line of great tenuity can be seen upon a dark ground where a dark line of the same thickness upon a bright ground could not; but Mr. Gordon will tell you whether an object, such as this particular structure, illuminated upon a dark ground, would behave as a self-luminous object or not.

* Journ. Quekett Micr. Club, iii. ser. 2, pl. 4, fig. 2, p. 42.

OBITUARY.

Henry Clifton Sorby. 1826–1908.

Plate XI.

Microscopical Science, as well as this Society, has suffered a serious loss by the death, on March 9, of Dr. Sorby. As President of the Society, in 1875–7, he contributed to our Journal two addresses of a very striking and suggestive character, while our own publications, as well as those of other scientific societies, contain many important communications from his pen, illustrating the enormous value of the Microscope as an instrument of scientific research.

Sorby's life was a singularly, and happily, uneventful one. Succeeding to a moderate fortune, and receiving a sound education in the grammar school of his native town, supplemented by private tuition, he, at a very early age, determined to devote his life to the study of science; and this devotion to scientific research was never interrupted by the duties owing to a family, by the cares of a business, or by the distractions of a profession. During his earlier years, Sorby's interest and activities were almost entirely confined to his native town of Sheffield and its scientific societies. In his later years, after the death of his widowed mother, he was in the habit of spending all the summer months on board his yacht, which, provided as it was with Microscopes and other apparatus for research, became a laboratory in which he carried on the multifarious investigations described in his numerous memoirs.

At the time that he was President of this Society, Sorby wrote as follows:—"My entire life has been spent either in scientific research or in preparation for it"—and this statement might have been justly repeated by him on his death-bed. For even during the last five years of his life, while confined to his bed by a series of accidents, he was actively engaged in completing and publishing the results of important investigations. Nor did the manifestations of his enthusiasm for research cease with the extinction of life itself—for a posthumous memoir of the highest value has just appeared in the Journal of the Geological Society; while, by the terms of his will, a large part of Sorby's fortune will go to the Sheffield University—in the foundation of which he took such an important part—and the Royal and Geological Societies receive bequests, to be devoted to the promotion of investigations of the same character as those which occupied the donor during his whole life.

A glance at the titles of more than two hundred and fifty papers published by Sorby will show how wide were his sympathies and how varied his scientific tastes. Scarcely any branch of physical or natural science escaped his attention, and he not unfrequently strayed into the domains of archæology, history, and art. Yet amid all this bewildering range of pursuits, one fact stands out conspicuously—his faith in and reliance upon the Microscope as a most potent aid in scientific research.

Sorby's contributions to microscopy may be classed under three heads:—1. Improvements in and additions to the Microscope, designed to increase its usefulness in scientific investigations. 2. Discoveries, often of the most curious and unexpected character, in relation to physics, natural history, and even to medicine, sanitation, and jurisprudence, achieved by the use of the Microscope. 3. The establishment of new methods of research by microscopic means, which have had the most profound influence on the progress of science and the improvement of technological methods.

1. Sorby's first work with the Microscope, commenced while he was very young, was devoted to the study of the minute shells from the Bridlington Crag. He tells us that he was pretty well versed in the use of polarised light, and that he had practised the art of drawing under the Microscope, and of representing objects in their true colours. He soon found, however, that to do useful work it was necessary, wherever possible, to obtain thin transparent sections of the objects studied; and having learned from Professor William Crawford Williamson how anatomists and botanists prepare thin sections of hard substances, it occurred to him that it would be possible by the same methods to make transparent sections of rocks. He at once set to work in this manner and in time introduced many improvements in the method. In employing such sections he was able to show that the polariscope, attached to the Microscope, is no mere toy, but a most powerful aid to scientific research.

On the announcement in 1860 by Bunsen and Kirchoff of their methods of spectrum analysis, Sorby at once directed his energies to the employment of the Microscope in this interesting field of research. Having devised a form of Microscope, with a spectroscopic attachment, he showed how in the most varied branches of scientific work important results were to be obtained by the use of the instrument.

The study of stony meteorites and of their chondritic constituents led Sorby in 1869 to employ the Microscope as an aid to blowpipe-analysis, and thus to furnish valuable aid to the chemist and mineralogist. By flattening blowpipe-beads while they were still hot, and then examining them under the Microscope, he showed that the characteristic crystals of various substances formed in a bead could be recognised. In this way he to some extent foreshadowed the methods so beautifully developed by Bořický, Behrens and others, known as "Microchemical Analysis."

In the same way the examination of the polished and etched surfaces of the metallic meteorites—and subsequently of artificial irons and steels—led Sorby to devise that useful method of illumination, the parabolic reflector.

A method of determining the refractive index of substances had been devised more than a century ago by the Duc de Chaulnes. But it remained nothing more than an interesting suggestion till Sorby showed how, by adding a graduated circle to the fine-adjustment and the employment of suitable gratings, the Microscope could be converted into a refractometer of great value in identifying minerals in the thinnest rock-sections.

Subsequent devices, as shown in the pages of this Journal, enabled him to solve the problem of determining double refraction under similar conditions.

In successive editions of Dr. Lionel Beale's useful manual, "How to Work with the Microscope," Sorby supplied a series of brief instructions concerning the new methods he had introduced for making thin sections of rocks and minerals, for determining refraction and double refraction, and for studying absorption and other spectra with the Microscope.

2. It is an almost impossible task even to enumerate the highly curious, and often important, discoveries to which Sorby's ingenious instrumental appliances and original methods conducted their author.

By the microscopical study of coals and limestones he was led to highly important conclusions concerning the polymorphism of carbon and calcium carbonate; while his investigations of ironstones and dolomites showed how great a part is played by pseudomorphism in the determination of the characters of those rocks. When he came to study slates and schists in thin slices under the Microscope, the theories of cleavage and foliation, by which he will always be remembered by geologists, suggested themselves to his mind. And, in the end, his study of the minute cavities in the crystals of rocks with their liquid contents—including supersaturated alkaline solutions and carbon dioxide—resulted in his far-reaching generalisations concerning the conditions under which deep-seated and erupted igneous rocks must have consolidated.

An examination of the curious phenomenon of impressed pebbles was to Sorby the starting point in a series of ingenious speculations, which culminated in the doctrine enunciated in his Bakerian lecture, "On the Direct Correlation of the Mechanical and Chemical Forces."

In the same way the study of meteorites, by the aid of the Microscope, led him to many ingenious deductions concerning the conditions under which these visitants to our globe must have been formed.

The invention of the "Microspectroscope" was signalised by a number of curious discoveries on the spectrum of the blood and the changes that blood undergoes in time, of the colours of hair in man and the lower animals, the colours of eggs, of insects, and of the leaves and flowers of plants, and their changes, of algæ, fungi, and many other organic bodies. The absorption spectra of gems, and the relations between absorption and fluorescence, were also studied by him, and ingenious methods based on these observations were devised for the analysis of organic substances and the detection of poisons.

In his later years, when he utilised his yacht for studies of marine organisms and their distribution, and when much of his time and attention was devoted to devising methods for preserving these organisms and preparing them for exhibition as lantern slides, we find him at all times utilising his Microscope in connection with his interesting work.

3. Sorby himself made the avowal that, throughout his career, he was always more concerned to seek out new and fruitful lines of research, than to pursue those already discovered to their ultimate development. It might perhaps be expected that, considering his wide range of interests, and the facility with which he abandoned old lines of investigation when attracted by new problems, the outcome of his labours would be varied, curious, and fascinating, rather than conducive to great advances in science or productive of valuable commercial results.

Nothing, however, could be further from the truth, for Sorby will always be honoured as the pioneer in one of the most important branches of geological science, and as the discoverer of a method which is having a most potent influence on the development of the industries of his native town.

At the recent centenary of the Geological Society, the geologists from every part of the globe united in hailing Sorby as the "Father of Microscopical Petrography"—for his early work resulted in the development of a method that has revolutionised the study of rocks. A large and ever-increasing yearly output of literature testifies to the importance which this branch of science has now assumed.

In the same way, the discoveries to which Sorby was led by his study of the metallic meteorites, concerning the nature of the compounds building up artificial irons and steels, have led to the recognition of the "sorbitic" method as one of the most important aids in investigating the causes of the strength or weakness of various products used in the industrial arts. And the use of the method has now extended to other branches of metallurgy.

Sorby's complete absorption in scientific labour and speculation

Yours very truly
H. C. Sorby

often rendered him completely oblivious to the ordinary interests of other men. This sometimes led to little peculiarities occasionally bordering on eccentricity, but always of the most amiable kind. His servants and sailors were devoted to him, and the few scientific friends who had the pleasure of knowing him intimately could not sufficiently admire the transparent simplicity and extreme loveableness of his character. Honours justly flowed to him from every quarter, but left him modest and undistracted from the research to which, in his youth, he determined to devote his life, and to which, in his old age, he remained so constant.*

John W. Judd.

[For the loan of the portrait we are indebted to the courtesy of the editor of the "Geological Magazine," Dr. Henry Woodward, LL.D. F.R.S. F.G.S. F.Z.S. F.R.M.S.—Ed.]

Charles Stewart, 1840–1907.

Charles Stewart was born in 1840 at Plymouth, where his father and grandfather had been in practice. He received his medical education at St. Bartholomew's Hospital, taking the M.R.C.S. in 1862. In 1866 he obtained the post of Curator of the Museum at St. Thomas's Hospital, and was subsequently Lecturer on Comparative Anatomy and joint Lecturer on Physiology at that institution. In 1884 his connection with St. Thomas's Hospital ceased, owing to his appointment as Conservator of the Museum of the Royal College of Surgeons, a post he held till his death on September 27, 1907.

From 1866 Stewart was a Fellow of the Linnean Society, and from 1890 to 1894 held the office of President. He became a Fellow of the Royal Microscopical Society in 1867, and was joint Secretary with H. J. Slack from 1873 to 1878, and from 1878 to 1883 with Sir Frank Crisp. In 1896 he was elected to the Fellowship of the Royal Society, and three years later the University of Aberdeen conferred on him the degree of LL.D. (honoris causa).

Stewart was a great lecturer; his words came easily and eagerly, and he was able to communicate his ideas and facts not

* Interesting autobiographical reminiscences of Sorby will be found in his "Unencumbered Research: A Personal Experience," published in the "Essays on the Endowment of Research," 1876, and in a lecture before the Sheffield Literary and Philosophical Society in 1879, entitled "Fifty Years of Scientific Research." A list of his numerous papers is given in "The Naturalist" for 1906.

only in graphic and striking language, but to illustrate them on the blackboard with wonderful freehand drawings. Though of recent years he rarely frequented the meetings of the Society, in former times he was an assiduous and constant attendant, and contributed during the active period the following papers to the Society :—

Note on the Scalp of a Negro. Read Jan. 1, 1873. Monthly Micr. Journ., 1873, p. 54.

Notes on *Bucephalus polymorphus.* Read June 2, 1875. Monthly Micr. Journ., 1875, pp. 1, 2.

On the Lachrymal Gland of the Common Turtle. Read Nov. 7, 1877. Monthly Micr. Journ., 1877, p. 241.

On a New Coral, *Stylaster stellulatus,* and Note on *Tubipora musica.* Read March 6, 1878. Journ. R.M.S., 1878, pp. 41–4.

On some Structural Features of *Echinostrephus molare, Parasalenia gratiosa,* and *Stomopneustes variolaris.* Read Nov. 10, 1880. Journ. R.M.S., 1880, pp. 909–12.

On a Supposed New Boring Annelid. Read May 11, 1881. Journ. R.M.S., 1881, pp. 717–19.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Shapes of Eggs.‡—D'Arcy W. Thompson discusses the factors which determine the shapes of the eggs of birds. Eggs may be spherical, elliptical, ovoid, or blunt at one end and pointed at the other. Selectionist interpretations suggest that the pointed egg is less apt than a spherical one to roll off a narrow ledge of rock, and that the conical form permits many large eggs to be packed closely under the mother-bird. But in dealing with organic forms, we should first try to interpret them in terms of "the intrinsic forces of growth acting from within and the forces of tension and pressure that may have acted from without." The problem is: given a practically incompressible fluid, contained in a deformable capsule, which is either (*a*) entirely inextensible, or (*b*) slightly extensible, and placed in a long elastic tube, the walls of which are radially contractile, to determine the shape under pressure. An incompressible fluid contained in an inextensible envelope cannot be deformed without puckering of the envelope taking place, and, as this does not occur, it may be assumed (*a*) that the envelope is to some extent extensible, or (*b*) that the whole structure grows under relatively fixed conditions—two suppositions which are practically identical with one another in effect. At all points the shape is determined by the law of the distribution of radial pressure within the given region of the oviduct, surface friction helping to maintain the egg in position. If the egg be under pressure from the oviduct, but without any marked component either in a forward or backward direc-

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Nature, June 4, 1908, pp. 111–13.

tion, the egg will be compressed in the middle, and will tend more or less to the form of a cylinder with spherical ends. The eggs of the grebe and cormorant (or crocodile) may be supposed to receive their shape in such circumstances.

When the egg is subject to the peristaltic contraction of the oviduct during its formation, then from the nature and direction of motion of the peristaltic wave the pressure will be greatest somewhere behind the middle of the egg; in other words, the tube is converted for the time being into a more conical form, and the simple result follows that the anterior end of the egg becomes the broader and the posterior the narrower.

In an egg, consisting of an extensible membrane filled with an incompressible fluid and under external pressure, the equation of the envelope is $p_n + T\left(\frac{1}{r} + \frac{1}{r^1}\right) = P$, where p_n is the normal component of external pressure at a point where r and r^1 are the radii of curvature, T is the tension of the envelope, and P the internal fluid pressure. This is simply the equation of an elastic surface where T represents the coefficient of elasticity; in other words, a flexible elastic shell has the same mathematical properties as the fluid membrane-covered egg. The author goes on to discuss particular applications of this equation of equilibrium.

Development of Polypterus senegalus.* — J. Graham Kerr has worked over the collection of eggs and embryos of *Polypterus* made by the late J. S. Budgett. The eggs seem to be deposited in shallow lagoons early in the rainy season, and apparently adhere to submerged twigs or water-plants. There is some indication that fertilisation is internal. The young fry apparently accompany a parent (probably the male) in a dense swarm.

The segmentation is complete, and in its earliest stages nearly equal; the invagination groove is at first nearly equatorial; as the curve described by the groove becomes closed, an enormous "yolk-plug" is formed; rudiments of external gills and cement organs appear at an early stage; the buccal cavity is for a while a widely-open space bounded by the cement organs, the lower side of the head, and the cardiac region.

The mesoderm of the trunk region arises as it does in *Lepidosiren*, *Protopterus*, and *Petromyzon*, by "delamination." A well-developed solid post-anal gut is present, which eventually breaks up and disappears. It is interesting to find that the secretory epithelium of the cement organ is endodermic, arising as a pair of hollow enteric diverticula, which become cut off from the rest of the endoderm and establish a connection with the outer surface.

The lung rudiment is median and ventral, and very soon shows asymmetry. The pancreas develops from three rudiments, and the liver is really a hepatopancreas, having pancreatic tissue spread out over part of its ventral surface.

* The Work of John Samuel Budgett (Cambridge, 1907) pp. 195–284 (3 pls. and 67 figs.).

The dorsal aorta arises from cells or protoplasmic masses derived from the sclerotome ; its lumen is derived from the fusion of originally separate vacuoles in these masses ; the endocardium appears to be mesoblastic in origin ; the blood-corpuscles appear suddenly, and it is suggested that they are mesenchyme cells set free by an epidemic of mitosis.

The chondrocranium is amphibian-like in early stages. The neural tube arises by overarching of the medullary folds. Both infundibulum and optic rudiments are clearly recognisable while the medullary groove is still widely open throughout. As in *Lepidosiren* and other forms, the brain is, during the earlier part of its development, divided into two, not three regions—the primitive forebrain and the rhombencephalon. The pineal outgrowth is single, and without any eye-like structure. In the adult the cerebellum becomes highly developed, and forms anteriorly a valvula cerebelli, while posteriorly it projects back in a quite similar manner into the fourth ventricle. The material forming the side walls of the thalamencephalon does not become pushed out to form cerebral hemispheres, but is accommodated partly by the great increase in the length of the thalamencephalon, partly by its becoming invaginated into the interior of the third ventricle. The two olfactory rudiments are apparently connected by an ectodermal thickening across the middle line in early stages ; the cavity of the olfactory organ is a secondary excavation in the originally solid rudiment.

On the whole, the general phenomena of development in *Polypterus* show frequent striking resemblances with what occur in Dipnoans and in the lower Amphibia. In the investigator's opinion these resemblances are sufficient by themselves to indicate the probability that the Teleostomes, the Dipnoans, and the Amphibians, have arisen in phylogeny from a common stem, which would in turn probably have diverged from the ancestral Selachian stock. The ancestors of the Amniota probably diverged either about one or about several points from the region of the stem common to Dipnoi and Amphibia.

The external gills develop in *Polypterus* exactly as they do in *Lepidosiren* and *Protopterus*, and in the more primitive Amphibia (Urodela and Gymnophiona), i.e. each one arises as an outgrowth from the outer side of the visceral arch (in this case hyoidean), composed of mesenchymatous core and an ectodermal covering. They appear before the perforation of the gill-clefts, and are probably organs of great antiquity. The respiratory epithelium of the gill-clefts has arisen by a spreading inwards from the ectodermal respiratory epithelium of the external gills.

The author returns to his theory that paired limbs are homodynamous with external gills in which the potential motor function has been accentuated.

Budgett showed that the condition of the fin-skeleton in the larva of *Polypterus* indicates its close relationship to the type of uniserial fin-skeleton in sharks ; Graham Kerr re-states the hypothesis that both can be referred back to a primitive biserial archipterygium like that of *Ceratodus*.

In the evolution of the head there has been a varying amount of displacement in an antero-posterior direction of the relative positions of mesoderm segments and visceral pouches; and it is suggested that the enterocœlic pouches were once wholly posterior to the visceral pouches, and that the two structures are really homodynamous.

The nervous material which corresponds with the whole of the cerebral hemisphere in the higher forms—including the pallium or mantle—lies in *Polypterus* in the thickened wall of the thalamencephalon. What is ordinarily called the pallium in a Crossopterygian is simply the roof of the thalamencephalon, and the conditions in Actinopterygian Ganoids and Teleosts are similar.

These are some of the general results of an exceedingly important investigation.

Development of Gymnarchus niloticus.* — Richard Assheton describes the development of this Teleost, which belongs to the Mormyridæ, a primitive Malacopterygian family. His material was collected in the Gambia by the late J. S. Budgett, and the memoir is the first account of the development of any Mormyrid. The development is on the whole typically Teleostean, but there are many interesting features. The egg is large (10 mm. in diameter) and the development is very rapid, the larva emerging upon the seventh day, whereas that of a trout takes 35–100 days, according to the temperature. The elongated embryo suggests that of an Amniote with almost typical "primitive streak"; the "archenteron" in so far as it occurs is more like that in an early stage of *Hypogeophis* (Brauer) than a "Kupffer vesicle." In the region of the primitive streak the hypoblast is continuous with the yolk and the primitive streak as it is in Amphibia, and not separated as it is in birds and mammals. There is a large mass of yolk, and the larvæ have very long gill-filaments hanging down in two blood-red branches.

The alimentary canal arises as a cleft among the hypoblast cells. At an early stage—or perhaps from the outset—the pharyngeal region is without a lumen. It does not acquire one until the larva is hatched. There is one pair of true gill-clefts between the 6th and 7th visceral arches; the other "gill-clefts" of embryonic life are invaginations of the ectoderm which undermine the visceral arches. There are long external uniramous gill-filaments on the 1st, 2nd, 3rd, and 4th branchial arches, which shrivel after the operculum has grown over them, excepting the proximal ends which give rise to the permanent gills. The whole apparatus is lined by epiblast from first to last.

The air bladder, which arises as a single diverticulum of the œsophagus a little to the left of the mid-dorsal line, has right and left lobes; its structure and vascular supply and the habits of the fish all point to its use as a lung. The yolk-sac is to be regarded as an appendage of the liver—due to the accumulation of yolk in that part of the egg which normally becomes the liver. The gall-bladder and liver arise by the constriction off of a large ventral recess of the alimentary canal just posterior to the œsophagus; the pancreas is developed as diverticula from the bile ducts (the constricted region just mentioned), and these grow backwards to mingle with the "islands of Langerhans"

* The Work of John Samuel Budgett (Cambridge, 1907) pp. 293–421 (6 pls., 80 figs.).

tissue and even with the spleen. The islands of Langerhans arise very early as a solid mass of epithelial tissue which becomes broken up by the splitting of the mesenteric artery.

There are certain features which suggest an earlier condition of Teleostean evolution than is the case with other Teleosts whose development is known. Assheton inquires speculatively whether the Teleosteans may be descended from a proto-amphibian stock, which by a mutation returned to strictly aquatic habits. He refers to the amphibian-like character of the lips of the blastopore, to the vestige of neural tube formation, to various features in the development of the excretory system, to the lung-like and vestigially double air-bladder, to the trace of an auricular septum and the suggestion of a double circulation, to the large size of the aortic arch of the fourth visceral arch, and to the peculiar character of the gill-clefts, filaments and arches.

Regeneration in the Pancreas.*—J. Kyrle has experimented with dogs and guinea-pigs, and finds that the pancreas has some regenerative capacity both as regards the parenchyma and the islands of Langerhans. From their own epithelial components both these kinds of tissue may effect regeneration, but this may be supplemented by re-growth from the efferent ducts.

Early Human Embryo.† — Alexander Low describes a human embryo of 13–14 mesodermic somites, 2·6 mm. in length. He has reconstructed a model of the whole and of various parts. The notochord lies in close relation with the endoderm forming the roof of the gut, and is not separated off at its cranial commencement, appearing more as a heaping up of cells than as an evagination. The aortic stem divides into a pair of aortic arch vessels, and there are traces of a second pair. The dorsal aorta is paired throughout. The mouth, which is separated from the pharynx by a complete bucco-pharyngeal membrane, shows on its roof a slight funnel-like beginning of the oral part of the hypophysis ; the pharynx shows four pairs of pouches. The medullary plate is still open at both ends ; the hind brain shows seven neuromeres.

Corpus luteum and Rut in Rabbits.‡—Cl. Regaud and G. Dubreuil have made experiments which they regard as proving that the corpora lutea do not condition rut. But F. Vuillemin,§ whose results are criticised by Regaud and Dubreuil, maintains his previous conclusion that, in the rabbit, as in other mammals, rut (like menstruation) is determined by the internal secretion of the cells of the corpus luteum.

Open Cleft in Embryonic Eye of a Chick of Eight Days.‖—Otto Landman found a case in which the fissure, which normally closes on the 6th day, was widely open on the 8th day. A complete cleft extended from the edge of the pupil to the region of the optic nerve ; there was an inversion of the lips of the fœtal cleft throughout its

* Arch. Mikr. Anat., lxxii. (1908) pp. 141–60 (1 pl.).
† Journ. Anat. Physiol., xlii. pp. 237–51 (3 pls. and 15 figs.).
‡ C R. Soc. Biol. Paris, lxiv. (1908) pp. 442–4.
§ Tom. cit., pp. 444–5.
‖ Anat. Anzeig., xxxii. (1907) pp. 456–9 (5 figs.).

entire extent except in the iris; pigment extended into the inner layer of the secondary optic cup; there were no ciliary processes. Had the embryo grown to maturity, it would have had a large coloboma of the iris, choroid, and retina.

American Alligator.*—A. M. Reese gives a general outline of the whole process of development in the American Alligator (*A. mississipiensis*), which has hitherto been little studied owing to the difficulty of procuring suitable embryological material. Owing to the fact that the embryo may undergo considerable development before the egg is laid, and also to the unusual difficulty of removing the young embryos, the earlier stages of development are very difficult to obtain. The mesoderm seems to be derived chiefly by proliferation from the endoderm, and in this way all that is anterior to the blastopore arises. Posterior to the blastopore, the mesoderm is proliferated from the lower side of the ectoderm in the usual way. No distinction can be made between the mesoderm, derived from the ectoderm and that derived from the endoderm. The ectoderm shows, during the earlier stages, a very great increase in thickness along the median longitudinal axis of the embryo. The notochord is apparently of endodermal origin, though in the posterior regions where the germ-layers are continuous with each other it is difficult to decide with certainty. The medullary folds have a curious origin, difficult to explain without the use of figures. They are continuous posteriorly with the primitive streak, so that it is impossible to tell where the medullary groove ends and the primitive groove begins, unless the dorsal opening of the blastopore be taken as the dividing point. The amnion develops rapidly, and entirely from the anterior end. The blastopore, or neurenteric canal, is a very distinct feature of all the earlier stages up to about the time of the closure of the medullary canal. Preceding the ordinary cranial flexure, there is a sort of temporary bending of the head region, due apparently to the formation of the head fold. During the earlier stages of development the anterior end of the embryo is pushed under the surface of the blastoderm, and hence is not seen from above. Body torsion is not so definite in direction as in the chick, some embryos lying on the right side, some on the left.

Of the gill-clefts, three open clearly to the exterior, and probably a fourth also. A probable fifth cleft was seen in sections, and in one surface view. The first trace of the excretory system is seen as a dorsally projecting solid ridge of mesoblast in the middle of the embryo, which ridge soon becomes hollowed out to form the Wolffian duct. The origin of the pituitary and pineal bodies is clearly seen; the latter projects backwards. No connection can be seen between the first rudiments of the sympathetic nerves and the central nervous system. The lumen of the œsophagus is for a time obliterated as in other forms. The choroid fissure is a very transitory but well-marked feature of the eye.

Embryos in Ichthyosaurs.†—W. Branca maintains that some of the embryos found in Ichthyosaurs were swallowed. Inside the

* Smithsonian Miscellaneous Collections, li. (1908) 66 pp., 23 pls.
† SB. k. Preuss. Akad. Berlin, 1908, pp. 392–6.

stomach of a *Xiphias* there were found 13 small porpoises and 13 dog-fishes, all unbitten. If in a case like this the animal died soon after its meal and was fossilised, it might present an appearance like that of some of the Ichthyosaurs with so-called embryos. Not that Branca denies the occurrence of embryos in Ichthyosaurs: his point is that there are sometimes so many young ones inside the body that some must have come in from outside.

Epibranchial Placodes of Ameiurus.*—F. L. Landacre has endeavoured to ascertain to what extent these ectodermic thickenings and proliferations enter into the composition of the cranial nerves. The communis ganglia of the 9th nerve and the visceral portions of the ganglia of the first two divisions of the 10th nerve are practically pure placodal ganglia; there is more doubt about the geniculate ganglion, although even here the incorporated neural crest portion must be very small; in the third division of the 10th there is a large neural crest portion which combines with the placodal portion so intimately that it is not possible to distinguish them. Every cranial nerve containing gustatory fibres comes from a ganglion which can be traced wholly or in part to an epibranchial placode.

Poison-glands of Salamander.†—E. Nirenstein has studied the development of these glands in *Salamandra maculosa*, and finds that they arise by the transformation of mucous glands when these are still in an undifferentiated state, and partly after they have become differentiated. Mucous glands are continually changing into poison-glands. The formation of the secretion from minute secretory corpuscles is described in detail. The secretory corpuscle is regarded as a definite differentiation of the cytoplasm, just as a myofibril or a trichocyst is.

Notes on Anuran Development.‡—E. J. Bles contributes some exquisitely illustrated notes on stages of *Paludicola fuscomaculata*, *Hemisus marmoratum*, and *Phyllomedusa hypochondrialis* collected by the late J. S. Budgett.

Teleostean Eggs and Larvæ from the Gambia.§—R. Assheton reports on a collection made by the late J. S. Budgett, including some stages supposed to belong to *Hyperopisus bebe*, and the larvæ of *Heterotis niloticus* and *Sarcodaces*.

Regeneration of Lens in Fishes.‖—Jan Grochmalicki has experimented with young trout (*Trutta fario* and *T. iridens*), and finds definite evidence that a lens may be regenerated. The process begins in a primordium on the upper iris margin or laterally, and it seems to be much slower than in Amphibians.

Development of Carp's Swim-bladder.¶—O. Thilo finds that the swim-bladder arises on the right side of the œsophageal wall, as a small

* Ohio Naturalist, xiii. (1908) pp. 251–5.
† Arch. Mikr. Anat., lxxii. (1908) pp. 47–140 (3 pls.).
‡ The Work of J. S. Budgett (Cambridge, 1907) pp. 443–58 (6 pls., 2 figs.).
§ Tom. cit., pp. 435–42 (6 figs.).
‖ Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 164–72 (6 figs.).
¶ Zool. Anzeig., xxxii. (1908) pp. 589–97 (5 figs.).

roundish diverticulum two days after the fish is hatched. It grows quickly and fills with air which is swallowed at the surface. It becomes spherical and is inclosed in a firm envelope. As the pressure increases a part of the bladder is protruded like a hernia. This grows quickly and becomes the anterior part of the hour-glass-shaped air-bladder. The shape gives the bladder relatively more strength to resist pressure, and it may be an advantage to have two bladders in a line instead of one large one.

Gestation in Acanthias vulgaris.*—L. Blaizot finds that in this dogfish there is no nutriment provided by a secretion or degeneration of the uterine wall, and that the embryos are not bound to the uterine wall by their vitelline vesicle. It may be said that *Acanthias* is intermediate between the oviparous dogfishes, and those with pronounced viviparous adaptations.

b. Histology.

Nervous Elements in Fishes.† — A. Nemiloff has studied the nerve-cells of the cerebral, spinal, and sympathetic ganglia, and discusses the minute cytoplasmic and nuclear structure, the structure of the surrounding envelopes, the "trophocytes" between the cell and its envelope, the interstitial tissue (including a small bundle of striped muscle in the ganglion of the vagus in *Lota vulgaris*), the inclosures and parasites, and the changes in the nucleus.

Ventricular Fibre of Brain of Myxinoids.‡ — Howard Ayers describes a fibre within the ventricular cavity of the brain of *Bdellostoma* and *Myxine*, which serves to connect the ependyma cells of the cavity and of the spinal canal. The fibre for the most part follows the outlines of the ventral portion of each chamber, but it is much coiled in the fourth ventricle. It consists of innumerable fibrils derived from the ependyma cells, lying in the cavity of the brain and spinal cord. It is certainly an organ of relation, bringing all parts of the ventricular cavity into intimate communication. It may be connected with the vaso-motor control of the ventricular lymph supply.

Epidermal Sensory Cells in Amphioxus.§—H. Joseph corroborates the occurrence of true sense-cells among the epidermic cells of the lancelet, and gives some details in regard to their (variable) distribution and minute structure.

Histogenesis of Nervous System.‖ — Oskar Schulze describes a number of observations on a large variety of animals, which contradict the widespread view that nerve-fibres grow out freely from central cells. He finds that the longitudinal growth of nerves comes about by mitosis in a chain of elements (the "nerve-fibre-cells"), whose nuclei have been previously regarded as the nuclei of Schwann's sheath. A nerve-fibre is a multinucleate neurofibrillar syncytium inclosed in a medullary mantle.

* Bull. Soc. Zool. France, xxxiii. (1908) pp. 57–9.
† Arch. Mikr. Anat., lxxii. (1908) pp. 1–46 (2 pls., 7 figs.).
‡ Anat. Anzeig., xxxii. (1908) pp. 445–8 (5 figs.).
§ Tom. cit., pp. 448–55 (7 figs.).
‖ SB. k. Preuss. Akad. Wiss. Berlin, 1908, pp. 166–77.

Histogenesis of Muscle.*—J. Mlodowska has studied the development of skeletal muscle in embryos of fowl, mouse, rabbit and pig. A muscle-fibre is equivalent to several cells fused in a syncytium ; it may be derived from cells which have belonged to several myomeres ; the myoblasts of adjacent myomeres coalesce by means of ever-broadening bridges of plasma, on which fibrils grow ; the disappearance of the metamerism is helped by mesenchyme cells, which arrange themselves in rows and unite with the bridge by numerous processes. The contractile fibrils are either the product of a single myoblast (in this case they grow independently into the other myoblasts which compose the syncytium), or they may owe their origin to several myoblasts (in this case they subsequently unite by their ends to form a single long fibril). A fibril may be the product of cells belonging to several myomeres. The fibril formed in one myomere may grow independently into the cell-territory of adjacent myomeres, the plasmic bridges previously formed serving as transitions. Fibrils have a certain individuality—of growing beyond their origin, of increasing in length and thickness, and of multiplying by splitting. Organogenetic processes lead to over-production of embryonic muscular tissue : part undergoes degeneration, and part becomes connective. Increase in the number of muscle fibres is due not only to longitudinal splitting of fibres, but also to the co-operation of mesenchyme cells which form chains.

c. General.

Scales of Fishes.†—E. S. Goodrich has studied the different types of scale in fishes, with special reference to their use in classification.

1. The placoid scale of Selachii and Holocephali begins as a cone of dentine deposited by mesoblastic scleroblastic cells below the epidermis, in continuity with the basement membrane. A basal plate may be present in the form of a direct extension inwards of the cone, never as a separate element which becomes fused on to it secondarily. Both the cone and the plate are composed of dentine or some allied substance, never of true bone ; the cone may pierce the epidermis when fully grown. The scales and plates of Heterostraci have been evolved by the combination of a covering of separate isolated denticles and an underlying plate.

2. The cosmoid scale, e.g. of *Megalichthys*, consists of a basal layer of parallel bony laminæ of "isopedine," over which is a bony zone with large vascular spaces. These canals combine near the surface in a more regular horizontal system, with vertical canals reaching the outer surface. Below the surface the canals expand into conical chambers, between which pass upwards another set of vertical canals, ending above in pulp-cavities. From these radiate a multitude of canaliculi. Williamson gave the name of "cosmine" to a peculiar dentine-like substance in "ganoid" scales, and Goodrich uses the term cosmoid for scales with a tissue with canaliculi like those of dentine. The cosmoid scale has an outer layer of dentine-like substance, a middle bony layer

* Bull. Internat. Acad. Sci. Cracovie, 1908, pp. 145–71 (2 pls.).
† Proc. Zool. Soc., 1907, pp. 751–74 (4 pls., 9 figs.).

with vascular spaces, and an inner layer of bony laminæ, probably ossified fibrous tissue of the cutis. The cosmoid scale grows in thickness only by the addition of new lamellæ below; its outer surface is covered with a thin shiny layer, the nature and origin of which are uncertain.

3. The ganoid scale is found in all Actinopterygii except the modern Teleostei. In its full development it is seen in the rhombic scales of *Palæoniscus* and *Lepidosteus*. It grows in thickness by the addition of new layers, not only below but also on the upper surface. The oldest part of the scale is the centre. The lower layers are bony or fibrous, the upper of much denser homogeneous enamel-like ganoine. The palæoniscoid and lepidosteoid scales are two distinct varieties of the ganoid scale.

Besides cosmoid, palæoniscoid, and lepidosteoid scales, certain other varieties are found, such as the Rhizodont and Dipnoan, which are probably to be derived from the cosmoid. The position of the Cœlacanth scale is at present difficult to determine; it may be a primitive form in which the denticles have not yet fused to a cosmine layer, as Williamson supposed; or it may be simply a degenerate cosmoid scale to the surface of which denticles have become attached.

The cosmoid scale occurs in the extinct Osteolepidoti (Crossopterygii) and Dipnoi, but in no other group of fish. Similarly, the ganoid scale occurs in the Teleostomi and never elsewhere. The palæoniscoid type is restricted to the Palæoniscidæ and their immediate allies; while the lepidosteoid type is universal among the Protospondyli, the Ætheospondyli and the Pholidophoridæ, and not found in any other group as far as is known.

The scale of *Polypterus* is of the ganoid type and belongs to the palæoniscoid variety. The scales of Acanthodii are not placoid, but approach most nearly to the lepidosteoid type.

Seasonal Change in Birds.* — C. W. Beebe publishes a preliminary report of some experiments on birds, undertaken with a view to finding out what factors determine the seasonal changes in the plumage of male birds. The tanager (*Piranga erythromelas*) and the bobolink (*Dolichonyx oryzivorus*), in which the summer and winter plumage are markedly different, were the subjects of these experiments, which dealt mainly with one factor—the condition of the bird as to fatness or thinness. Males in full nuptial plumage, which had not been allowed to breed, were kept in small cages in a dim light, and fed rather more abundantly than usual. They soon became less active, ceased to sing, and increased in weight. In autumn no trace of the usual moult could be discovered, and the birds remained in perfect health. A few were taken into the light, and their diet changed, and they soon began to sing. A sudden alteration of temperature either upwards or downwards wrought a radical change. They stopped feeding, lost weight, and rapidly moulted into the normal winter plumage. Those that were kept the whole time in dim light with high feeding were gradually brought into normal conditions in spring, and very quickly they began to moult into new nuptial plumage, having skipped the winter stage

* Amer. Naturalist, xlii. (1908) pp. 34–8.

altogether. The investigator, while admitting that these experiments do not yet afford a sufficiently wide basis for generalisation, claims that they prove in regard to the two species concerned, that the sequence of plumage is not in any way predestined by inheritance, but that it may be interrupted by certain changes in the environmental complex.

Muscles of the Tail in Peacock and Turkey.*—A. Porta describes this musculature, to which no particular attention has hitherto been paid. He distinguishes five pairs—elevators of the coccyx, depressors of the coccyx, external pubo-coccygeals, internal pubo-coccygeals, and inter-transversala. He also describes four anal muscles.

Mammal-like Reptiles.† — R. Broom regards the mammal-like reptiles as forming a well-defined group, whose earlier members show so much affinity with the primitive Diaptosaurians and with the higher Cotylosaurians as to render it highly probable that from some Cotylosaurian ancestor all the later reptiles are descended. On the other hand, the higher mammal-like reptiles approach so closely to the mammals, that it is not always possible to distinguish between them. Thus *Tritylodon* is held by many to be a reptile, by others it is believed to be a mammal; *Dromatherium*, *Microconodon*, and *Karoomys* are generally believed to be mammals, but it is just possible they may be reptiles; while *Sesamodon* and *Melinodon*, which are believed to be Cynodont reptiles, may possibly prove to be mammals. The difference between a Cynodont reptile and a Monotreme is less than the difference between a Monotreme and a Marsupial, and this, again, is not much greater than that between a Marsupial and an Insectivore.

Feeding Snakes in Captivity.‡—P. Chalmers Mitchell and R. J. Pocock note that at the Gardens of the Zoological Society no species of snake, poisonous or non-poisonous, refused to take dead food. It was found unnecessary to give live food to any individual snake. They note that a human hand slowly and carefully advanced on a small bird or mammal has just as much power of fascination as a snake has—that is to say, none. Except in the case of monkeys (not including Lemurs) there is no evidence that animals have any specific fear of snakes. It is probable that human beings have inherited a specific fear of snakes from their anthropoid ancestors.

Dogs affected with Kala-azar.§—Ch. Nicolle and Ch. Comte find that the parasite associated with kala-azar occurs in dogs in Tunis, and suggest that man is infected through fleas.

Tunicata.

Winter-buds of Clavelina lepadiformis.‖—H. Kerb describes the formation of "winter-buds" in unfavourable conditions. They are

* Zool. Anzeig., xxxiii. (1908) pp. 116–20 (4 figs.).
† Proc. Zool. Soc., 1907, pp. 1047–61 (4 figs.).
‡ Tom. cit., pp. 785–94.
§ Comptes Rendus, cxlvi. (1908) pp. 789–91.
‖ SB. Ges. Nat. Freunde Berlin, 1907, No. 6, pp. 167–70 (1 pl.).

small chambers on the side of a stolon, containing nutritive material and blood-cells, covered with epithelium and tunicin. Inside these buds a complete Ascidian is built up.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Environmental Studies on the Limpet.*—E. S. Russell seeks to correlate certain modifications of the shell of *Patella vulgata* with definite environmental conditions. As to the homing habit, he concludes that every limpet of 15 mm. and upwards, occupies for long periods at a time a definitely fixed position to which it returns after any wanderings that it may make for food; that limpets under 15 mm., if not yet settled in a definite position, never wander far away, and generally keep to the same stone. The movements are chiefly when covered by the tide. High-water and low-water limpets differ in definite ways, which are carefully tabulated. Adult exposed shells are lower spired, narrower, thicker, and more irregular than sheltered shells. An interesting conclusion is that the "rough" types occur on rough stones; the "smooth" types (var. *cærulea*) on polished stones. A small change in an environment may produce through its continuous action a large cumulative result by a summation of successive little effects.

Experimental Dwarfing of Water-snails.† — R. Legendre has experimented with *Lymnæus stagnalis* and *Planorbis corneus*, rearing parts of the same brood in varied conditions. He finds, as previous experimenters have done, that it is not difficult to produce dwarf forms by crowding. Unlike Semper and De Varigny, however, he finds reason to believe that the excreta in the water act in an inhibitory manner on growth.

Philomycus.‡—V. Sterki makes some notes on this genus of nearctic slugs, which is distinguished from *Limax* by having the mantle extended over almost the whole body. He defines a few species, and proposes to give the genus the attention which it merits.

δ. Lamellibranchiata.

Parthenogenetic Development in Mactra.§—K. Kostanecki found, in 1905, that a potassium chloride sea-water solution served as a stimulus to the parthenogenetic development of the eggs of *Mactra*. In studying the matter further, he finds that there is mitotic nuclear division without corresponding cell-division.

Structure of Phaseolicama magellanica.‖—J. Igel gives an anatomical description of this bivalve, which occurs under stones on the

* Proc. Zool. Soc., 1907, pp. 856–70 (12 figs.).
† Arch. Zool. Exper., viii. (1908) Notes et Revue, No. 3, pp. lxxvii.–lxxxiv.
‡ Ohio Naturalist, viii. (1908) pp. 265–6.
§ Bull. Internat. Acad. Sci. Cracovie, 1908, pp. 97–101 (1 fig.).
‖ Zool. Jahrb., xxvi. (1908) pp. 1–44 (2 pls.).

shores of the Falkland Islands. As in the related form, *Modiolarca trapezina*, there is a brood-chamber. The eggs pass into the inner gills, are fertilised, and develop there till they have attained their definitive form. The various systems—nervous, muscular, alimentary, and so on —are described at length.

Relation between Body and Shell in Bivalves.*—R. Schwarz has studied this problem in a large number of cases. He finds two styles of architecture, the one represented by *Cardium*, *Venus*, *Cytherea*, *Tapes*, *Artemis*, etc., and the other by *Mytilus*, *Avicula*, *Pecten*, *Ostrea*, etc. He also deals with aberrant forms, such as *Lima* (which belongs to the *Cardium* style, not to that of Pectinids), *Hippopus*, and *Tridacna*, and seeks in general to show that the study of the shell apart from the body is sure to mislead. More definitely, as he says, the assumption that the shell-margin or the hinge in one bivalve is homologous with the shell margin or the hinge in another, must be entirely given up.

Concentration of Nervous System in Lamellibranchs.†—Paul Pelseneer describes the close approximation of the ganglia in *Lima squamosa*, where cerebral, pedal, and visceral ganglia are close together below the œsophagus. In *L. inflata* the arrangement is intermediate between that of *L. squamosa* and the typical wide separation.

Arthropoda.

α. Insecta.

Accessory Chromosome in Aplopus Mayeri.‡—H. E. Jordan has traced the history of the accessory chromosome in this Phasmid. Some spermatozoa have 18 chromosomes, like the ova ; others have one less. The accessory chromosome appears in the resting stage of the secondary spermatogonia as a chromatin nucleolus characteristically close to the nuclear wall. At the last spermatogonial division it passes over into the resting stage of the primary spermatocyte without entering a reticular stage as do the ordinary chromosomes. Both the primary and secondary spermatogonia have a metaphase group of 35 chromosomes. Metaphase groups of follicle cells of the ovary contain 36 chromosomes.

Synapsis occurs in the early stages of the growth period by an end-to-end union of pairs of univalent elements. Equatorial plates of primary spermatocytes contain 18 chromosomes. The accessory chromosome passes undivided to one pole of the first maturation spindle, and thus produces a dimorphism of the daughter-cells and the resulting spermatozoa.

The first maturation division is reductional ; the second is equational. Equatorial plates of secondary spermatocytes show a disparity in the number of chromosomes. One group contains a large U-shaped element peripherally, and numbers 18 ; those groups lacking a body of such form contain only 17 chromosomes. The accessory chromosome can be traced

* Morphol. Jahrb., xxxviii. (1908) pp. 91–134 (3 pls.).
† Bull. Classe des Sciences Acad. Roy. Belgique, Nos. 9–10 (1907) pp. 874–8 (3 figs.).
‡ Anat. Anzeig., xxxii. (1908) pp. 284–95 (48 figs.).

as a specific structure throughout until it disintegrates in the head of the ripening spermatozoon.

Diaposematism.*—Guy A. K. Marshall discusses reciprocal mimicry and some limitations of the Müllerian hypothesis of mimicry. He points out the difficulty of accepting the idea of a mutual simultaneous mimicry between two unpalatable species, such as is postulated by the hypothesis of "diaposematism." It is suggested that an initial inequality in the individual numbers of the two distasteful species is an essential condition for the production of Müllerian mimicry, and that in such circumstances the mimetic approach would always be in one direction only, namely, from the rarer species towards the more abundant. Any initial variation from the latter towards the former must be disadvantageous.

The various cases which have been cited in evidence of diaposematism or reciprocal mimicry are critically examined, and it is argued that the facts can be more satisfactorily interpreted on lines which do not involve the assumption of a mutual interchange of characters between mimic and model. Müller's principle is important, but it has definite limitations, and the attempt to explain all cases of mimicry among butterflies on the Müllerian theory is contested. The wide significance of Bates's principle has not been adequately appreciated. Indeed the theory of Bates will explain many cases of mimicry between unpalatable species which have been previously considered as purely Müllerian in character.

Accessory Chromosome in Anasa tristis.† — E. B. Wilson, in opposition to the criticisms of Foot and Strobell, who could find no accessory chromosome in *Anasa tristis*, confirms his previous conclusion that the number of chromosomes in the spermatogonia is 21, in the eggs 22; and that the accessory chromosome in the second maturation division passes undivided to one pole, so that half of the spermatozoa have 10 chromosomes, and half have 11 chromosomes.

Cutaneous Glands of Wasps.‡—L. Bordas finds in various species of *Vespa*, groups of unicellular glands on the anterior margin of the two last abdominal sternites. Each gland is a large spherical cell, with a delicate canal passing to the exterior, and often uniting with several others.

Cave Beetles.§—R. Jeannel describes a large collection (31 species) of beetles from Pyrenean and other caves. He deals with several new forms—e.g. *Speodiætus* g.n. and *Speonomus* g.n., including species previously referred to *Bathyscia*.

Development of the Alimentary Canal during Metamorphosis.‖ P. Deegener follows up his previous account (1904) of the development of the alimentary canal in *Cybister roeselii*, with a careful description of all the changes undergone in *Malacosoma castrensis* during metamorphosis.

* Trans. Entomol. Soc., London, 1908, pp. 93–142.
† Science, xxv. (1907) pp. 191–3.
‡ Bull. Soc. Zool. France, xxxiii. (1908) pp. 59–64 (3 figs.).
§ Arch. Zool. Exper., viii. (1908) pp. 267–326 (3 pls.).
‖ Zool. Jahrb., xxvi. (1908) pp. 45–182 (5 pls. and 1 fig.).

New European and Mediterranean Cicadinæ.* — S. Matsumura notes that new species of beetles and butterflies are hardly to be found in Europe, but there are still plenty of Cicadinæ undiscovered. He himself, during his stay in Europe and the Mediterranean region, has found 90 new species, and he gives a description of about half of these in the present communication. He found in Port Said and Egypt the well-known *Delphax furcifera*, first described by Horvath from Japan, and two other forms injurious to the rice crops in Japan and Formosa—namely, *Nephotettix apicalis* Motsch. and *Nisia nervosa* Leth., were found in Tangiers.

Freezing Insect Larvæ.†—James S. Hine subjected the larvæ of a moth, *Bellura obliqua*, which live in the stems of the cat-tail reed (*Typha latifolia*), to six consecutive nights and days of freezing in water (the temperatures varying from $-6°$ F. to $-16°$ F.). None of the specimens shows signs of injury from the treatment. Three larvæ treated similarly, but without water, received no notable injury. He refers to other cases, and points out that the susceptibility to cold is as marked in some types as indifference to it in others.

Odoriferous Gland of Cockroach.‡—L. Bordas describes the large arborescent gland found in the posterior part of the abdomen in male cockroaches (*Periplaneta orientalis* and *P. americana*). It has been erroneously regarded by some as an annex to the male genital system. The whole of each of the component tubes is glandular. The secretory cells are described, and it is noted that the defensive volatile secretion is distinctly alkaline.

Genitalia of Male Cockroach §—W. Wesché distinguishes the following parts :—(1) a tube for the passage of spermatozoa into the containing apparatus, and a gland (Miall's conglobate) for the production of some semi-viscid fluid, used in the formation of the spermatophore ; (2) the combination of the theca and the hypophallus, penis, and paraphalli, by movements of which the viscid secretion and the spermatozoa are brought together ; (3) the containing apparatus, with a covering-plate held down over it by the apodeme. On excitement, the lever would relax the muscles holding down the cover, and a fourth part —the spinus—bending over would transfix a spermatophore and transfer it to the cloaca of the female. The author compares the parts of the complex mechanism with the similar structures in Diptera.

Insects Injurious to Olives and Figs.‖—G. Martelli discusses the habits and life-history of the olive-fly (*Dacus oleæ*) ; F. Silvestri deals with the number of generations in a year ; F. Silvestri, G. Martelli, and L. Masi have studied the Hymenoptera parasitic on the larvæ of the fly. F. Silvestri discusses *Prays oleellus* ; L. Masi deals with the various parasites of *Dacus oleæ* ; F. Silvestri describes *Occophyllembius neglectus*

* Journ. Coll. Sci. Tokyo, xxiii. (1908) Art. 6, pp. 1–46 (1 pl.).
† Ohio Naturalist, viii. (1908) pp. 258–60.
‡ Bull. Soc. Zool. France, xxxiii. (1908) pp. 31–2. See also Ann. Sci. Nat. (Zool.) vii. (1908) pp. 1–24 (1 pl., 7 figs.).
§ Journ. Quekett Micr. Club, x. (1908) pp. 235–42 (2 pls.).
‖ Boll. Lab. Zool. Scuola Agric. Portici, ii. (1908) pp. 1–358.

g. et sp. n., a new moth whose larvæ eat the olive leaves. G. Martelli records his observations on the scale-insects of the olive and their parasites. F. Silvestri and G. Martelli describe *Ceroplastes rusci*, the scale-insect of the fig.

Study of Thysanura.*—F. Silvestri describes new species of *Lepisma* from South Africa, new genera and species of myrmecophilous and termitophilous Lepismids, new Thysanura from Corfu, and a new Italian species of *Japyx*.

Cephalic Glands of Machilis maritima.†—L. Bruntz finds two sets of head-glands—an anterior pair opening at the base of the masticatory cavity near the mandibles, and a posterior pair opening into the excretory canal of the "labial kidneys." The secretion of the first pair may help in mastication, that of the second pair may help to wash out the excretory products. The salivary glands described by various workers are the labyrinths and excretory canals of the "labial kidneys."

Kidney of Machilis maritima.‡—L. Bruntz finds in the epithelium of the excretory canals of the so-called kidney of this Thysanuran a highly developed network of tracheæ, the branches of which penetrate between the epithelial cells. He also gives some information as to the cytoplasmic structure of the cells composing the excretory canals.

Labial Excretory Organ in Thysanura.§—L. Bruntz distinguishes on this organ, a saccule which eliminates ammoniacal carmin injected during life into the body cavity, and a labyrinth which does the same for carminate of indigo. He describes the details of this labyrinth in *Machilis maritima*, and his histological results confirm the physiological conclusion (based on injections of carmin) that the organ in question is a true kidney.

Structure of Collembola.‖—R. W. Hoffmann has made an elaborate study of *Tomocerus plumbeus* L., with especial reference to the mouth-parts, the cerebral ganglia, the musculature and innervation of the head. He has discovered near the cerebral ganglia two peculiar dendriform bodies—very peculiar cell-complexes—which he proposes to call "head-kidneys."

β. Myriopoda.

Studies on Julidæ.¶—Karl W. Verhoeff continues his researches on Diplopoda in a discussion of the Julidæ and some Polydesmids. He deals with *Leptoiulus* and *Ophiiulus*, *Leptophyllum*, *Micropachyiulus*, *Allotyphloiulus*, *Cylindroiulus*, *Typhloiulus*, *Heteroiulus*, and *Brachyiulus*, and with various morphological questions concerning the appendages.

* Boll. Lab. Zool. Scuola Agric. Portici, ii. (1908) pp. 359–96 (24 figs.).
† Comptes Rendus, cxlvi. (1908) pp. 491–3.
‡ Tom. cit., 871–3.
§ Tom. cit., pp. 1045–7.
‖ Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 598–689 (5 pls. and 18 figs.).
¶ Arch. Natur., lxxiii. (1907) pp. 423–74 (2 pls.).

Cavernicolous Myriopods.*—F. Silvestri describes from the eastern region of the Pyrenees (*a*) two new Diplopoda—*Spelæoglomeris doderoi* g. et sp. n. and *Sp. racovitzæ* sp. n., and (*b*) a new centipede, *Lithobius allotyphlus*.

δ. Arachnida.

Cave Pseudoscorpionidæ.†—Edr. Ellingsen reports on a dozen false scorpions from Pyrenean and other caves, including *Obisium longidigitatum* sp. n., and a new blind variety of *Chthonius tetrachelatus*. It should be noted that some of the dozen species discussed are only accidentally cavernicolous.

ε. Crustacea.

Stridulating Organ in Crabs.‡—W. T. Calman describes a well-developed stridulating organ in males of an African river-crab, *Potamon* (*Potamonautes*) *africanum*. It is formed by groups of modified spines on the upper surface of the coxæ of the first and second pairs of walking legs, and on parts of the free branchiostegal edge of the carapace immediately opposed to them. The organ occurs in some other species of this genus, but it is not known in other genera of Potomonidæ. Stridulation, or the possession of apparently stridulating organs, has been reported in *Matuta*, *Ozius*, *Platyonychus*, *Ocypode*, *Macrophthalmus*, *Sesarma*, and some other Grapsidæ, but in these cases the main portion of the apparatus consists of ridges or granules on the surface of the exoskeleton, never of modified spines, although the latter are commonly found in the stridulating organs of the Arachnida.

Hydrotropism in Crabs.§ — Anna Drzewina has studied the behaviour of shore crabs (*Carcinus mænas*) when taken away from the sea. Even at a distance of over 100 m. they make for the water. This is independent of illumination, time of day, wind, etc. The crabs may ascend inclined planes in making for the sea. They are hydrotropic. When the sand is very wet with rain they do not go straight for the sea. They walk along a bar with water on each side of them, as if equally attracted in the two directions. Crabs that live near high-tide mark are very much more sensitive hydrotropically than those from low-tide mark. Experience counts. In investigating reactions the past of the animal must be borne in mind. Crabs taken from the wrack-covered rocks of the seaweed zone make for rocks and sea-weed patches rather than for the sea.

Visceral Nervous System of Decapods.‖— G. Police has studied this in *Palinurus*, *Homarus*, *Astacus*, *Scyllarus*, *Penæus*, *Galathea*, *Maja*, *Dromia*, *Carcinus*, and other Decapod Crustacea. The anterior portion of the visceral nervous system includes two lateral centres (the paired visceral ganglia) and an unpaired median ganglion. The relations of

* Arch. Zool. Exper., viii. (1908) Notes et Revue, No. 3, pp. lxv.–lxxiii. (14 figs.).
† Tom. cit., pp. 415–20.
‡ Ann. Nat. Hist., series 8, i. (1908) pp. 469–73 (5 figs.).
§ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1009–11.
‖ MT. Zool. Stat. Neapel, xix. (1908) pp. 69–116 (2 pls. and 1 fig.).

these three ganglia are very fully discussed. The posterior portion of the visceral nervous system is formed in Macrura by nerves which arise from the last ganglion of the ventral chain, and from the branches which innervate the telson. In Brachyura the posterior portion of the visceral nervous system comes from the single ventral concentration of ganglia and from the two median nerves passing back from this.

Development of Crayfish.*—Benedykt Fuliński describes the origin of the mesoderm, distinguishing two kinds—the nauplial and meta-nauplial (primary and secondary of Reichenbach). He also deals with the vascular system. The heart-wall consists of two layers of cells, the outer adventitia and the inner muscularis; both arise from the visceral mesoderm; no internal endothelium is discernible. The cavities of pericardium, heart, and blood-vessels must be regarded as remains of the blastocœle. The vessels arise in the visceral mesoderm as gutter-like primordia, in part independently of the heart, in part as outgrowths of its wall. These distal and central primordia of vessels meet to form blood-vessels. The sternal artery is at first paired, but the right or the left component degenerates. The blood-cells are partly mesodermic and partly endodermic in origin.

Cambarus montezumæ.†— E. A. Andrews makes some notes on this Mexican crayfish, which are of interest in themselves and in connection with Ortmann's theory that all the species of *Cambarus* may be derived from ancestors once living in the Mexican region. The sexes seem to be about equal in number: in the lot of 179 purchased in the market of the city of Mexico, 91 were males, and 88 females. Forty-four females had the seminal vesicle on the right side of the body, and 44 were sinistral. The first pleopods are absent in the females. The attached larvæ differ from those of other species in the perfection of their sensory clubs, in the size of spinules, dentation of mandibles, and perfection of the last pleopods. They support the view that the early larvæ of *Cambarus* have degenerated from more active forms in connection with a life of dependence upon the mother.

Regeneration in Asellus.‡—Margarete Zuelzer has studied in *Asellus aquaticus* the influence of regeneration on the rate of growth. The animal can re-grow its antennæ, walking legs, and furca. The new parts appear after the first moult after the amputation, and have the normal size after the third moult. During the regenerating period there is a hastening of the moultings.

New Marine Isopod.§—E. G. Racovitza describes *Anoplocopea hanseni* g. et sp. n., an interesting new Sphæromid from the Gulf of Ajaccio. It is related to *Campecopea* and to the cavernicolous Sphæromids, which Hansen has ranked in the section Monolistrini.

* Zool. Anzeig., xxxiii. (1908) pp. 20–8 (6 figs.).
† Op. cit., xxxii. (1908) pp. 665–9.
‡ SB. Ges. Natur. Freunde Berlin, No. 9 (1907) pp. 283–4.
§ Arch. Zool. Exper., viii. (1908) Notes et Revue, No. 3, pp. lxxxiv.–xc. (1 fig.).

New Terrestrial Isopod.*—R. S. Bagnall describes *Philoscia patiencei* sp. n., found in a hot-house of the Botanical Gardens, Kew. It strongly resembles the common British *Trichoniscus pusillus* in colour, shape, size, and movements, but it seems to belong to the genus *Philoscia*, in the vicinity of *P. couchii*.

New Phyllopods.†—Joh. Thiele describes some interesting new species—e.g. *Apus frenzeli*, from Argentina, *A. madagassicus*, *Streptocephalus distinctus*, *Leptestheria villigera*, *Lynceus madagascarensis*, *Chirocephalus sinensis*.

Species of Corophium.‡ — J. C. Bradley describes *Corophium spinicorne* Stimpson and *C. salmonis*, in regard to which we have hitherto had very vague information. He also gives a diagnostic key for the genus, based on the work of Stebbing.

Annulata.

Œsophageal Pouches of Spionidæ.§ — W. Salensky describes the structure and development of these interesting pockets in larvæ of *Polydora cornuta*, and in adults of *Spio fuliginosus*. They are very similar to those previously described by the author in *Polygordius* and *Saccocirrus*. In the *Polydora* larva there are five symmetrical pouches, but only the first two persist as open clefts. They are comparable to the pouches in Enteropneusts and Chordata, and they increase the plausibility of the view that the Chordata evolved from an Annelid stock.

Neuroglia in Leeches.‖—A. W. Jakubski has made a comparative histological study of the supporting tissue of the nervous system in various Hirudinea—*Hirudo medicinalis*, *Aulostomum gulo*, *Nephelis vulgaris*, *Clepsine sexoculata*, and *Pontobdella muricata*.

Nematohelminthes.

Peculiar Nematode.¶—A. Porta describes *Gnathostoma paronai* sp.n. from the intestine of *Mus rajah*, from the island of Mentawei. The mouth has two lips, there are numerous rows of hooks on the head and strange tridendate scales or lamellæ covering the anterior two-thirds of the body. The genus *Gnathostoma* was founded by Owen in 1836, and is synonymous with *Cheiracanthus* Diesing (1839).

Platyhelminthes.

New Tapeworm in Moorhen.**—Pasquale Mola describes *Tænia marchali* sp.n. from *Gallinula chloropus*, and suggests that the other host is the Mollusc *Cyclostoma elegans*.

* Ann. Nat. Hist., ser. 8, i. (1908) pp. 428–31 (1 pl.).
† SB. Ges. Natur. Freunde Berlin, No. 9 (1907) pp. 288–97 (2 pls.).
‡ Univ. California Publications, Zoology, iv. (1908) pp. 227–82 (5 pls.).
§ Bull. Acad. Imp. Sci. St. Pétersbourg, ser. 6 (1908) pp. 687–708 (23 figs.).
‖ Bull. Internat. Acad. Sci. Cracovie, 1908, pp. 86–91.
¶ Zool. Anzeig., xxxiii. (1908) pp. 8–9 (2 figs.).
** Bull. Classe Sci. Acad. Roy. Belgique, Nos. 9–10 (1907) pp. 886–98 (1 pl.).

Hymenolepis fragilis.* — T. B. Rosseter describes this tapeworm, which he found in a wild duck (*Anas boschas, fera* L.). This is the only recorded instance of its having been found since Krabbe discovered the species in a teal (*Anas crecca* L.), and called it *Tænia fragilis.*

Studies on Cestodes. — O. von Linstow † describes *Hymenolepis furcifera* Krabbe, and *Tatria biremis* Kow., from *Podiceps nigricollis.*

P. E. Garrison ‡ discusses the cestode parasites of man in the Philippine Islands, and describes *Tænia philippina* sp. n., the Cysticercus of which remains unknown.

Ludwig Cohn § describes *Lytocestus adhærens* g. et sp. n., from the intestine of *Clarias fuscus.* It is apparently a Tetraphyllid, but the genital system is quite different from that of previously described genera.

C. v. Janicki ‖ gives a valuable account of the structure of *Amphilina liguloidea* Diesing, showing in particular how it occupies an intermediate position between Trematodes and Cestodes, and that there is much to be said in support of Pintner's view that it is a pædogenetic larval form.

Cytological Study of Triclad Pharynx.¶—A. Korotneff describes a remarkable process of nucleus-expulsion in the cell-plate which limits the wall of the pharynx in Planarians. He thinks that the process is not so unique as it may seem ; thus various authorities have described a nucleus-expulsion in the development of red blood-corpuscles. In the case of the Planarian pharynx the nucleus seems to disappear when the cytoplasm ceases to be plastic or even active.

Parasite of Cockle.** — P. Hallez describes *Proderostoma cardii* g. et sp. n., a parasitic Rhabdocœl which lives in the stomach of *Cardium edule* (in 44 p.c. of those examined). It is one of the Vorticidæ, and is allied to *Graffilla* and to the parasite of *Tellina* which Graff has called *Provortex tellinæ.* It may be called a protandrous hermaphrodite, but spermatozoa are produced after as well as before the period when the ovary functions. Numerous cocoons (over 70) are produced by each animal and are lodged in the connective tissue of the parent. A cocoon contains 1 to 3 ova, usually 2, and the young bore their way out of the parent into the cockle's stomach.

Syncytial Nature of the Gut in Rhabdocœlids.††—P. Hallez has studied the embryos of *Proderostoma cardii*, and finds that the gut has no lumen, that it is a syncytium, and that it does not differ from the connective syncytium except in imprisoning the remains of the yolk. The gut never shows any epithelium, and there is no distinc-

* Journ. Quekett Micr. Club, x. (1908) pp. 229–34 (1 pl.).
† Centralbl. Bakt. Parasitenk., xlvi. (1908) pp. 38–40 (5 figs.).
‡ Philippine Journ. Sci., ii. (1907) pp. 537–50 (5 pls.).
§ Centralbl. Bakt. Parasitenk., xlvi. (1908) p. 134–9 (4 figs.).
‖ Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 568–97.
¶ Tom. cit., pp. 555–67 (2 pls. and 2 figs.).
** Comptes Rendus, cxlvi. (1908) pp. 1047–9.
†† Tom. cit., pp. 1106–8.

tion in structure or origin between gut and mesenchyme. There is no trace of endodermic primordium, not even of the four transitory endodermic cells which are seen in Triclads.

New Species of Rhynchodemus.* — W. E. Bendl gives a description of two new Planarians in this genus—*R. henrici* (European) and *R. purpureus* (East African). He calls attention to the very varied states of the male genital apparatus in different species—from great simplicity in *R. ochroleucus*, to relative complexity in *R. henrici*—and he finds that the forms with simple copulatory apparatus are oriental and Australian, while those with complex parts are palæarctic and Ethiopian. He takes a survey of the known forms, and arranges them in order of differentiation.

Stichostemma Eilhardi.†—Charles Perez found in a garden tank at Bordeaux specimens of this fresh-water Nemertean, which was discovered by F. E. Schulze in an aquarium in the Zoological Institute at Berlin, in 1893, and studied by T. H. Montgomery. Perez notes that the number of eyes is variable, and that protandrous hermaphroditism is very marked.

Incertæ Sedis.

Structure of Echinoderidæ.‡—A. Schepotieff re-affirms, in answer to Zelinka, his previous statements as to the structure of these peculiar forms. He regards the Echinoderidæ as related to Gastrotricha on the one hand, to Gordiacea and Nematodes on the other.

Lower Silurian Brachiopods.§—F. Schmidt discusses a number of forms from the Eastern Baltic, chiefly from Lower Silurian strata, belonging to the genera *Plectambonites* Pand., *Leptæna* Dalm., and *Strophonema* Blainv.

Brachiopod Homœomorphy.‖—S. S. Buckman points out that it is easy but dangerous to group under one name a series of shells of similar appearance, especially when they are in the smooth catagenetic stage, because this smooth stage may have been attained by the loss of different distinctive features, pointing to polygenetic origins. An instructive case in this respect is found in the series of forms called *Spirifer glaber*, a heterogeneous series, including representatives of at least three genetic series, as the author shows.

North American Incrusting Chilostomatous Bryozoa.¶ — Alice Robertson deals with 45 species (in 18 genera) of incrusting Chilostomata from the west coast of North America. Of these species six are new. Some of the descriptions given by Hincks (from scanty

* Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 525–54 (2 pls.).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 476–7.
‡ Zool. Anzeig., xxxii. (1908) pp. 585–9.
§ Bull. Acad. Imp. Sci. St. Pétersbourg, 1908, pp. 717–26.
‖ Quart. Journ. Geol. Soc., lxiv. (1908) pp. 27–33.
¶ Univ. California Publications (Zoology) iv. pp. 253–344 (11 pls.).

material) are amplified. Nineteen of the species discussed are restricted to the west coast of North America, the remainder being cosmopolitan or circumpolar. Attention is directed to the relationship existing between a Cyphonautes-larva frequently met with, and *Membranipora villosa* Hincks, a species rather abundant on the Pacific coast.

Rotatoria.

Rotifers from Gough Island.*—James Murray reports that a small tuft of moss brought from Gough Island by the 'Scotia' expedition harboured *Philodina flaviceps* Bryce, *Callidina angusticollis* Murray, and a Bdelloid egg.

Echinoderma.

Luminosity of Ophiuroids.†—E. Trojan has studied the luminosity of *Ophiopsila aranea*, *O. annulosa*, and *Ophiocantha spinulosa*. It increases with stimulation, is not separable from the animal, has not to do with exuded mucus, and is entirely intracellular. The seat of the luminosity is in some of the epidermic cells.

Observations on Ophiopsila.‡ — A. Reichensperger finds that the brittle-stars of this name have an epithelium which is able to form strong "cilia" at various parts of the surface, e.g. on the "ciliated spines" beside the internal "tentacular scale." The rows of "cilia" keep currents going over the disk, and thus help in nutrition and respiration. The "cilia" are really comparable to the "combs" of Ctenophores; they arise from a cell-complex by the fusion of many individual cilia. The "ciliated spines" are movable by a muscle, and are transitional between lateral spines and tentacular scales. In *O. annulosa* there are usually twelve pores on the Madrepore plate; in *O. aranea* there are very few (1 to 3); both species have five Polian vesicles, instead of four, as in the other five-rayed Ophiuroids that have been studied; the water-vascular system forms a close whole. The tentacles have a strongly differentiated sensory epithelium; in the distal parts of the arms they bear sensory buds.

Japanese and East Indian Echinoderms.§—H. L. Clark gives an annotated list of 70 species, including new species of *Pteraster* (2), *Asterias* (1), *Ophiozona* (1), *Ophioglypha* (1), *Ophiocreas* (1), *Spatangus* (1), and *Molpadia* (1). Except in the case of *Asterias*, a list of the known species is given, and a diagnostic key of great service.

Cœlentera.

Species of Hydra.‖—W. Weltner discusses the distinctions between the German species of *Hydra*. It seems that *H. viridis*, *H. grisea*, and *H. fusca* may be distinguished by their colour, form, length of tentacles,

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 127–9.
† Biol. Centralbl. xxviii. (1908) pp. 343–52.
‡ Zeitschr. Wiss. Zool., lxxxix. (1908) pp. 173–92 (1 pl., 3 figs.).
§ Bull. Mus. Comp. Zool. Harvard, li. (1908) pp. 279–311.
‖ Arch. Natur., lxxiii. (1907) pp. 474–8 (1 fig.).

and the details of the cnidoblasts. There is, however, another form (Brauer's *Hydra* sp., Hefferan's *H. monœcia*) which is near *H. fusca*, but different in the shape of the ova and the manner of depositing the ova. It is diœcious, though it is called *H. monœcia*. Weltner describes well-fed specimens of *H. grisea*, which formed numerous small ova, but showed no hints of testes. The eggs were set adrift and soon broke up. The species is normally hermaphrodite. Unisexual conditions of *H. viridis* have also been noticed. One of the specimens of *H. grisea*, which is figured, had nine eggs, a body 1·1 cm. long, and six tentacles 2·75 cm. long.

Cordylophora in Egypt.*—Charles L. Boulenger reports the abundant occurrence of *Cordylophora lacustris* in the brackish water of Lake Qurun. This is the first record of the genus from Africa. The colonies were very vigorous, the hydrocaulus in some attaining the height of 8 or 9 cm. The lake is 150 miles inland, and at present without communication with the sea, except by the Nile. Geological evidence shows, however, that in late Pliocene times the depression in which the lake lies must have been a large brackish fjord in communication with the Mediterranean.

New Varieties of Hydroids.† — A. Billard describes *Thecocarpus myriophyllum* L. var. *orientalis* v. n. and *perarmatus* v. n., from the eastern part of the Indian Archipelago. The interesting features are the presence of a closed corbula and a supplementary asymmetrical dactylotheca. In specimens showing regeneration there are modified hydroclads similar to the phylactocarps of *Lytocarpus*. The occurrence of this western species in the far east is interesting geographically.

Limnocnida tanganicæ in the Niger.‡—E. T. Browne discusses this fresh-water medusa, which the late J. S. Budgett discovered in the Niger delta. He shares the view of Boulenger that *Limnocnida* is a relic of the fauna of a Middle Eocene sea which stretched across the Soudan to India. This would account for the occurrence of the medusa in localities so far apart as Lake Tanganyika and the Niger delta. It seems probable that a hydroid stage exists, and has still to be discovered. This interesting animal has affinities with the Olindiadæ, but still remains unclassifiable.

New Gorgonids.§ — W. Kükenthal gives diagnoses of some new species. Among Primnoidæ he reports three new species of *Thouarella*, and two of *Primnoella*. He regards *Amphilaphis* as inseparable from *Thouarella*, and he improves the definition of *Primnoella*. To the genus *Acanthogorgia* three new species are added ; *Iciligorgia ballini*, *Spongioderma chuni*, and *Titanidium hartmeyeri*, are interesting new forms. In *Erythropodium stechei* sp. n., Kükenthal finds a transition from the Alcyonid to the Scleraxonial type, and to *Solenocaulon* in particular.

* Ann. Nat. Hist., i. ser. 8., pp. 492–3.

† Arch. Zool. Exper., viii. (1908) Notes et Revue, No. 3, pp. lxxiii.–lxxvii. (3 figs.).

‡ The Work of John Samuel Budgett. Edited by J. Graham Kerr, Cambridge, 1907, pp. 471–80 (1 pl.).

§ Zool. Anzeig., xxxiii. (1908) pp. 9–20.

British Actinians.*—Charles L. Walton discusses the occurrence of *Sagartia luciæ* Verrill at Plymouth. It was found on the American coast about 1892, and in Plymouth Docks in 1896, and it may be that it was introduced into both areas about the same time. The author makes some interesting notes on Sagartiidæ and Zoanthidæ from Plymouth, and in another paper † he reports on fourteen species collected by the 'Huxley' in the North Sea in the summer of 1907.

Porifera.

Inclusion of Foreign Bodies by Sponges.‡—Igerna B. J. Sollas describes *Migas porphyrion* g. et sp. n. from Mozambique, an interesting Monaxonid whose skeleton consists of foreign bodies as well as "proper" spicules. Reasons are given for believing that the inclusion of sand-grains is due to the activity of small granular amœbocytes on the cortex. Other cases — *Euspongia officinalis* var. *rotunda* and *Tedania commixta*—are discussed. In the former the cells of the free surface, in the latter those of the basal surface appear to engulf foreign matter.

Protozoa.

Rhizopods and Heliozoa of the Netherlands.§—H. R. Hoogenraad gives a faunistic account, including over fifty species of *Amœba*, *Vampyrella*, *Arcella*, *Difflugia*, *Quadrula*, *Raphidiophrys*, etc.

Rhizopods from Gough Island.‖ — James Murray reports that a small tuft of moss brought from Gough Island by the 'Scotia' Expedition harboured *Heliopera petricola* Leidy, var. *amethystea* Penard, *Euglypha ciliata* Ehr., another species of *Euglypha*, and a species of *Difflugia*.

Protozoa of Sandusky Bay.¶—F. L. Landacre gives a faunistic list of the Protozoa collected in or near this bay (Lake Erie). The locality is very rich in Infusoria and Mastigophora, and the list is a long one. The bibliography of papers dealing with North American Protozoa will be found useful.

Studies on Colpoda.**—P. Enriques discusses various species of this genus, distinguishing *Colpoda cucullus* O. F. Müller, *C. maupasi* sp. n., and *C. steini* Maupas emend. He also deals with some structural features, e.g. the buccal appendage, which turns out to consist of distinct cilia, not of a continuous membranella.

Regeneration in Ceratium.††—C. A. Kofoid finds that in Dinoflagellate genera, such as *Ceratium*, in which the theca is shared between

* Journ. Marine Biol. Assoc., viii. (1908) pp. 217-14.
† Tom. cit., pp. 215-26.
‡ Ann. Nat. Hist., ser. 8, i. (1908) pp. 395-401 (5 figs.).
§ Tydschr. Nederland. Dierk. Ver., x. (1908) pp. 384-424.
‖ Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 127-9.
¶ Proc. Ohio Acad. Sci., iv. (1908) pp. 421-72.
** Arch. Zool. Exper., viii. (1908) Notes et Revue, No. 1. pp. i.-xv. (10 figs.).
†† Univ. California Publications (Zoology) iv. (1908) pp. 345-86 (33 figs.).

the daughter-schizonts at schizogony, compensatory regeneration of the newly forming part of the exoskeleton occurs. Skeletons of senile appearance may be removed by exuviation, plate by plate, often at the time of schizogony. This exuviation makes it possible for the animal to effect readjustments of specific gravity and specific surface to changing conditions of flotation.

Autotomy of the two antapicals, or of all three horns, is of widespread occurrence among many species of *Ceratium*, especially in those from deeper levels in the sea. It is caused by local resolution of the cellulose wall, and is regulatory in character, preserving in the horns after autotomy the proportions characteristic of the species. Autotomy assists in the adjustment of specific surface, and possibly also of specific gravity to changing conditions of flotation, especially as affected by temperature. Regeneration with or without preceding autotomy may occur in all three horns. It is also regulatory, and tends to preserve the norm of the species.

Turbilina instabilis, a variety of Strombilidium gyrans.*— E. Fauré-Fremiet points out that the oligotrichous Infusorian described by P. Enriques as *Turbilina instabilis* g. et sp. n., is simply a new variety of *Strombilidium gyrans*, described by Stokes in 1888, and more recently by J. Roux. He makes some notes on the posterior attaching filament and on the peculiar nuclear conditions.

Hæmogregarine of Leptodactylus ocellatus.†—J. Lesage reports a new species, *Hæmogregarina leptodactyli*, in the blood of the common Argentine frog, *Leptodactylus ocellatus*, the counterpart of *H. theileri* in the edible frog.

Parasites of Drosophila confusa.‡—E. Chatton and E. Alilaire find in this Muscid, which frequents breweries and the like, and does not bite, two Flagellate parasites, namely, *Leptomonas drosophilæ* sp. n., and *Trypanosoma drosophilæ* sp. n. This is the first record of the occurrence of a "true" trypanosome in a non-biting Arthropod.

Hæmogregarine in Blood of a Himalayan Lizard.§—E. A. Minchin describes *Hæmogregarini thomsoni* sp. n., discovered by F. Wyville Thomson in *Agama tuberculata*, and makes some notes on its intra-corpuscular and free vermicule stages.

Solitary Encystation in Gregarines.‖—C. Schellack finds that among the Eugregarines solitary encystation does not occur in the Polycystideæ (except in abnormal cases), but that it does frequently occur in the Monocystideæ, although its significance is not known. But among the Schizogregarines solitary encystation is the rule in the Aggregatidæ during the period of schizogony.

Influence of Salinity on Contractile Vacuole.¶—Margarethe Zuelzer has found that adding sea-water to the fresh-water in which *Amœba*

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 428–30.
† Tom. cit., pp. 995–6. ‡ Tom. cit., pp. 1004–6 (8 figs.).
§ Proc. Zool. Soc., 1907, pp. 1098–1104 (2 pls.).
‖ Zool. Anzeig., xxxii. (1908) pp. 597–609.
¶ SB. Ges. Natur. Freunde Berlin, 1907, No. 4, pp. 90–4 (2 figs.).

verrucosa was living, till there were equal parts of fresh and salt, led to the disappearance of the contractile vacuole. She was led to this and similar experiments, which require further extension, from a study of marine Heliozoa, in which there is no contractile vacuole.

Trypanosoma congolense.* — A. Laveran inoculated a goat with *T. congolense*, and re-inoculated it after its recovery. The second attack was mild and the cure rapid. Two subsequent inoculations had no result, the goat had become immune. But a subsequent inoculation with *T. dimorphon* was followed by a well-marked infection. Therefore he concludes that *T. congolense* and *T. dimorphon* are distinct species.

* Comptes Rendus, cxlvi. (1908) pp. 853–6.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Karyokinesis in Œdogonium.*—C. van Wisselingh finds that the karyokinesis in *Œdogonium* agrees closely with that of higher plants; the origin of the chromosomes, formation of the nuclear plate, etc., resemble those of the embryo-sac of *Fritillaria* and *Leucojum*. The nucleolus is like that of higher plants, but unlike that of *Spirogyra*. There are nineteen chromosomes of very different lengths, some of which are heterogeneous. The author considers that the production of four swarm-spores upon germination of the oospore, is very significant, and he regards *Œdogonium* as a generation with a simple number of chromosomes, reduction taking place in the oospore. From this it would follow that it exhibits no alternation of generations.

Function of the Centrosome.†—R. F. Griggs has made a cytological study of *Synchytrium*, with the ultimate hope of correlating it with other plants and animals, in such a way as to throw some light on the general problems of cell-organisation, and finally to arrive at some conclusions regarding the relationships of the Chytridiales. While the exact history of the structures here described is provisional, the present work confirms Kusano's statements that the rays of the centrosome inclose the vacuole which surrounds the chromosomes, and form the deeply staining nuclear membrane around it.

Structure and Development.

Vegetative.

Historic Fossil Cycads.‡—G. R. Wieland gives a brief account of *Cycadeoidea etrusca*, *C. Reichenbachiana*, *Williamsonia gigas*, and *Anomozamites minor*.

The vegetative features of *C. etrusca* agree closely with those of the Maryland Cycads; the synangia are clearly of the Marattiaceous type, while the pollen is seemingly mature. *C. Reichenbachiana* has a columnar type of trunk with very large leaf-bases, and its flower-buds agree closely with those of *C. dacotensis*; the author considers that, in the light of the new facts disclosed by this specimen, English writers are mistaken in classing the Cycadeoideæ in the Bennettiteæ, and that the latter term should be used in a very restricted sense. *Williamsonia gigas* forms an

* Bot. Centralbl., xxiii. (1908) pp. 137–56 (1 pl.).
† Ohio Nat., viii. (1908) pp. 277–86 (2 pls.).
‡ Amer. Journ. Sci., xxv. (1908) pp. 93–101 (1 fig.).

important connecting link between *Cycas* and cycadeoidean types with reduced, laterally borne fructifications. This specimen indicates an entire plant with mature fronds and large fruits, having a foliar crown of the same size as a *Zamia* of Florida, with fronds rather less than two feet in length, but with a more slender stem. The author considers that this type favours Newell Arber's idea of a true pre-Angiosperm or hemi-Angiosperm. *Anomozamites minor* is to be regarded as of great importance, in that it is suggestive of relationships to primitive Angiosperms, i.e. the Magnoliaceæ.

Cone of Pinus.*—G. R. Wieland contributes a note upon the accelerated cone growth in *Pinus rigida.* The cluster of cones is formed of fifty-three cones of normal development, and resembles a single huge cone like that of *Pinus Coulteri*; as usual, the main vegetative axis was prolonged. The author regards the production of ferns as the greatest achievement in vegetal evolution, and believes that since Silurian times, Pteridosperms, Gymnosperms, and Angiosperms have been derived from Ferns by such methods as extreme reduction, development of generalised types or organs, rearrangement of fertile axes, etc. The present instance of a simple form of accelerated branching, seems to support this view, by showing that new "emplacements" may lead to an entirely new series of modifications in organs of reproduction.

Reproductive.

Polar Conjugation in the Angiosperms.†—J. H. Schaffner contributes a short note on the origin of polar conjugation in the Angiosperms. The author favours the theory put forward by Porsch, who regards the two synergids of Angiosperms as homologous with the neck canal cells of the Gymnosperms, and the upper polar as equivalent to the ventral cell. In short, the typical embryo-sac of the Angiosperms represents two archegonia, the vegetative cells having disappeared. The present writer quotes two of his own papers in support of this theory, and is of the opinion that all polar conjugations had their origin in the former conjugation of one or both polars with the second sperm. Lack of such fusion may represent either a primitive condition or a more recent parthenogenetic condition. Conjugation without the presence of a second sperm must be looked upon as a special parthenogenetic development. Finally, no endosperm resulting from any of these fusions can properly be called an embryo.

Albumen of Caprificus.‡—L. du Sablon has studied the structure and development of the *Caprificus*, and finds that the albumen will develop in the absence of fertilisation; it is parthenogenetic, and is digested by the larva in the same manner as normal albumen. The fully formed larva completely fills the pericarp, and no trace of albumen then remains. The parthenogenetic albumen differs somewhat from ordinary albumen in its structure, for its cell-walls are destitute of cellulose, and its thick protoplasmic contents contain globoids of varying

* Amer. Journ. Sci., xxv. (1908) pp. 102–4 (1 fig.).
† Ohio Nat., viii. (1908) pp. 255–8.
‡ Rev. Gén. Bot., xx. (1908) pp. 14–24 (1 pl., 6 figs.).

size. The nuclei are large, irregular, and have one or more nucleoli ; there may be several in a single cell. In the rare cases where fertilisation has taken place, the albumen then formed is identical with that found in Smyrna figs. It would appear that the development of parthenogenetic albumen is dependent upon the deposition of the eggs of the *Blastophagus* in the female flowers, for Capri figs which had not been visited, withered before maturity. The impulse given by the visit of the insect replaces that given normally by fertilisation, and upon it depends the future growth of the ovule, pericarp, and albumen.

Physiology.

Chemical Changes.

Colouring Matter of Chlorophyll.*—L. Marchlewski and J. Robel contribute a preliminary note upon their researches in connection with the colouring matter of chlorophyll. The authors have treated an 80 p.c. alcoholic solution of chlorophyll with gaseous hydrochloric acid, and have succeeded in obtaining a black-brown sediment which can be used in the preparation of various chlorophyll derivatives. This sediment, to which the name phyllogen is given, appears to be identical with phæophytin—a substance lately prepared by Willstätter, by the action of oxalic acid on crude chlorophyll solutions—since the physical and chemical properties of both are alike. The authors consider, however, that further investigations are necessary, since the composition of various chlorophyll derivatives is so similar, that constancy of composition does not prove homogeneity.

Change of Colour and Emptying of Decaying Leaves. — M. Tswett† has made experiments upon decaying leaves, and considers that there are two stages in their autumn colouring : shades of red or yellow prevail while the leaf is dying, while grey, brown, and black indicate that the leaf is dead. During the breaking-down and disappearance of plastic materials, the leaves remain fresh and turgescent, even to the epidermal cells, and the experiments show that both epidermal and mesophyll cells retain the semi-permeable plasmatic membrane. Even after leaf-fall, cell-life may be retained for a considerable time. In the second stage the leaves lose their turgescence, owing to a soluble, oxidising enzyme, which is prevented from acting in living leaves through the osmotic limits of the cell-contents. The author confirms the old opinion that the more important constituents of the ash and the nitrogen compounds return from the leaves to the mother-shoot before leaf-fall. Most of the experiments made with regard to the emptying of leaves are unsatisfactory, and only the re-transmission of the nitrogen is at present fully established.

In a second paper ‡ the author states that yellow leaves contain only traces of normal colouring matters, their colour being due to a new pigment, termed "autumn xanthophyll." The latter is probably a

* Bull. Acad. Sci. Cracovie, x. (1907) pp. 1037–9.
† Ber. Deutsch. Bot. Gesell., xxvi. (1908) pp. 88–93.
‡ Tom. cit., pp. 94–101.

degradation product of xanthophyll and carotin. The soluble yellow pigment, obtained by boiling yellow leaves, is a mere artificial product, and has nothing to do with the colouring of leaves while they are still alive, although it acts in this way after they are dead.

General.

Phytecology of the Eastern Part of Kabylia.*—G. Lapie has studied the vegetation of this region, and finds five distinct zones. The ridges of Djurdjura form the cedar zone, and are characterised by such trees as *Cedrus Libani*, *Acer obtusatum*, *Quercus Mirbeckii*, etc., shrubs as *Cratægus laciniata*, *Lonicera arborea*, etc., and small plants such as *Pæonia corallina*, etc., together with a few mosses. The Arbalou and the older summits form the oak zone, the eastern portion being covered with *Quercus Ilex*, while the western sides abound in *Q. Suber*. The third zone is mainly characterised by deciduous oaks, e.g. *Quercus Mirbeckii* and *Q. Afarès*, with an abundant undergrowth of *Erica arborea*, or in more shady districts various species of *Genista*, *Cytisus*, *Pteris*, etc. The fourth zone comprises the lower summits of Numidia, a part of Cretace and Medjanien, and here the sandstone ridges are covered with *Quercus Suber*, together with *Thymus numidicus*, *Erica arborea*, etc. The clay soil of the lower districts and of Numidia is covered with the olive tree, and forms the fifth zone. The undergrowth is composed of *Pistacia Lentiscus*, etc. In general, the sides and summits of the lofty peaks have a xerophytic vegetation ; the summits of lower peaks with a calcareous substratum have similar plants, but if the substratum is of sandstone, the plants are tropophyllous. On the low grounds the chemical and physical nature of the soil exerts great influence on the vegetation, being xerophytic in the region of the olive tree and semi-xerophytic with the evergreen oak. The summits of medium height present the highest degree of humidity, while the presence of a sandstone substratum diminishes the xerophytic character of the vegetation.

Philippine Woods.†—F. W. Foxworthy contributes a preliminary paper with the object of facilitating a ready identification and classification of the commoner Philippine woods. The present paper contains a general and technical discussion of the gross morphology and minute anatomy of wood. This is followed by a brief description of its physical and chemical properties, and information connected with its durability and decay. The author then gives short notes on the structure, appearance, common names, range and usefulness of individual species, and finally a very complete index. It is hoped that this will put an end to the confusion now existing concerning the woods of Manila, and will lead to a better understanding of their uses, and the discovery of further uses. It may also be expected that the present work, together with the parts to be published later on, will be a help to discovering the relationships existing between the woods of the Philippine Islands and those of the rest of the world.

* Comptes Rendus, cxlvi. (1908) pp. 649–52.
† Philippine Journ. Sci., ii. (1907) pp. 351–404 (4 pls.).

Pendulation Theory.*—H. Simroth publishes an account of a theory by which he claims to explain the changes and distribution of living organisms, and to trace back the theory of descent to one uniform cosmic principle. The author supposes that the earth has two fixed poles, between which the north and south axis swings slowly backwards and forwards, and these vibrations indicate the geological periods. The portion of the earth's surface which is most strongly affected by the vibrations lies on a meridian passing through Behring Straits, and is constantly changing its latitude and position towards the sun. The water, under the influence of centrifugal force, acts upon the land, so that dry parts become submerged, and *vice versâ*. The change between land and water gives rise to continued formation of living organisms; and for this reason the human race and all living things, so far as they can be traced back, arose in the eastern hemisphere, and spread thence in ordered lines over the whole of the earth's surface. The author makes the remarkable claim that all creation, the geological periods, volcanoes, earthquakes, meteorological phenomena, etc., can be explained by his theory.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A. F.L.S.)

Tropical American Ferns.†—W. R. Maxon publishes the first of a series of studies of tropical American ferns, designed to include notes on some of the earlier species, corrections in nomenclature, revisions of certain genera and smaller groups of species. He first treats of *Asplenium salicifolium* Linn., and carefully isolates it, showing how it has been misunderstood, and how it has been confused with half a dozen other species. These latter he distinguishes, and adds to them a new species of near affinity. In *Holodictyum* he describes a new Asplenioid genus founded on *Asplenium Ghiesbreghtii* Fourn. and *A. Finckii* Baker. He discusses the identity of *A. rhizophyllum* L.; supplies a new generic name, *Pessopteris*, to replace *Anaxetum* Schott; adds a new species of *Adiantopsis* to the three already recorded for Cuba; and describes *Ananthacorus*, a new genus allied to *Vittaria* and founded on *Pteris angustifolius* Sw. He supplies a chapter of miscellaneous notes and corrections of nomenclature; and concludes with a series of descriptions of twelve new species of various genera.

Philippine Ferns.—E. B. Copeland ‡ gives a list of new or interesting Philippine ferns, among which is a new genus *Davallodes*, founded on the *Leucostegia hirsuta* of J. Smith, which was transferred to *Microlepia* by Presl. Copeland adds to it two new species. In other genera he describes four new species and six varieties, and calls attention

* Die Pendulationstheorie. H. Simroth.
† Contrib. U.S. Nat. Herb., x. (1908) pp. 473–503 (2 pls.).
‡ Philippine Journ. Sci., iii. (1908) pp. 31–39 (6 pls.).

to *Hemigramma latifolia*, *Tectaria crenata*, and some presumed hybrids between the two, illustrating his remarks with photographs.

The same author* publishes notes on the Steere Collection of Philippine Ferns named by Harrington,† and corrects the erroneous determinations.

Copeland ‡ also publishes a revision of *Tectaria*, with special regard to the Philippine species. He defines the groups into which the species fall, supplies a key to the 17 Philippine species, and adds descriptive remarks to each of those species.

Symbiosis in Fern Prothallia.§—D. H. Campbell cites numerous instances of symbiotic association of fungi with higher plants, and also of Schizophyceæ with hepatics and other plants. The presence of mycorhizal fungi in the roots of Cupuliferæ, Orchidaceæ, and Ericaceæ, and in a large number of diverse families, having been considered, more particular attention is directed to the presence of similar endophytic fungi in the prothallia of Pteridophytes—Ophioglossaceæ, Lycopodiaceæ, Osmundaceæ, Marattiaceæ, and Gleicheniaceæ. The author describes his own researches in connection with the last three families, describing and figuring the structure of the endophyte. As to the significance of the endophyte, the author points out that though an important part of its functions is to supply nitrogen compounds to the host, another part may be to supply carbon compounds directly or indirectly, especially where the host is destitute of chlorophyll. The host having acquired the habit of associating itself with the fungus, the gradual development of such purely saprophytic subterranean gametophytes as those of Ophioglossaceæ is readily conceivable.

North American Fern-Hybrids of the Genus Dryopteris.‖—P. Dowell gives an account of some new North American ferns which he describes as hybrids of the genus *Dryopteris*. They are not referable to any single recognised species, but have characteristics in common with two known species; they tend to be sterile, the sporangia being largely abortive; they occur only occasionally, and rarely in large numbers in any one locality; they grow in places favourable for the mingling of the gametes and usually associated with the supposed parent species. Four new hybrids are described, based on the parent species *D. Clintoniana*, *D. intermedia*, *D. Goldiana*, *D. marginalis*.

Anatomy of Sigillaria.¶—E. A. N. Arber and H. H. Thomas give an account of the structure of *Sigillaria scutellata* Brongn., and other Eusigillarian stems, in comparison with those of other Palæozoic Lycopods. The chief material described came from the lower Coal Measures of Shore-Littleborough in Lancashire, two well preserved stems. These, and other specimens alluded to, belong to species of the *Rhytidolepis* section of the Eusigillariæ. The medulla, protoxylem,

* Philippine Journ. Sci., ii. (1907) pp. 405–7.
† Journ. Linn. Soc. Bot., xvi. (1877) p. 25.
‡ Philippine Journ. Sci., ii. (1907) pp. 409–18.
§ Amer. Nat., xlii. (1908) pp. 154–65 (figs.).
‖ Bull. Torrey Bot. Club, xxxv. (1908) pp. 135–40.
¶ Proc. Roy. Soc., ser. B, lxxx. (1908) pp. 148–50.

primary and secondary wood, and medullary rays are preserved. Phloem, inner cortex and cambium are not preserved. Ligules and ligular pits are found to be present. The course of leaf traces has been followed. The trace consists of a double xylem strand. The bundle is collateral without secondary wood. The parichnos is present. The Eusigillariæ are compared anatomically, first with the Subsigillariæ, and then with *Lepidodendron* and *Lepidophloios*.

Bryophyta.

(By A. Gepp.)

British Mosses.—C. H. Waddell * states that *Orthotrichum diaphanum* var. *aquaticum*, found by Nicholson on willows near Lewes, Sussex, also occurs on trees below flood-mark by the river Lagan, at Magheralin, Co. Down.

D. Lillie † gives lists of mosses collected in Shetland, Orkney, Caithness, and West Sutherland, which are additional to the records of the Census Catalogue of the Moss Exchange Club.

P. Culmann's ‡ description of *Barbula* (or *Didymodon*) *Nicholsoni*, a new moss discovered on the wall of a culvert, Amberley Wild Brooks, Sussex, by W. E. Nicholson, is reproduced.

W. G. Travis § records the discovery of the rare moss, *Swartzia inclinata*, on boggy ground at Rainford Junction, in Lancashire. It was fertile and was growing associated with *Lophozia badensis*. It was probably the same species, and not *S. montana*, which was collected by Skelhorne in the neighbourhood more than fifty years ago.

Notes on European Bryophytes. ‖—A. Coppey discusses in some detail the relationship of his *Barbula papillosissima*, collected at an altitude of 7000 to 8000 feet on Mt. Khelmos (Aroania), in Greece; showing that it is identical with a presumed Sardinian moss named *B. ruralis* var. *hirsuta* by Venturi, but it is specifically distinct from *B. ruralis*, being characterised by the presence of a remarkable solitary hollow papilla upon each leaf-cell. P. Culmann ¶ publishes a descriptive note upon the true *Seligeria brevifolia* of Lindberg, which he has succeeded in finding at three stations in Switzerland; and shows how it differs from *S. pusilla* var. *Seligeri*, regarded by Limpricht as a synonym of the former moss. He also records some new hepatics for Canton Berne. Potier de la Varde ** having discovered the rare Alpine hepatic *Marsupella Sprucei* near Guingamp in Brittany, describes its habitat, its conditions of growth, and the difficulty of finding it at all. E. Ballé †† gives an enumeration of pleurocarpous mosses collected in the environs of Vire, Calvados.

Italian Muscineæ. ‡‡—G. Zodda publishes a first contribution to the moss-flora of the province of Belluno, based upon a collection of 106

* Journ. of Bot., xlvi. (1908) p. 172.
† Loc. cit.
‡ Tom. cit., p. 173.
§ Tom. cit., pp. 123–4.
‖ Rev. Bryolog., xxxv. (1908) pp. 74–9.
¶ Tom. cit., pp. 79–80.
** Tom. cit., p. 81.
†† Tom. cit., p. 82.
‡‡ Malpighia, xxi. (1907) pp. 479–511.

mosses and 18 hepatics made by R. Pampanini in the heart of the dolomitic Alps of Cadore. He gives a list of the localities visited by Pampanini, some notes upon the previous bryological literature concerning this region, and adds some notes upon distribution. Three species and 11 varieties are new to the Italian moss-flora; 13 mosses and 6 hepatics are new for the province of Belluno; and 39 species or varieties are new for the province of Veneto. Specially notable are the very rare species *Grimmia Holleri* and *Bryum bimoideum*.

North American Mosses.*—A. J. Grout publishes the fourth part of his "Mosses with Hand-lens and Microscope," a non-technical handbook of the more common mosses of the north-eastern United States. It is freely illustrated from standard works, provides keys to the genera and species, and emphasized descriptions with helpful annotations. The purpose of the book is to enable moss-students to identify all the less rare species with as little microscope work as possible.

Hepaticæ of Puerto Rico.†—A. W. Evans publishes his ninth contribution to the study of the hepaticæ of Puerto Rico, giving an account of the following genera:—*Brachiolejeunea*, *Ptychocoleus*, *Archilejeunea*, *Leucolejeunea*, and *Anoplolejeunea*. 1. Two species of *Brachiolejeunea* were already known from the West Indies; to these is now added a new species, *B. insularis*. 2. *Ptychocoleus* Trev. is here used to replace *Acrolejeunea* as defined by Spruce and by Schiffner; *P. polycarpus* occurs in Puerto Rico and is re-described by Evans. 3. *Archilejeunea* is represented by *A. viridisima* in Puerto Rico; a careful description of this species is supplied. 4. The widely distributed *Leucolejeunea xanthocarpa* occurs in Puerto Rico, and is re-described. 5. *Anoplolejeunea* of Schiffner was monotypic. Evans finds the type to be indistinguishable from *Lejeunea conferta* Meissn., and unites the two, giving a detailed description of the species. Many critical annotations are included in the paper.

Mosses of the Canaries.‡—H. N. Dixon gives an account of a small collection of mosses made by Miss Wells in the Canary Islands. They are twenty-two in number; four of them are additions to the moss-flora of the Canaries, and five to the moss-flora of the Atlantic Islands as a whole. *Brachythecium purum* var. *canariense* is a curious novelty from Palma.

Bryophytes of French Guinea.§—E. G. Paris reports upon a further collection of mosses collected by Pobeguin in Fouta-Djallon, in tropical French West Africa, including 20 mosses, six of which are new, and 3 hepatics, one of which is new. In a brief summary the author points out that before 1902 not a Bryophyte was known from French Guinea, but that owing to the efforts of three French collectors—Normand, Maclaud, and especially Pobeguin—in six years 176 mosses

* New York City: published by the author, pt. iv. (1908) pp. 247–318 (figs.).
† Bull. Torrey Bot. Club, xxxv. (1908) pp. 155–79 (3 pls.).
‡ Journ. of Bot., xlvi. (1908) pp. 184–6.
§ Rev. Bryolog., xxxv. (1908) pp. 57–61.

and 29 hepatics have been gathered in that region, and of these 128 mosses (73 p.c.) and four hepatics (14 p.c.) have proved to be new to science.

Mosses of the Belgian Congo.*—J. Cardot publishes preliminary diagnoses of mosses collected in the Belgian Congo by Laurent and Paque, and near Oussouye on the Casamance by Mathieu. He hopes later to give fuller descriptions accompanied by figures. Eighteen novelties are described, and most of the specimens from the French Congo are previously unknown species of *Fissidens* or *Calymperes*.

Mosses of the Philippine Islands.†—V. F. Brotherus publishes a list of 98 mosses collected in the Philippine Islands by Merrill and others. Twenty-two of the species are new to science. New also is the genus *Merrilliobryum*, agreeing with *Fabronia* in structure of stem and leaves, but differing much in its sporogonium.

Hepatics of New Caledonia.‡—E. G. Paris gives a list of 16 hepatics collected by Le Rat in New Caledonia, and determined by Stephani. None of them are new to science, but some are recorded for New Caledonia for the first time.

Studies of Javanese Anthocerotaceæ.§—D. H. Campbell has published studies on some Javanese Anthocerotaceæ. He separates off from *Anthoceros* certain species, which had been grouped together on account of their spiral elaters and the absence of stomata on the sporogonium, into a new genus *Megaceros*, which has the additional characters of multiple chromatophores and green spores. Two new species from Java are added. They are both monœcious. The thallus-form and apical growth and archegonia are as in typical *Anthoceros*; the large solitary antheridium is more like that of *Dendroceros*. The early divisions in the embryo recall *Dendroceros*; the amount of sporogenous tissue is great as in *Notothylas*. As in *Anthoceros*, the primary chromatophore of the spore-mother-cell divides into four before the nucleus divides; the spores are small and thin-walled and contain a large chloroplast. The elaters are multicellular as in *Dendroceros*. The sporophyte has much green tissue but no stomata; the cells contain 2–6 chromatophores. The foot is large and has root-like extensions. Campbell also treats of *Notothylas javensis* and of two unnamed Javan species of *Dendroceros*. Finally he discusses the affinities of the Anthocerotaceæ, and would keep them in a special class distinct from both Marchantiales and Jungermanniales, though perhaps approaching somewhat to *Cyathodium* in the former of these two.

Antiquity of the Hepaticæ.‖—D. H. Campbell discusses the distribution of the Hepaticæ and its significance. He is strongly of opinion that, though fossil remains of indubitable Bryophytes are very

* Rev. Bryolog., xxxv. (1908) pp. 62–7.
† Philippine Journ. Sci. Manila, iii. (1908) pp. 11–30.
‡ Rev. Bryolog., xxxv. (1908) p. 62.
§ Ann. of Bot., xxi. (1907) pp. 467–86; xxii. (1908) pp. 91–102 (5 pls. and figs.).
‖ New Phytologist, vi. (1907) pp. 203–212.

scarce in Palæozoic formations, we must not conclude that the hepatics are therefore of comparatively late origin. They are almost as scarce in the later formations. Their delicate leaves do not lend themselves to preservation, and their elaters and other more durable structures are too small to attract notice. The existing geographical distribution of the hepatics is a line of research that would throw light on the degree of antiquity of the group; but it has not been much examined. The spores are not suited for wide distribution, but usually require speedy germination. After briefly surveying the distribution of other groups of plants, the author treats that of hepatics in more detail, indicating broadly the distribution of several genera of wide range. The obvious conclusion from such a study of the hepatics is the small number of genera and their wide distribution, especially in case of the genera of older type. No recently developed group could have acquired such a wide distribution of its simpler forms with so little modification.

Calypogeia trichomanis and its Allied Forms.*—C. Meylan publishes some researches upon *Calypogeia trichomanis* Corda. This old species has in recent years been divided into six species : *C. trichomanis*, *C. suecica*, *C. sphagnicola*, *C. submersa*, *C. fissa*, *C. Mulleriana*. Meylan has studied each of these species or subspecies carefully in the field and under the Microscope. He divides his subject into two parts, treating first of the forms which avoid growing in marshes, and secondly of the marsh forms. Having to deal with plants mostly sterile, he employs vegetative characters ; and, stating that the shape of the upper part of leaf is of very little value owing to its variability on the same plant, he prefers to employ as characters the shape of the amphigastria and the areolation of the leaves. Having discussed the various forms, he concludes that there are two types or well defined species :—*C. trichomanis* and *C. suecica*, the first growing always on humus and bogs, the second always on rotting wood ; that the former has the varieties *Neesiana*, *fissa*, *Sprengelii* (with a form *submersa*) ; that the latter has a variety or form *erecta*. He adds that there remains a group of forms which grow associated with species of *Sphagnum*, namely *C. sphagnicola* ; but he prefers to regard it, not so much a species, as a variety of the same value as *Sprengelii*. In fine, *C. trichomanis* (exclusive of *C. suecica*) varies enormously according to environment, producing a multitude of forms useless to classify, as they grade into one another.

Monograph of Philonotis.†—G. Dismier publishes a monograph of the French species of *Philonotis*, and indeed of all the European species, for he treats of all the other European forms of this difficult genus which have been described as species. He bases the delimitations of the species upon the form and direction of the cauline leaves, their areolation, denticulation, flat or revolute margins, and the position of the papillæ on the cells. The species recognised by him are eight :—*P. rigida*, *P. marchica*, *P. capillaris*, *P. cæspitosa*, *P. fontana*, *P. tomentella*, *P. seriata*, *P. calcarea*. The result is that the numerous puzzling forms are gathered into clearly defined groups.

* Rev. Bryolog., xxxv. (1908) pp. 67–74.

† Mém. Soc. Sci. Nat. Math. Cherbourg, xxxvi. (1908) pp. 367–428. See also Rev. Bryolog., xxxv. (1908) p. 83.

Note upon Hookeria papillata.*—E. G. Paris shows that No. 93 of the Cuban Mosses gathered by C. Wright (1856–8) was wrongly referred by Sullivant to *Hookeria papillata* Mont.; that it is really *H. crenata* Mitt., which species Mitten founded upon No. 92 of the same exsiccati (wrongly referred to *H. Merkelii* Hornsch). Sullivant, says Paris, made the same blunder over Montagne's species in connection with a specimen collected by the Wilkes Exploring Expedition,—a specimen which he had previously distinguished as *H. oblongifolia*.

Fruit of Campylopus polytrichoides described.†—A. Luisier has brought together the few facts hitherto known about the sporogonia of *Campylopus polytrichoides*, old material only, collected in Portugal. In the past few years further examples have been found on the coast of Portugal. And Luisier, having himself been fortunate enough to find some of these specimens, has drawn up a description of pedicel, capsule, calyptra, and peristome, and illustrates it with some figures.

Abnormal Archegonium in a Hepatic.‡—F. M. Andrews describes and figures an abnormal form of archegonium observed in *Porella platylla*. It contained two perfectly formed egg-cells, each with a row of canal cells. He also figures some branched elaters found in the same species.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Nomenclature of Algæ.§—G. B. de Toni has been appointed secretary of the algological section of the special committee appointed by the Botanical Congress of Vienna in 1905, to consider the subject of Cryptogamic Nomenclature, and report to the Congress of Brussels in 1910. He asks for the opinions of algologists upon general problems or particular cases of algological nomenclature, as an aid to the settlement of the priority of generic names, and the best way of settling the claims of various authors. He gives some instances of changes attempted by Trevisan, Ruprecht, O. Kuntze; of objections raised by Le Jolis; of views advanced by Nordstedt—for instance, that for the Desmidieæ the starting-point should be "The British Desmidieæ" of Ralfs (1848).

Fixation of Nitrogen by Algæ.‖—B. Heinze gives the results of his researches into the question of the fixation of free nitrogen by algæ, and supplies a summary of the literature of the subject. Some bacteria have this property, but fungi have not. Some algæ, such as *Nostoc*, possess the power to a certain degree; association with such nitrifying organisms as *Azotobacter*, however, greatly promotes the function.

* Rev. Bryolog., xxxv. (1908) p. 61.
† Bull. Soc. Portugaise Sci. Nat., i. (1907) pp. 89–91.
‡ Bot. Gazette, xlv. (1908) p. 340 (figs.).
§ Nuov. Notar., xix. (1908) pp. 67–71.
‖ Centralbl. Bakt., xvi. 2 (1906) pp. 640–53; 703–11.

Japanese Algæ.—K. Okamura,* who has published six numbers of "Illustrations of the Marine Algæ of Japan" during the last few years, is now continuing the series under the title of "Icones of Japanese Algæ." Six parts have already appeared, each of which contains five quarto plates. The figures show the habit of each alga as well as the details of its structure, and they are all accurately and clearly drawn. Descriptions in English are given for those species which are either new or little known.

Algæ of Middle Europe.†—W. Migula continues the publication of his "Kryptogamen-Flora," which occupies vols. v.–vii. of Thomé's "Flora von Deutschland, Osterreich und der Schweiz." The Chlorophyceæ are brought to an end in Part 48, a full index being provided. In Part 49, the treatment of the Rhodophyceæ is begun; the group of the Bangiales occupying but a few pages, the remaining group—Florideæ—is soon reached, and the following four orders of Florideæ are discussed—Nemalionales, Gigartinales, Rhodymeniales, and Cryptonemiales. Keys to the families, genera, and species are supplied; and brief and clear descriptions of them all are given, further assistance being afforded by means of figures.

Oceanic Algæ.‡—A. Mazza continues his studies of marine algæ, and treats of some of the Delesseriaceæ, giving critical notes upon three species of *Martensia* and ten species of *Nitophyllum.*

Calcareous Algæ.§—M. Foslie publishes the fourth part of his Algological Notes, in which he describes a number of species of *Lithothamnion*, *Goniolithon*, *Lithophyllum*, *Melobesia*, and *Mastophora*, from all parts of the world, most of them new to science. On the species previously known he gives interesting notes. The paper is written in Norwegian.

Griffithsia acuta Zanard.‖—G. B. De Toni gives an account of *Griffithsia acuta*, an unpublished species found in Zanardini's herbarium, and gathered at Alexandria in Egypt, perhaps by Portier. It is a sterile plant. De Toni compares its dimensions carefully with those of *G. furcellata* and *G. Duriaei*, and other species.

Critical Notes on Laminariaceæ.¶—W. A. Setchell publishes some critical notes on Laminariaceæ. He has succeeded in discovering what must be the type of Areschoug's *Hafgygia Ruprechtii*, misplaced and labelled with another name in Areschoug's herbarium at Stockholm. In habit, colour, lack of bullæ, it closely resembles *Laminaria bullata* f. *cuneata* of Setchell and Gardner, but appear to differ in length of stipes and position of mucilage ducts in the stipes. There is great need for a study of the forms referred by Kjellman and others to *L. bullata.*

* Icones of Japanese Algæ. Tokyo: 1907–8, i. Nos. 1–6 (30 pls.).

† Gera: F. von Zezschwitz, vi. 1 (1907) lief. 40–8, pp. 673–918 (47 pls.); also vi. 2 (1908) lief. 49–53, pp. 1–144 (25 pls.).

‡ Nuov. Notar., xix. (1908) pp. 49–66.

§ Kgl. Norske Vidensk. Selsk. Skrift, No. 6 (1907) pp. 30.

‖ Nuov. Notar., xix. (1908) pp. 85–9.

¶ Tom. cit., pp. 90–101.

Setchell also treats of the species grouped by Griggs under his recently established genus *Renfrewia*. *R. parvula* Griggs is identical with *L. ephemera* Setchell. Setchell states in detail his reasons for regarding *Renfrewia* as not separable from *Laminaria*, and as not being a primitive form of *Laminaria*, but as a later form modified by environment. Setchell next discusses the fructification of *Pterygophora*, and its relationships which he thinks to be with *Alaria* rather than with *Laminaria*. The unknown species *Alaria marginata* of Postels and Ruprecht seems to be identical with *A. prælonga* and *A. laticosta* of Kjellman. Setchell also treats of some other species of *Alaria*, etc.

Scytothamnus australis.*—C. M. Gibson writes on the morphology and systematic position of *Scytothamnus australis*. She gives a short history of the plant, and then describes the mature thallus, which is composed of three zones, the thallus being solid, and not hollow. Hairs were found on all parts of the thallus, having no connection whatever with the reproductive organs. They were traced by the author from the earliest stages, close to the apex of the thallus. An examination of the growing point showed that the apex is occupied by a group of meristematic cells and not by a definite apical cell. The apex is always blunt. Sporangia are only found on plants in which growth in length has ceased and the tissues are quite mature right up to the apex. They are unilocular only, occur all over the surface, and are formed from modified cells of the limiting layer. Stages in the development of the sporangia are described and figured. *Scytothamnus* lies between Dictyosiphonaceæ and Chordariaceæ as regards the mature vegetative structure. It agrees with the former in the position and structure of its sporangia, but differs from it in the lack of an apical cell. The author shows that *Scytothamnus australis* is quite distinct from *Dictyosiphon fasciculatus*, and that *S. rugulosus* is also a good species.

Algal Blight on Tea.†—C. M. Hutchinson gives an account of *Cephaleuros virescens*, the "red rust" of tea, an alga belonging to the Chlorolepideæ group. It does much damage to the tea crops of North-east India, and, it is said, to mango-trees in Bengal. It attacks the leaves and stems of the former and the stems of the latter. It settles in crevices of young plants and forms yellow patches, and pierces the tissues. It is propagated by means of water-borne zoospores and of air-borne sporangia.

Structure of Diatoms.‡—W. Bally discusses the gelatinous substance which is found surrounding the girdle of certain marine plankton diatoms, notably species of *Chætoceras*. He describes the neutral results obtained by staining both fresh and preserved material, and makes suggestions as to the origin and nature of the substance observed; and he thinks it consists most probably of gelatinous matter which has exuded between the girdle and the valve. Minute investigation has shown the author that only one, and that the older, of the two valves

* Journ. Bot., xlvi. (1908) pp. 137–41 (2 pls.).
† Mem. Depart. Agric. India (Bot.) i. No. 6 (1907) 35 pp. (8 pls.).
‡ Ber. Deutsch. Bot. Gesell., xxvi*a*. (1908) pp. 147–51.

remains in connection with the girdle, and that the girdle consists of a simple hollow cylinder, while the valves show a strong incurving on the side turned towards the girdle. Thus the connection between valve and girdle is a very loose one. For a final explanation of the gelatinous external band investigation of other species is necessary. It seems to be absent in *C. boreale* and *C. constrictum*, while in *C. decipiens*, the species principally studied, it was not always present. As regards the object of the gelatinous band, the author is of opinion that it is connected with the floating apparatus, and indeed bears the same relation to the external rays of *Chætoceras* as the silk of an umbrella does to the ribs.

Membrane of Diatoms.*—L. Mangin has studied the constitution of the membrane of diatoms, and finds that it is not composed, as has been believed, of cellulose or of something akin to that substance; but that it responds, on the other hand, to pectic reagents, and is therefore clearly composed either of pecten or of substances closely akin to it. Diatoms which are fresh or have been preserved in alcohol do not respond well to the action of stains, and it is necessary to prepare the material by the use of certain salts (iron-alum, ammonium vanadate, etc.), and stain with old hæmatoxylin-alum.

Other methods of preparation are described also, and the use of ruthenium and of old hæmatoxylin-alum is recommended previous to mounting in Canada balsam. Comparison is drawn between the constitution of the membrane of Diatoms and that of Peridinieæ, in which the substance is almost pure cellulose. The author finds that calcination is a considerable aid to the study of the minute structure of the valves, but the process can only be applied to bottom forms, as plankton diatoms are too delicate. The staining of plankton is an important factor in a study of their structure, and has enabled the author to correct certain erroneous views concerning *Chætoceras* and other genera. He divides *Chætoceras* into two groups, which he briefly defines, and into one of which he sinks Schütt's genus *Peragallia*. A paper containing more details on the subject is promised shortly.

New England Desmids.†—J. A. Cushman records 49 species of *Closterium* from New England, 19 of which have not been noted before from that district. One new species, *C. Novæ-Angliæ*, is described: it is one of the longest species of the genus, and is near *C. Calamus* Playfair. A short diagnosis and measurements are given for each record, as well as references to literature, and reliable plates. In a short introduction the author describes the principal characters of the genus and of the two groups into which it is divided.

Origin of Californian Petroleum.‡—A. M. Edwards discusses the origin of petroleum in California, and states his reasons for supposing that the connection observed between deposits of marine diatoms and asphalt and petroleum indicates that petroleum rock-oil and asphalt are products of the decomposition of beds of marine diatoms.

* Comptes Rendus, cxlvi. (1908) pp. 770–3.
† Bull. Torrey Bot. Club, xxxv. (1908) pp. 109–34 (3 pls.).
‡ Nuov. Notar., xix. (1908) pp. 72–78.

Origin of the Bacillariæ.*—A. M. Edwards discusses the origin of the Bacillariæ. He has searched shaded damp places for microscopic algæ, and states that he has found in such places *Lyngbya muralis*, and seen it die down and grow into *Spirogyra* and *Cladophora*. And he also declares among them are particles as of clay, which turn into *Monas lens* and then into *Navicula quadrangula*. He gives a list of diatoms found in the sediment from a New Jersey stream-bed, allowed to stand in the sun.

Diatoms of the Jura Lakes.†—P. Prudent adds to his studies of the diatomaceous flora of the lakes of the Jura, some lists of the species collected by him in the Lac d'Aiguebelette and the Lacs de Saint Jean-de-Chevelu. The former, situated at an altitude of 1260 ft. in Savoy, furnished 117 species, two of which are new for the French flora, and some of which are rare forms, and one of which is a marine species. On the other hand the two lakes of Saint Jean-de-Chevelu produced 86 forms, one being new and another quite rare.

Phytoplankton of Scotch and Swiss Lakes.‡—H. Bachmann publishes a comparative study of the Phytoplankton of the lakes of Scotland and of Switzerland. He visited Scotland in 1905 and published his results in 1907. In the present paper he reduces his results to a more compact form. He first treats in a general manner of the eight Scottish lakes he visited—depth, dimensions, altitude, climate, temperature, and their effects. He then shows in a table all the species of phytoplankton found in each Scottish lake, indicating the comparative frequency. In the following list he gives a systematic enumeration of the plankton found in fifteen Swiss lakes. He then states the results that follow from a comparison of the two floras. Some of the more interesting species he discusses at greater length, giving for instance numerous figures of *Ceratium hirundinella* from thirty Swiss lakes and from the Scotch lochs. *Chlamydomonas stipitata* is a new species. Notes on the vertical distribution and the annual periodicity of the phytoplankton are added.

BACH, E. B.—**The Characeæ of Michigan.**
[Partial list of the Characeæ of Michigan—13 species; and appeal to botanists to collect more.]
Michigan Acad. Sci., Ninth Report, 1907, p. 126.

DE TONI, G. B.—**Matteo Lanzi.**
[Born 1824, died 1908. Expert diatomist and mycologist; residing at Rome. Account of his life and work, with an enumeration of his published papers.] *Malpighia*, xxi. (1907) pp. 512–18.

LIGNIER, O.—**Sur une Algue Oxfordienne (Glœocystis oxfordiensis sp. n.).**
[On *Glœocystis oxfordiensis*, a new species of fossil algæ, found on a fragment of *Araucarioxylon* in the Oxford Clay in Calvados.]
Bull. Soc. Bot. France, liii. (1906) p. 5 (fig.).

* Nuov. Notar., xix. (1908) pp. 79–84.
† Ann. Soc. Bot. Lyon, xxxi. (1906) pp. 51–8. See also Nuov. Notar., xix. (1908) pp. 104–6.
‡ Arch. Sci. Phys. Nat. Genève, xxv. (1908) pp. 249–68, 360–72 (figs.).

Fungi.

(By A. Lorrain Smith, F.L.S.)

Obituary Notice of W. A. Kellerman.*—While on a scientific expedition to Guatemala, the editor of the Journal of Mycology died very suddenly from malarial fever. He had gone there for the fourth time to collect material, and the trip was almost completed. Kellerman was born in 1850; the latter years of his life he was Professor of Botany in the Ohio State University. Every moment he could spare from class and laboratory work was devoted to the collecting of plants and building up herbaria. Since 1902 he had been the sole editor of the Journal. He has been a devoted worker in the cause of Mycology. Nearly eleven pages are occupied by a list of his publications in various branches of botany, though chiefly on parasitic fungi. A portrait of Kellerman forms the frontispiece.

Development of Saprolegnia monoica.†—P. Clausen found that the researches of Davis and Trow on the cytology of the Saprolegniaceæ led the authors to opposite results, and that these results were not in harmony with those of more recent studies on Ascomycetes and Basidiomycetes. He gives a sketch of previous work, and describes his own methods of culture with ants' eggs as substratum, and of fixing, colouring, and embedding. In this species both oogonia and antheridia are formed, the latter arising from the stalk that bears the oogonia, though occasionally they are borne on more distant hyphæ. The oogonia are multinucleate and full of plasma in the early stages. Later, degeneration sets in, and there is only a thin layer of plasma and a few nuclei left. The nuclei divide by mitosis simultaneously, and the oosphores are formed round certain of the nuclei, each one being uninucleate and each nucleus having at the beginning a centrosome. The antheridia pierce the membrane of the oogonium, and either branch or remain simple; they apply themselves to the oosphere and a nucleus passes over which fuses with the oosphere nucleus; the older oospores are always uninucleate. The small size of the nuclei made it impossible to count the chromosomes exactly: he reckoned about 10 to 14, but it is certain that no reduction took place, and Clausen was led to the conclusion that it did not occur until germination of the oospore. In this respect it agrees with the process observed in the zygote germination of *Coleochæte*.

Parasitic Laboulbenia.‡—Edouard Chatton and François Picard describe one of these fungi, *Trenomyces histophorus* g. et sp. n., characterised by its having advanced further on the way to parasitism than any other member of the same order. The basal cell of the organism is spherical; it pierces by a tube the cuticle of the insect, and feeds on the adipose tissue—without, however, seriously injuring the host.

Erysiphaceæ of Japan.§—E. S. Salmon publishes a supplementary paper based on a collection of examples on 120 different hosts sent to

* Journ. Mycol., xiv. (1908) pp. 49-63.
† Festschrift. Deutsch. Bot. Gesell., xxvi. No. 5 (1908) pp. 144-61 (2 pls.).
‡ Comptes Rendus, cxlvi. (1908) pp. 201-3.
§ Ann. Mycol., vi. (1908) pp. 1-16.

him from Morioka, Province Rikuchu. Salmon's determinations are made on morphological lines, and by this means he brings together very diverse hosts. He finds a new variety of the gooseberry mildew, *Sphærotheca mors-uvæ*, growing on leaves of *Stephanandra*; several new varieties are described, and in many cases new hosts for species already known. He appends an alphabetical list of the hosts, with their parasites.

Two little-known Myxosporiums.*—C. W. Edgerton describes two fungi, one parasitic on *Liriodendron tulipifera*, the other on apple and pear trees. He considers them new species of the genus *Myxosporium*. A general account is given of bark-canker of apple and pear caused by the fungus, and contrasts are drawn with those that cause rot. The species on *Liriodendron* is also described; the twigs on which it grew were dead, though it was not ascertained that the fungus had killed them. Edgerton calls his new fungi *Myxosporium corticolum* on apple, and *M. longisporum* on the tulip tree.

Research on Fungi imperfecti.†—K. Klebahn has experimented with the fungus *Septoria piricola*, a parasite on the leaves of *Pyrus communis*. He describes the action of the mycelium on the host-plant, and the conidia of the fungus, comparing them with other species recorded on the same leaves, *Depazea piricola* and *D. pyrina*, *Septoria nigerrima*, *S. Pyri*, and also *S. dealbata*, all of which he finds to be synonymous with *S. piricola*. The ascus form, *Mycosphærella sentina*, is also described. Leaves of *Pyrus* were infected with the ascospores, and pycnidia were produced; cultures were also made on plum-agar, and the pycnidia of *Septoria piricola* were again formed.

Hyphomycetes.‡—G. Lindau's latest fascicle deals with a series of genera characterised by brown muriform conidia of varying form, a difficult group to arrange. One subdivision is made to consist of but one genus, *Sirodesmium*, distinguished by its muriform spores borne in chains on a very short stalk. Lindau retains both *Dictyosporium* and *Speira*, very closely allied genera. *Stemphylium*, *Mystrosporium*, and *Macrosporium* form another well-nigh inseparable trio of genera, badly differentiated. As usual the genera are well illustrated, though more figures would have been welcome.

Systematic Position of Achorion and Oospora.§—F. Guéguen has produced in his cultures of *Oospora* chlamydospores and spiral hyphæ, with two to five spirals, which break up into smaller portions, something like a letter S or small open rings. He has also demonstrated by his cultures that *Oospora* has a septate mycelium, which removes it from the Microsiphoneæ. Guéguen finds that spirals are characteristic of the Gymnoasceæ, and for that and other reasons he considers *Oospora* a conidial form of that group. He places *Achorion*, which is allied to *Trichophyton*, in the same systematic group as *Oospora*.

* Ann. Mycol., vi. (1908) pp. 48–53 (2 figs.).
† Zeitschr. Pflanzenkr., xviii. (1908) pp. 5–17 (1 pl.).
‡ Rabenhorst's Kryptogamen-Flora, i. abt. 9, lief. 108 (Leipzig, 1908) pp. 177–240.
§ C.R. Soc. Biol. Paris, lxix. (1908) pp. 852–4.

Uredineæ.*—J. B. Dandeno supplies an account of experiments and observations on *Puccinia malvacearum*. He finds that in the case of this rust, which produces teleutospores alone, the reproduction of the fungus in the following year is provided for by mallow plants that have survived the winter and in which the mycelium is perennial. The theory that the seed carries over the fungus was found to be incorrect, as also the over-wintering of the teleutospores: none were induced to germinate after a winter's duration. The mycelium of the fungus is intercellular, though occasionally a haustorium is developed that penetrates a cell of the host.

Basidiomycetes.—M. Peltereau † publishes his studies and observations on *Russula*, a genus well defined and easily recognised, but the species of which are difficult to diagnose. This is owing to the various forms each species may assume and to the changing colours under different conditions. The author takes them in groups and gives characteristics of each. Incidentally he remarks that the mild forms are all edible, some of them very good—and even some of the acrid species may be eaten with impunity.

F. Guéguen ‡ gives his observations on some species of *Lepiota*. He tested the rate of growth in *L. lutea* in the dark and in light, and found they grew much larger in the dark. A small form allied to *L. lutea* was named L. *Boudieri*. It is entirely sulphur-yellow coloured and grew in hot-houses.

A. Courtet § reports some cases of poisoning by *Tricholoma tigrinum*. It had been collected and eaten under the impression that all grey kinds, such as *Clitocybe nebularis*, were harmless. Another case was due to eating *Amanita muscaria*, it being mistaken for *A. cæsarea*. Neither of the cases proved fatal, though the symptoms of poisoning were severe.

Ph. Guinier ‖ and R. Maire give examples of the influence of geotropism on the orientation of *Ungulina fomentaria*. A specimen was found that had commenced growing on a standing tree in the usual normal manner. Then the tree had fallen to the ground and a new growth of the fungus had commenced, entirely covering the pores with a hard tissue and forming a second fungus at right angles to the first.

Contribution to our knowledge of Corticeæ.¶—Fr. v. Höhnel and V. Litschauer contribute a study of this group based on the plants of several important herbaria in Vienna, Geneva, and Berlin. They have changed the genera of several species. Other species they have found to be synonymous with those of earlier date. A diagnosis of the genus *Aleurodiscus* is given, with a list of the species. The authors have traced the development of *Ægerita candida*: it never forms spores; the globose bodies are abnormal basidia of some *Peniophora*, and the fungus must be known as *P. Ægerita*. Two new genera have been diagnosed:

* Michigan Acad. Sci., Ninth Report, 1907, pp. 68–73 (5 figs.).
† Bull. Soc. Mycol. France, xxiv. (1908) pp. 95–120.
‡ Tom. cit. pp. 121–32 (3 figs.). § Tom. cit., pp. 133–7.
‖ Bull. Soc. Mycol. France, xxiv. (1908) pp. 138–40 (2 figs.).
¶ SB. k. Akad. Wiss. Wien. Math.-Nat. Kl., cxvi. Abt. 1 (1907) pp. 739–852 (4 pls., 20 figs.). See also Ann. Mycol., vi. (1908) pp. 73–7.

Glœopeniophora, which forms glœocystidia as well as *Peniophora*-cystidia, and *Dendrothele*, which has thorn-like growths on the fruiting surface. A number of new species belonging to different genera are also described.

Fomes pinicola Fr. and its Hosts.*— L. H. Pennington has studied the habitat of several of the larger Polypores, more especially *Fomes pinicola*. He found that it was the most common of the fungi that affect Conifers. The fruiting bodies were almost always found on dead trunks after the wood had become much decayed. On standing trunks they grew near the ground. Occasionally the fungus was formed on the wood of deciduous trees; in one district it grew abundantly on balsam poplars. The fruiting bodies vary in shape, depending largely on the rate of growth; the colours of the pileus vary according to the age of the fungus; in some instances on deciduous trees the pileus may be entirely destitute of red and yellow colours.

Polyporus annosus.†—L. Wittmack publishes a photographic plate and a description of a young fir-tree, six years old, that bore about middle height a large fruiting specimen of *P. annosus*. It surrounded the young tree and the branches, which looked as if they had grown through the fungus. In the near neighbourhood there had been an old stump attacked by this fungus, which had spread to the sapling.

Mycotheca of the École de Pharmacie.‡—In a first paper G. Bainier presents a series of observations on the development of several Hyphomycetes. The rather confused sporiferous head of *Periconia* is described as bearing a number of globose or oblong smooth basidia, each with a short chain of muriculate conidia. Several forms of *Brachycladium* and *Dendryphium* are also figured and described. In the latter genus the author establishes a new subgenus, *Dendryphiopsis*, with conidia borne in verticils on the conidiophore. A second paper deals with a new species, *Sterigmatocystsis insueta*, entirely dark brown, very minute, and with much-branched conidiophores.

Chestnuts filled with a dark powder were examined and cultures made, which produced a Hyphomycete, *Harziella Castaniæ* sp. n. Minute conidia are borne at the tips of obpyriform basidia clustered near the apex of the branches. *Stachylidium bicolor* is also described and figured.

Bainier describes and figures *Sordaria vestita* and *S. decipiens*. The latter species has an 8-spored ascus, and varieties with 4, 16, and 32 spores in each ascus, differing from each other in the smaller size of the spores as these increase in number. These spores have an appendix at each end; at one end, in the form of a mass of small filaments, at the other end, in addition, a long cylindrical cell growing out from the centre of the shorter filaments.

Diseases and Pests of Coffee.§ — F. C. von Faber gives a review of the numerous enemies of the coffee-plant, both vegetable and animal.

* Mich. Acad. Sci., Ninth Report, 1907, pp. 80–2.
† SB. Ges. Nat.-Freunde Berlin, ix. (1907) pp. 298–9 (1 pl.).
‡ Bull. Soc. Mycol. France, xxix. (1908) pp. 73–94 (4 pls.).
§ Centralbl. Bakt., xxi. (1908) pp. 97–117 (12 figs.).

He is impressed with the necessity of grouping in this manner the pests of tropical plants. First on the list of fungal parasites he places *Hemileia vastatrix*, the Uredine of which the life-history was worked out by Marshall Ward. Faber goes over the ground again, and describes in detail the different spores, their germination and development, and their growth on the host-plant. He gives an account of the annual attack of the fungus, the spores of which are dispersed by the monsoon. The leaves are destroyed by the fungus and fall from the trees, then follows a loss in flower and fruit, owing to the weakened condition of the tree. Very great damage has been caused by this fungus ; an account is given of the varying degrees of susceptibility of the different varieties of coffee plants, and methods of combating the disease are also discussed. Another disease, due to a *Corticium*, on the branches and leaves, is also fully dealt with. *Pellicularia koleroga* forms a black-rot or leaf-rot ; it appeared first in Jamaica, but has been detected in Java, India, and Venezuela. It is chiefly a leaf-disease. Other leaf-diseases are *Glœosporium coffeanum*, *Cercospora coffeicola*, and *Colletotrichum coffeanum*, all of which cause spots on the leaves, and lower the vitality of the host-plant.

Diseases of Plants.*—The pathologist to the Board of Agriculture reports on specimens of gooseberry plants from Dunstable, which were found to be covered by a harmless *Phoma* ; seed-potatoes from Chester were infested with *Macrosporium Solani*, causing brown patches in the interior of the tuber ; potatoes from Feltham were attacked by *Phytophthora*.

H. T. Güssow † records a new tomato disease for this country, whither it has evidently been imported from the Continent. The plants are attacked by *Septoria Lycopersici*, which develops on the leaves and destroys them. Spraying with Bordeaux mixture is recommended as soon as the disease appears ; badly attacked plants should be cut back or destroyed by burning.

Some other cases of disease are recorded ; ‡ *Gymnosporium clavariæ orme* was found on pink thorn, distorting the branches, and violet root-rot, *Rhizoctonia violacea*, was causing the decay of stored potatoes.

D. v. Hegyi § describes cases of crumpling and distortion in wheat, caused sometimes by an insect and sometimes by the fungus *Helminthosporium gramineum*, or by unfavourable weather conditions.

A. Stift ‖ publishes a long review of all the cases of disease recorded as occurring on beet and potato during the year 1907, including insect as well as fungus attacks. On beet he notes chiefly *Phoma Betæ*, *Peronospora Schachtii*, *Uromyces Betæ*, etc., discussing the causes in soil or climate that favour their development. A series of fungi that attack potatoes is next dealt with. *Phytophthora infestans* was of less importance than some other diseases. *Phellomyces sclerotiophorus* has been found to be the stroma of *Spondylocladium atrovirens* ; *Stysanus*

* Journ. Board of Agric., xv. (1908) p. 47.
† Tom. cit., pp. 111–15 (figs.). ‡ Tom cit., pp. 119–20.
§ Zeitschr. Pflanzenkr., xvii. (1907) pp. 334–6.
‖ Centralbl. Bakt., xxi. (1908) pp. 117–43.

stemonitis has been proved to be a parasite, but the damage does not go very deeply into the tissue of the tuber. *Fusarium oxysporum* has been the cause of very considerable loss, while *Phytophthora*, *Rhizoctonia*, and *Bacteria* add largely to the score. An account is given of the feeding of pigs with more or less diseased tubers, and the results on the health of the animals is stated; they were not affected unless the potatoes were very badly diseased.

Potato Scab in America.—W. J. Morse * states that the disease is caused by a minute parasitic fungus *Oospora scabies*. It has increased greatly during the last few years, and the bulletin has been issued to warn growers of the serious nature of the disease and to advise them as to remedies. Morse recommends the use of sulphur on the land, which tends to acidify the soil, a condition inimical to the fungus, but above all he advises disinfection of seed potatoes to prevent the propagation of the fungus. Soaking them in formalin solution has been found of value, or exposing them to formaldehyde gas. Morse explains the best methods of applying the gas.

A second paper † by the same author treats of potato diseases generally: early blight due to *Alternaria Solani*; late blight to *Phytophthora infestans*, and forms of scab. He discusses the various methods of spraying, disinfecting, etc., and gives results of experiments with fungicides, etc.

Fungi Parasitic on the Vine Phylloxera.‡—P. Baccarini received from G. B. Grassi some *Phylloxeras* that had evidently been killed by fungi; the bodies of the insects were almost mummified, being penetrated and filled by brown hyphæ. He describes the different fungus fructifications that he noted in cultures on media in which he had placed the insects, some on one and some on another. They were species of *Cladosporium*, *Macrosporium*, *Fusarium*, *Phoma*, *Alternaria*, and *Penicillium*. Descriptions of these fungi are given.

Fungi Parasitic on Hevea brasiliensis.§—The culture of this plant has developed enormously in Ceylon of late years, with the increased demand for indiarubber, and has become subject to a number of parasitic and other fungi, some of which cause great damage. T. Petch has followed the growth of these fungi, and writes an account of them. He gives a historical sketch of the indiarubber culture in Ceylon, explaining the conditions that prevail and that are more or less favourable to the spread of the parasites. The young plants in the nurseries are well protected by coco-nut leaves from the sun and the rain, and any leaves that are exposed become covered with spots on which several leaf fungi settle; such are *Helminthosporium Heveæ*, *Pestalozzia palmarum*, *Glœosporium elasticæ*, *G. Heveæ*, and several other members of the fungi imperfecti. Petch deals next with the root fungi, and much of the root trouble he attributes to the custom of leaving stumps in the ground when trees are felled: these are the

* Maine Agric. Stat., Bull. No. 141, 1907, pp. 81–92.
† Op. cit., No. 149, pp. 287–330 (figs.).
‡ Bull. Soc. Bot. Ital., 1908, pp. 10–16 (figs. *a–g*).
§ Zeitschr. Pflanzenkr., xviii. (1908) pp. 81–92.

breeding ground for *Fomes semitostus* and other fungi. The ants follow destroying roots already attacked by the fungus, and in the case of standing trees a high wind blows them over. Some microfungi that attack roots are also described. On stems and twigs he records a large number of parasitic forms, several of them new and peculiar to *Hevea*. Finally on the fruit there is found the same *Phytophthora* that attacks cocoa-pods. No method has yet been devised of effectually dealing with this fungus, but as the fruit is only valuable on account of the seed, the economic damage is so far negligible.

New Subterranean Parasite.*—A. Trotter found at Avellino on the roots of *Crepis bulbosa* protuberances or galls 4–5 mm. in diameter, quite distinct from the tubers natural to the plant. He describes the microscopic structure of these galls and of the fungus; the spores of which filled the numerous cavities. The gall itself is formed of the tissue of the host-plant excited to abnormal growth by the presence of the parasite.

Notes on Portuguese Mycology.†—C. Torrend remarks on the very abundant phanerogamic flora of Portugal, and compares it with the cryptogamic, which promises to be equally rich. He gives coloured figures and descriptions of some rare forms that he has found there recently: *Lycoperdon fragile*, a species common in America; *Terfezia rosea*, one of the Tuberaceæ; *Colus hirudinosus*, a Phalloid found in S. France, Algeria, and New Caledonia; finally, *Torrendia pulchella*, one of the Hymenogastraceæ that grows in the open. It has a distinct stalk, and a pileus in which is a chambered receptacle. These fungi are illustrated by coloured plates.

Peptonification of Milk by Moulds.‡—It has been found that certain moulds coagulate milk and then peptonise the casein by the secretion of trypsin. A. Sartory experimented with pure cultures of some 30 moulds, and chronicles the results, which were very different in species intimately connected morphologically. He suggests that this property of the moulds might be used as a specific test. In some cases the action was rapid, 3 days or so, in others slow, 11 to 14 days; in others again there was no peptonification produced.

Atkinson, Geo. F.—**Notes on some New Species of Fungi from the United States.**
[Species belonging to the Hymenomycetes.]
Ann. Mycol., vi. (1908) pp. 54–62.

Bresadola, J.—**Fungi aliquot gallici novi vel minus cogniti.** (Some French fungi new or little known.)
[The fungi were collected by H. Bourdot, in the neighbourhood of Moulins.]
Tom. cit., pp. 37–47.

Bubak, Fr.—**Neue oder Kritische Pilze.** (New or critical fungi.)
[New species are diagnosed, and copious notes are given on others—all microfungi.]
Tom. cit., pp. 22–9 (13 figs.).

* Ann. Mycol., vi. (1908) pp. 19–22 (3 figs.).
† Bull. Soc. Portug. Sci. Nat., i. (1908) pp. 177–83 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 789–90.

GUÉGUEN, FERNAND—**Sur un Oospora nouveau.**
[*Oospora lingualis*, associated with *Cryptococcus linguæ-pilosæ* on "black tongue."] *Comptes Rendus*, cxlvi. (1908) pp. 994–6.

HEIMERL, A.—**Beitrag zur Flora des Eisacktales. III.** (Contribution to the flora of the Eisack valley.)
Verh. k.k. Zool.-Bot. Ges. Wien, 1907, pp. 415–57.
See also *Ann. Mycol.*, vi. (1908) p. 72.

JAAP, O.—**Mykologisches aus dem Rhöngebirge.** (Fungi of the Rhone mountains.)
[A list of 323 fungi.] *Allg. Bot. Zeitschr.*, xiii. (1907) p. 169.
See also *Ann. Mycol.*, vi. (1908) p. 77.

JACKSON, H. S.—**Sorosporium Ellisii Wint.—a composite species.**
[The writer considers that two species are here included; he separates *S. confusum* sp. n. (on *Aristida*).]
Bull. Torrey Bot. Club, xxxviii. (1908) pp. 147–9.

KAUFFMAN, C. H.—**Unreported Michigan Fungi for 1906.**
[A list of the larger fungi found in the State.]
Mich. Acad. Sci., Ninth Report, 1907, pp. 83–7.

LINDAU, G., & P. SYDOW—**Thesaurus litteraturæ mycologicæ et lichenologicæ ratione habita præcipue omnium quæ adhuc scripta sunt de mycologia applicata.** (Thesaurus of mycological and lichenological literature, chiefly of applied mycology.) Leipzig: Brothers Bornträger, i. pt. 1 (1907) 400 pp.

MASSEE, G.—**New or Critical British Fungi.**
[An account of several species new to Britain, with critical notes.]
Journ. Bot., xlvi. (1908) pp. 151–5.

MALKOFF, KONSTANTIN—**Erster Beitrag zur Kenntniss der Pilzflora Bulgariens.** (First contribution to a knowledge of the fungus flora of Bulgaria.)
[A list of 208 species is published, all of them parasitic.]
Ann. Mycol., vi. (1908) pp. 29–36.

MORGAN, A. P.—**North American Species of Agaricaceæ.**
[Species of *Hypholoma* and *Stropharia* are described.]
Journ. Mycol., xiv. (1908) pp. 64–75.

PETER, A.—**Die Pyrenomyceten und Tuberaceen der Göttingen Flora.**
[A list of these fungi from Gottingen, with locality and distribution. Several of them are new or rare in Germany.]
Nachricht. k. Ges. Wiss. Gött. Math.-Phys. Kl., i. (1908) pp. 28–52.

RICK, J.—**Contributio ad monographiam Agaricacearum et Polyporacearum Brasiliensium.** (Contribution to a monograph of Brazilian Agarics and Polypores.)
[Several new species are included in this survey.]
Brot., vi. (1907) pp. 65–92 (9 pls.).
See also *Ann. Mycol.*, vi. (1908) p. 81.

SYDOW, H. & P.—**Einige neue von Herrn J. Bornmüller in Persien gesammelt. Pilze.**
[Diagnosis of five species of microfungi.] *Ann. Mycol.*, vi. (1908) pp. 7–18.

Lichens.

(By A. LORRAIN SMITH.)

Chemical Monograph of the Cladoniæ.* — W. Zopf has worked through the species of this genus that occur in Germany, with a view of determining their chemical constituents, and testing by this means their systematic position. He upholds the larger groups of those with red apothecia and those with brown, but he is impelled to make several changes within these groups; he recommends a more careful morpho-

* Festschr. Deutsch. Bot. Gesell., xxvi. (1908) No. 3, 113 pp. (4 pls.).

logical examination to see if they cannot be classified in a way that will also express their chemical affinities. Zopf has isolated several new acids, and in some cases he finds that plants looked on as varieties must be treated as species; thus *C. fimbriata* f. *nemoxyna* has been made a species by the author because it contains no fumar-protocetrar-acid, such as is found in *C. fimbriata* and others closely allied.

Mycetozoa.

(By A. Lorrain Smith.)

Spongospora Solani.*—T. Johnson publishes a carefully worked out study of this organism, which he considers to be a slime-fungus closely allied to *Plasmodiophora*. It causes scabs on potato tubers, and in some districts in Ireland it is as injurious to potatoes as finger-and-toe is to turnips. The spores are grouped in balls, comparable to grains of sand, and just visible to the naked eye. When still immature the spore-contents appear as one fairly dense body; at a more advanced stage they contain six or eight distinct bodies—swarm-spores which escape into the surrounding medium, and serve to propagate the *Spongospora*. Scabby potatoes when planted produce other scabby tubers; sometimes the rhizome is affected. Clean seed-potatoes are essential to a healthy crop. Johnson gives advice as to checking or overcoming the disease.

Existence of Myxomonas Betæ.† — This organism was originally described by Brzezinski as a pseudo-myxomycete which lived parasitically on beetroot. The results were questioned by Trzebinski in a later paper, and now by F. C. von Faber, who has gone over the whole ground carefully, and in his summing up says:—"No stage whatever of any myxomycete of any kind could be found in the roots, and it can be stated with absolute certainty that *Myxomonas Betæ* does not exist." Faber gives proofs of his statement; he finds that what were considered to be zoospores in motion were protoplasmic particles in Brownian motion, or perhaps bacteria that had got into the cultures.

Dimorphism in a Myxomycete.‡—E. Pinoy records further observations on a culture of *Didymium nigripes*. With white plasmodia placed in his culture tubes he was able to obtain fructifications in 10 to 20 days. Some of the tubes, however, showed a plasmodium that was yellow or orange, others blackish violet. From neither of these did he obtain fructifications, only sclerotia. He tried again by mixing the two plasmodia, and failed; he then made separate cultures of the two sclerotia, and taking the myxamœbæ obtained he mixed a few of them in a third culture tube. Under these conditions he obtained fructifications in 10 or 12 days. Pinoy considers that he is dealing with a form of sexuality, that he has + and − spores, such as were found by Blakeslee in *Mucor*, that with one or the other alone there is no fructification, but only when the two kinds are mixed.

* Econ. Proc. Roy. Dublin Soc., i. (1908) pp. 453–64 (1 pl.).
† Ber. Deutsch. Bot. Gesell., xxvi. (1908) pp. 177–82.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 630–1.

Unusual Growth of Spumaria alba.*—Th. Wulff describes a growth of *Plysarum cinereum*, which covered large patches of grass in a meadow, and considerably lowered its value. In the same field he now records an equally abundant invasion of *Spumaria alba*, which showed itself chiefly in great masses on the mowed grass. The field belonged to the Swedish experimental station at Flahult, and consisted of well-drained moss-land mixed with sand and manured with lime and minerals, but not with saltpetre or dung. A very wet season from the middle of June to the end of August preceded the unusual development of the myxomycete. Wulff is unable to say if the grass was injured, but in any case it looked unappetising.

Schizophyta.

Schizomycetes.

Streptothrix in Chronic Suppuration.†—M. P. Neschczadimenko has isolated a streptothrix organism from the purulent discharge of an umbellical fistula. Microscopically, the pus, when stained by Gram's method, showed stained and unstained cocci and rods, and large quantities of long, sometimes branched threads $0 \cdot 75$–$1\ \mu$ in width; in sterilised water the pus showed irregular white clumps, which, on shaking, broke up into small flocculi, consisting of a tangle of threads and cocci; these flocculi were transferred to various fluid and solid media, and under strictly anaerobic conditions growth occurred at 36°–37° C. More vigorous growth was obtained in broth with yolk of egg after 8–10 days; it consisted of white granules adhering to the wall of the tube, the medium remaining clear; microscopical examination showed long threads often branched, and bent and twisted rods with thickened ends. On agar it forms irregular-shaped colonies, grey-white at first, but becoming darker and of a yellow tint, especially at the centre, and consists of rod-forms resembling the diphtheria bacillus. No growth was obtained on gelatin or on potato. The organism did not grow under aerobic conditions, and it does not appear to be pathogenic for animals; it is not acid-fast. The etiological relation of this streptothrix to the suppuration in this case is not certain.

Micrococcus catarrhalis (Pfeiffer) and Gonococcus.‡—J. Bruckner refers to the difficulty of distinguishing the *Micrococcus catarrhalis* from the *Gonococcus* and *Meningococcus*, on ascitic agar or serum agar, on account of the variable forms assumed, but finds that it is easy to distinguish these organisms in ascitic broth by the formation by *M. catarrhalis* of opaque white flocculi which are deposited and leave the broth clear, whereas the *Gonococcus* and the *Meningococcus* cloud the broth, form a delicate pellicle, and a flocculent deposit, which disappears on shaking, but the broth always remains cloudy.

Differential Diagnosis of Gonococcus and certain other Micrococci.§ Rothe finds that the *Gonococcus* ferments dextrose, but not lævulose or

* Zeitschr. Pflanzenkr., xxiii. (1908) pp. 2–5 (1 pl.).
† Centralbl. Bakt. 1te Abt. Orig. xlvi. (1908) p. 573.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) p. 619.
§ Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 645.

maltose; that *Meningococcus* ferments dextrose and maltose, but not lævulose; that *Diplococcus flavus* ferments dextrose, lævulose, and maltose; and that *Micrococcus catarrhalis* and *M. cinereus* ferment neither dextrose, lævulose, nor maltose.

Bacillus fusiformis (Vincent) cultivated in Symbiosis.*—G. Proca finds that *B. fusiformis* grows especially luxuriantly in a broth containing *B. subtilis* and streptococcus, and, instead of forming a thick deposit, is distributed through the liquid medium. Similar abundant growth occurs when *B. fusiformis* and streptococcus are grown in a sterilised broth culture of *B. coli* or *B. typhosus*: if the broth is diluted with distilled water so that the growth of the streptococcus can hardly take place, the *B. fusiformis* still grows abundantly. *B. fusiformis* inoculated together with *B. subtilis* on pepton agar, prepared without meat, forms after 3–4 days' incubation, small round, circumscribed, whitish-yellow opaque colonies, composed of typical bacillary forms. In broth, in the presence of *B. subtilis* and streptococcus, the *B. fusiformis* has a spirillar appearance; this spirillum form when transferred to solid media reproduces the typical fusiform bacillus.

Bacterium cystinæ.†—H. Müller-Thurgau describes four new species of cyst-forming organisms (bacterienblasen). (1) *Bacterium mannitopœum* is found occasionally in fruit wines as snow-white flocculi measuring 1–3 cm. in diameter, composed of short or long, jointed or unjointed rods up to 50 μ long: the rods are not motile, and have no flagella; spore-formation does not occur; they tend to form zooglœic masses; growth occurs on gelatin, which is not liquefied; the rods stain by ordinary dyes, and also by Gram's method: it is a potential anaerobe, with a minimum temperature of 8°–10° C., and an optimum of 25°–30° C.: it ferments lævulose and saccharose, but not maltose, dextrose, or mannite. (2) *B. gracile* resembles the preceding: it is found in zooglœic masses and bladders in fruit wines, especially in certain perry; it occurs as short non-motile rods 1–1·2 μ long, long threads not being observed. No spore-formation occurs; the staining reaction and chemical characters were not examined. (3) *Micrococcus cystiopœus* forms zooglœic masses and bladders in fruit wines, and occurs as cocci, diplococci, and tetrads. (4) A micrococcus resembling the preceding, and found in bladders in fruit wine, but was not studied in pure culture.

Studies in Mediterranean Fever.‡—E. Sergent and others find that the goats of Algiers are only affected to a small extent in comparison with the Maltese goats, viz. 4·2 p.c. as against 30–50 p.c., and suggest that this is due probably to the fact that Algerian goats are impure breeds, strongly mixed with Spanish goats. Mediterranean fever seems to be enzooic with goats of Maltese breed. The author finds that the infection may be conveyed to all domestic animals and to man by ingestion or by contact of the micrococcus excreted in the milk or the urine.

Intestinal Flora of certain Orthoptera.§—A. Sartory and Clerc have made cultivations on agar, glucose-agar, and in broth from the

* C.R. Soc. Biol. Paris, lxiv. (1908) p. 771.
† Centralbl. Bakt., 2te Abt., xx. (1908) p. 445.
‡ Ann. Inst. Pasteur, xxii. (1908) p. 209.
§ C.R. Soc. Biol. Paris, lxiv. (1908) p. 544.

intestinal contents of different Orthoptera, and have isolated various moulds and bacteria, including especially *Penicillium glaucum*, and *Mucor mucedo*, *B. subtilis*, *B. coli*, and *Staphylococcus aureus*.

Bacillus causing an Exanthematous Fever.*—T. Horiuchi has isolated from the stools and in some cases also from the urine of patients suffering from an exanthematous fever, during the Russo-Japanese war, a bacillus which is culturally similar to the *B. paratyphosus*, but gives a positive indol reaction ; it agglutinates with the serum of the patient from whom it was isolated, and with that of others suffering from an identical illness, and it appears to be the specific cause of the fever. The author has named the organism *B. febris exanthematici Mandschuriæ*.

Plague Bacillus in the Bed Bug.† — V. Jordansky and N. Kladnitsky conclude from their experiments that the coccobacillus of plague retains its virulence in the bug for at least 10 days, and from this fact the inference may be drawn that in certain cases the bug may become an infective agent.

Toxin of Bacillus virgula.‡—L. Verderau finds that the toxin of *B. virgula* is a definite alkaloid, and analogous to the active principle of other vegetables.

Symbiosis of Bacillus vulgaris and Bacillus butyricus.§—C. Crithari finds that if sufficient care be taken to maintain a permanent acidity of the medium the phenomena of butyric fermentation are reduced to a minimum. The details are tabulated in three sections which show the results of the action of the bacteria singly and in combination.

Micrococcus neoformans and Cancer.‖—M. Doyen finds that cancer may be diagnosed by the specific reaction with *M. neoformans* on the following grounds : (1) The serum of cancerous patients contains specific bodies. (2) These specific bodies exert an elective action on the extract of powder from the tumour, and of *M. neoformans* and on young cultures of this microbe, so as to produce either fixation of the complement or agglutination. (3) The diagnosis of deep-seated cancer may be definitely made in the majority of cases by a combination of three tests : (1) fixation of complement ; (2) agglutination ; (3) determination of the opsonic index.

Bacteria as Agents in the Oxidation of Amorphous Carbon.¶—M. C. Potter finds that under conditions of exposure to the air, a slow oxidation of amorphous carbon takes place through the agency of bacteria ; during this action CO_2 is given off and heat is evolved.

MARSHALL, C. E., & B. FARRAND.—**Bacterial Associations in the Souring of Milk.** *Centralbl. Bakt.*, 2te Abt. xxi. (1908) pp. 7–59.

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* Centralbl. Bakt. 1te Abt. Orig., xlvi. (1908) p. 586.
† Ann. Inst. Pasteur, xxii. (1908) pp. 455–62.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 803–5.
§ Tom. cit., pp. 818–20. ‖ Tom. cit., pp. 816–18.
¶ Proc. Roy. Soc., Series B, lxxx. (1908) pp. 239–59.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

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

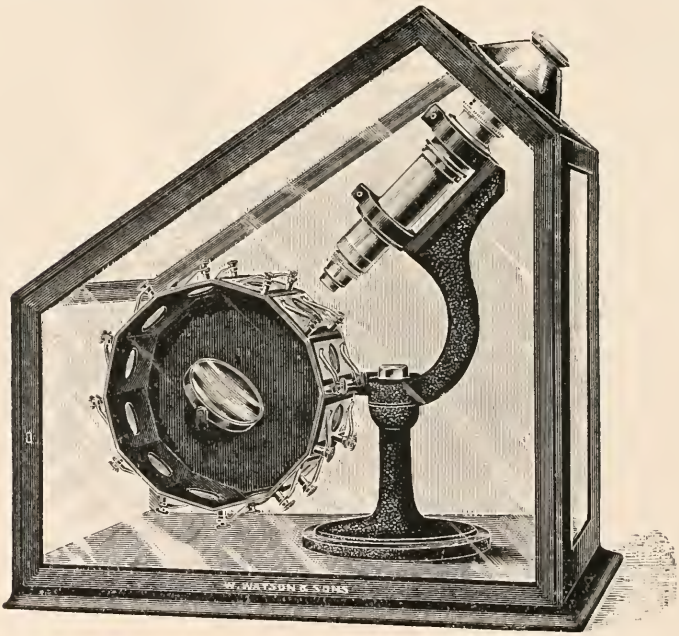


Fig. 121.

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

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

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

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

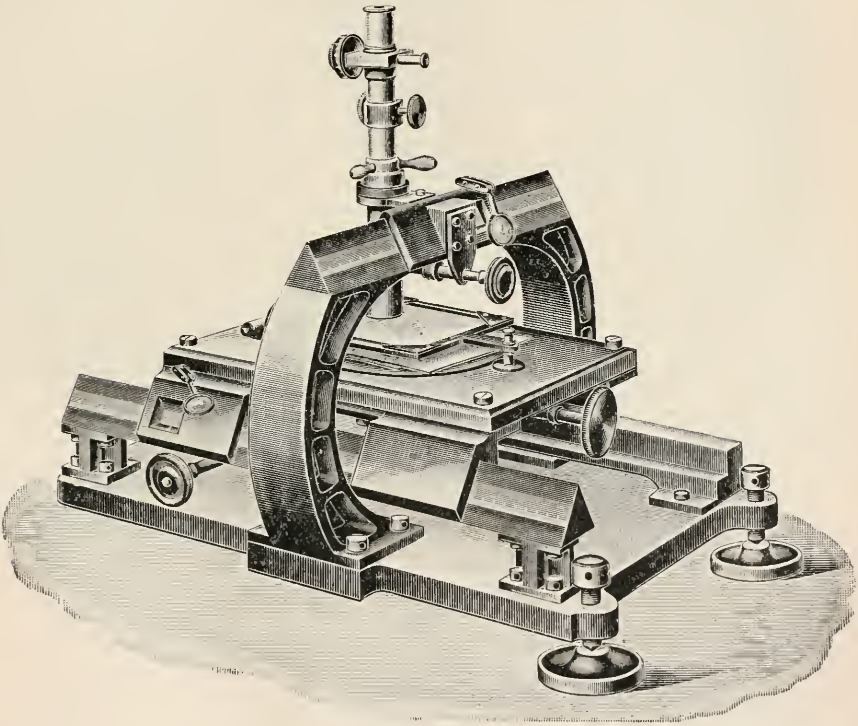


FIG. 122.

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

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

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

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

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

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

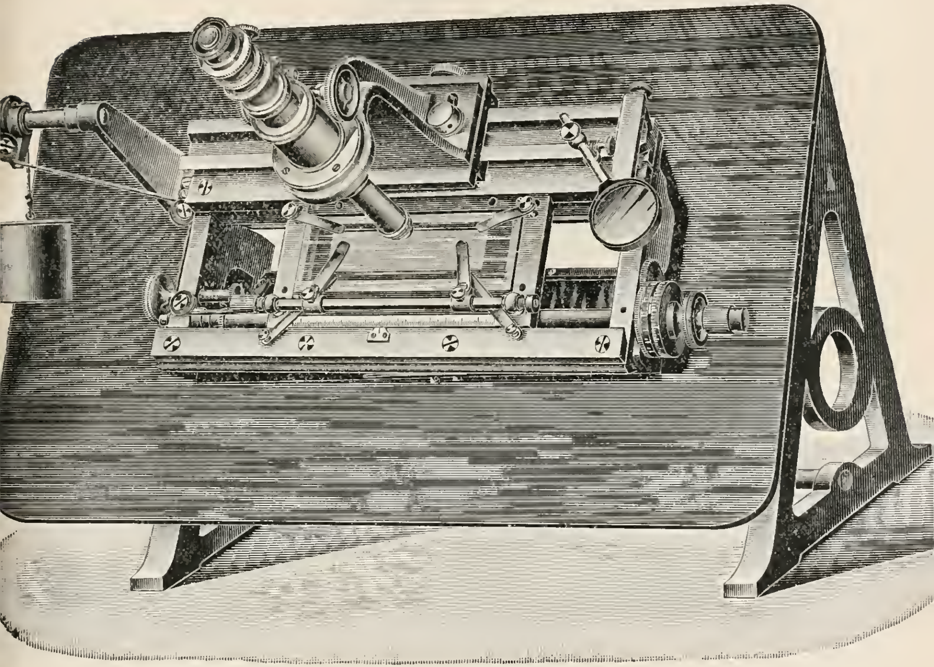


FIG. 123.

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

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

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

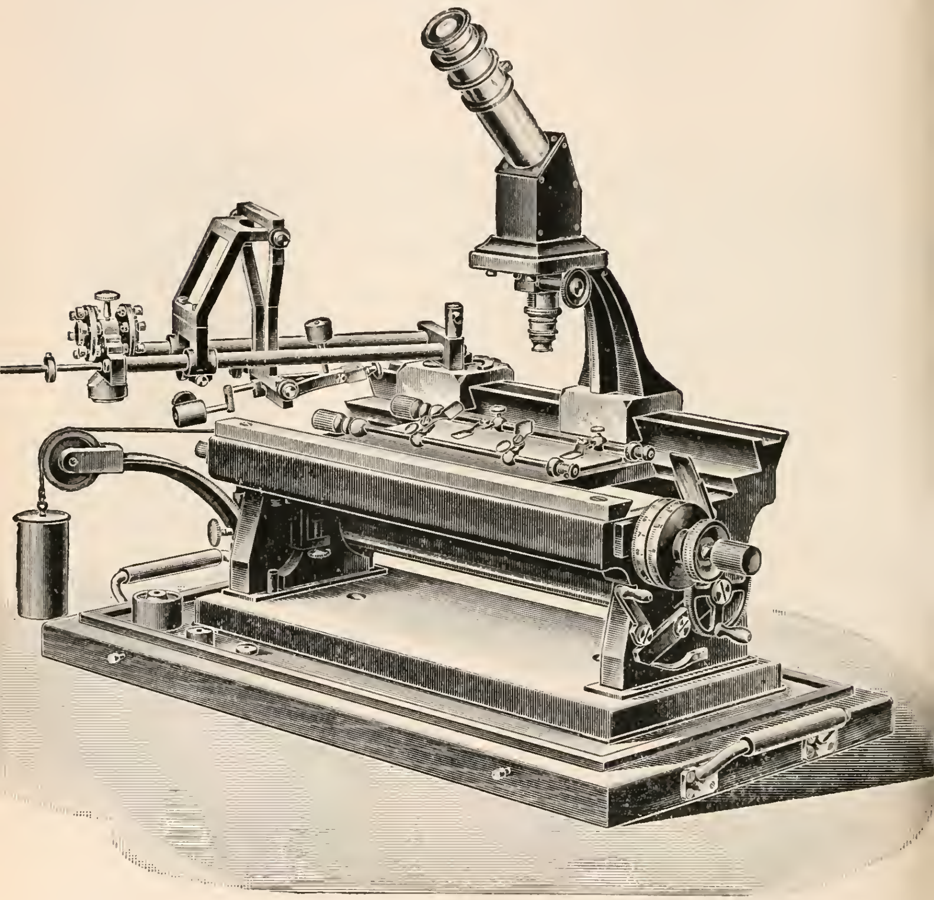


Fig. 124.

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

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

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

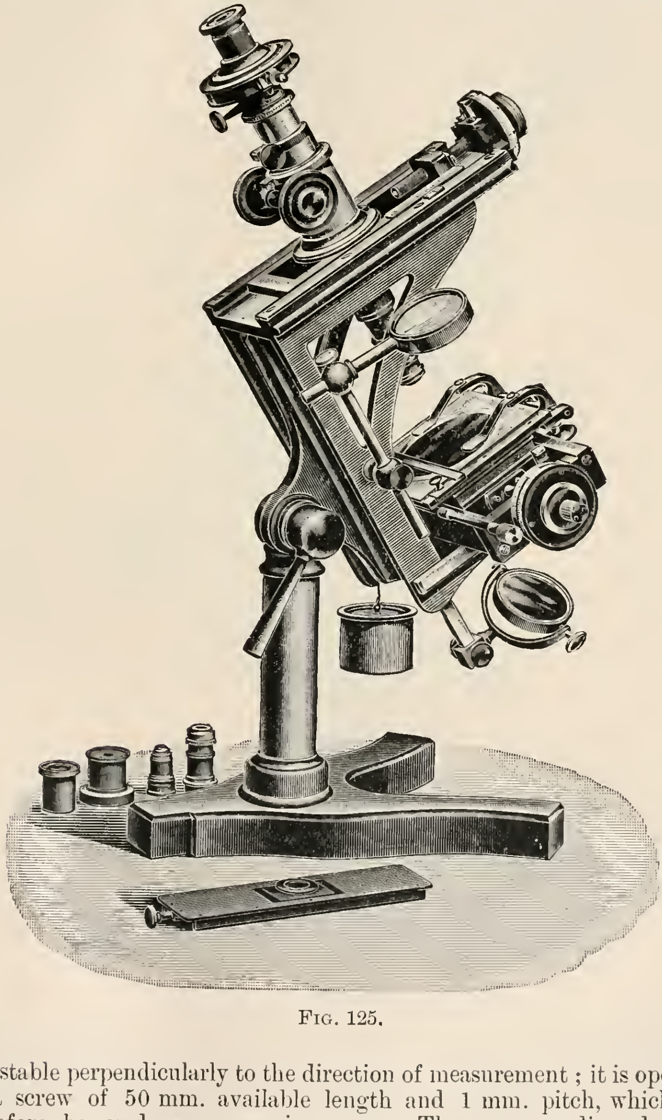


FIG. 125.

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

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

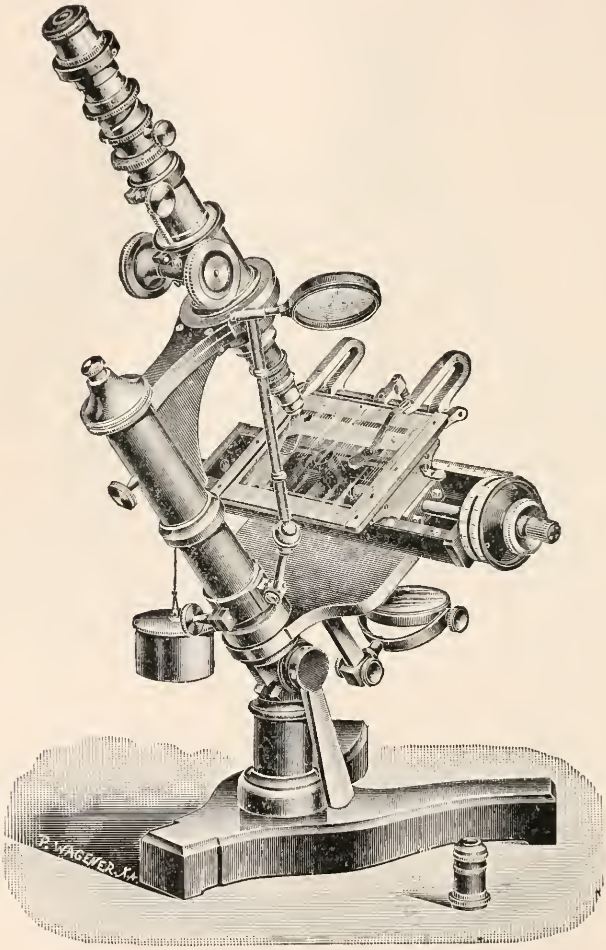


Fig. 126.

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

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

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

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

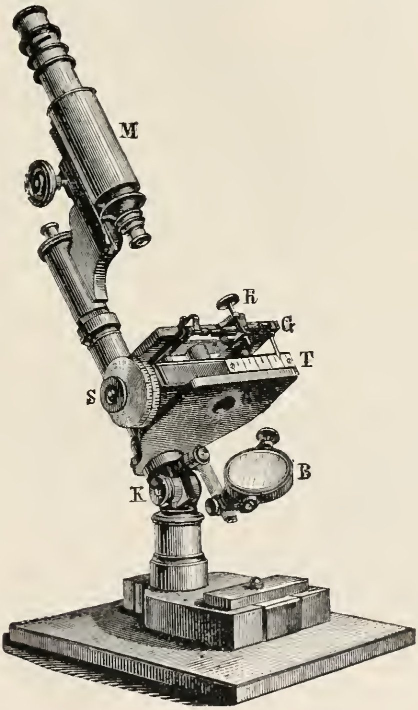


FIG. 127.

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

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

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

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

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

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

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

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

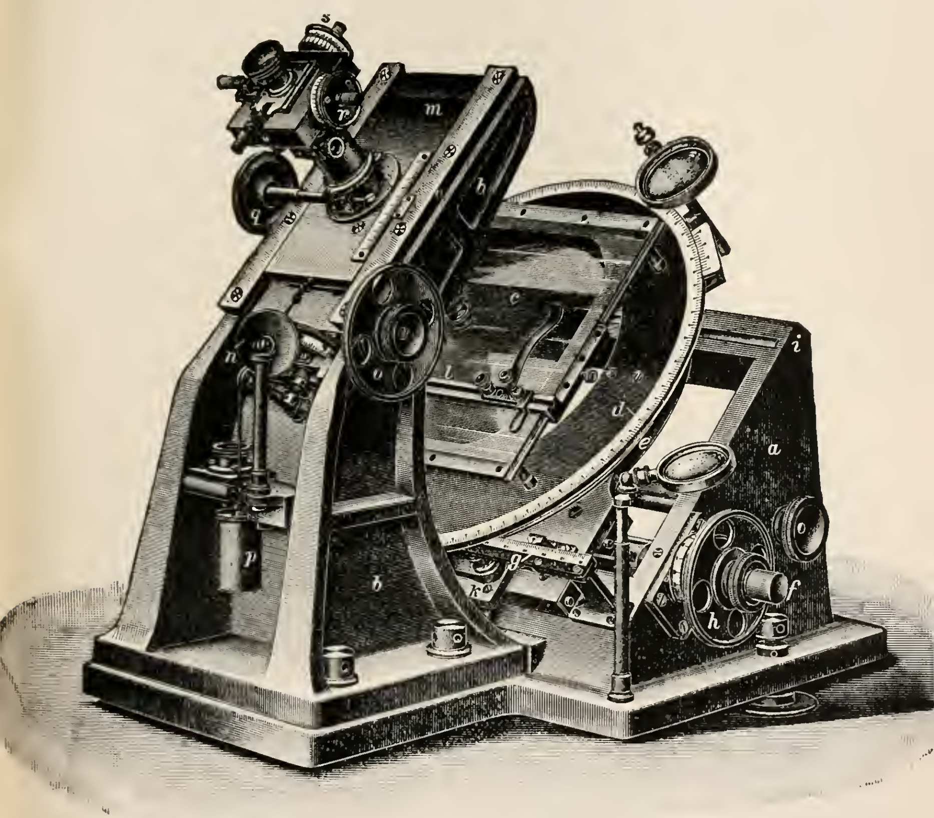


Fig. 128.

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

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

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

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

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

(3) Illuminating and other Apparatus.

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

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

* Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 382–93 (16 figs.), with a bibliography of some 30 references.
† Tom. cit.. pp. 370–81 (7 figs.).

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

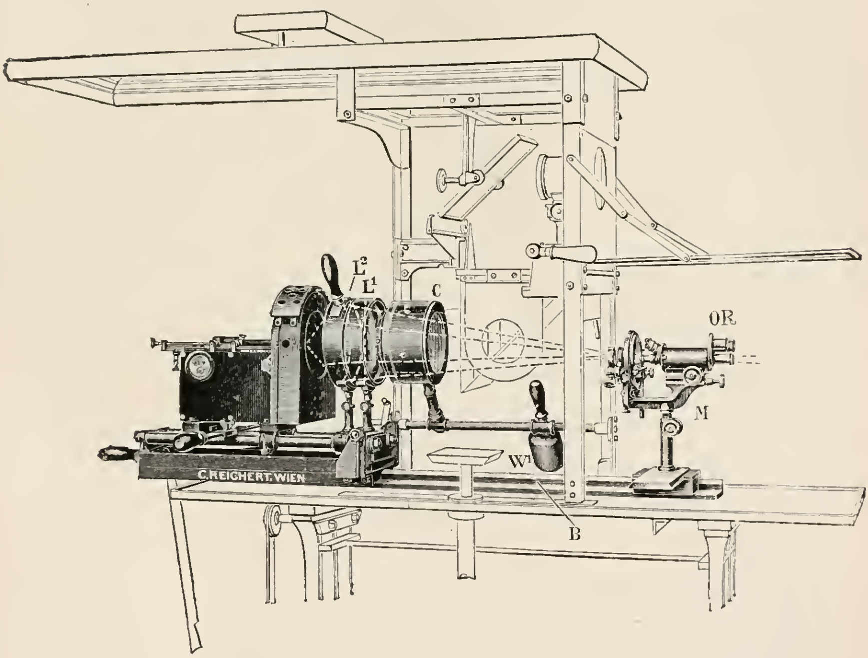


FIG. 129

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

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

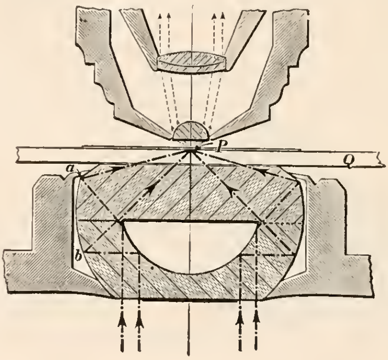


Fig. 130.

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

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

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

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

(4) Photomicrography.

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

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

(6) Miscellaneous.

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

* English Mechanic, lxxxvii. (1908) p. 295 (3 figs.).
† Tom. cit., pp. 110–11 (1 fig.).

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

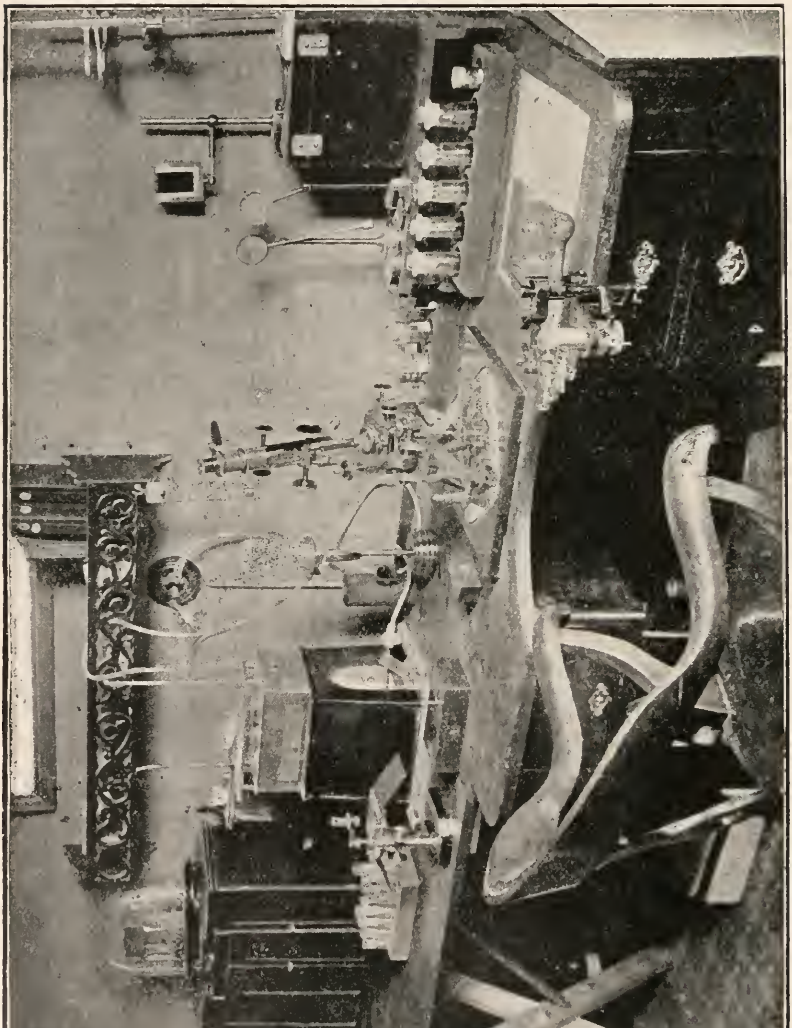


Fig. 131.

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

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

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

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

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

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

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

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

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

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

Fig. 132.

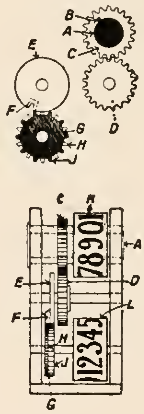


Fig. 133.

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

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

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

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

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

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

B. Technique.†

(1) Collecting Objects, including Culture Processes.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

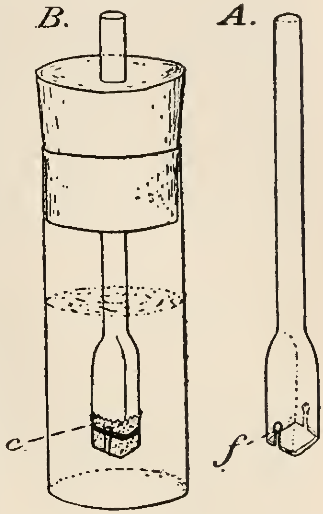


Fig. 134.

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

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

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

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

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

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

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

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

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

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

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

(2) Preparing Objects.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

* Bot. Zeit., 1te Abt. (1908) pp. 89–117 (1 pl.).
† Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 353–6.

(3) Cutting, including Imbedding and Microtomes.

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

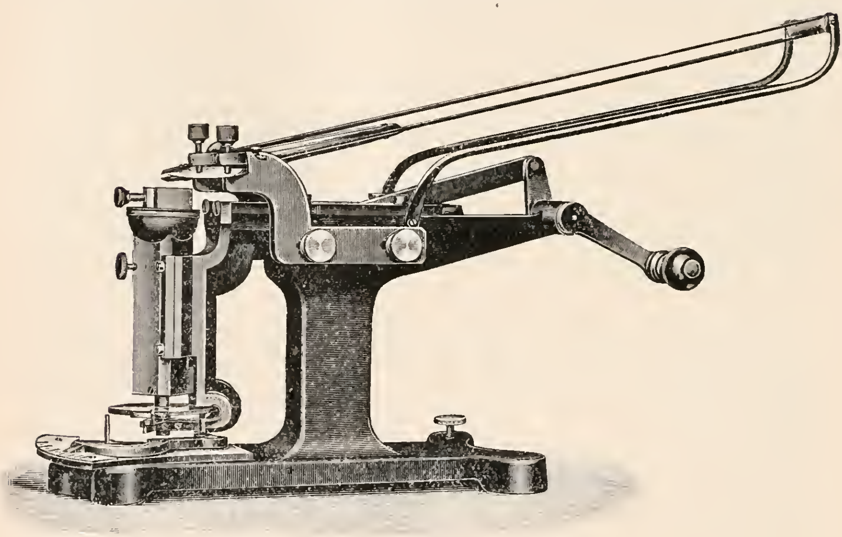


Fig. 135.

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

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

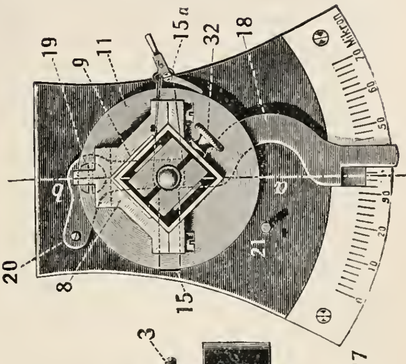


FIG. 137.

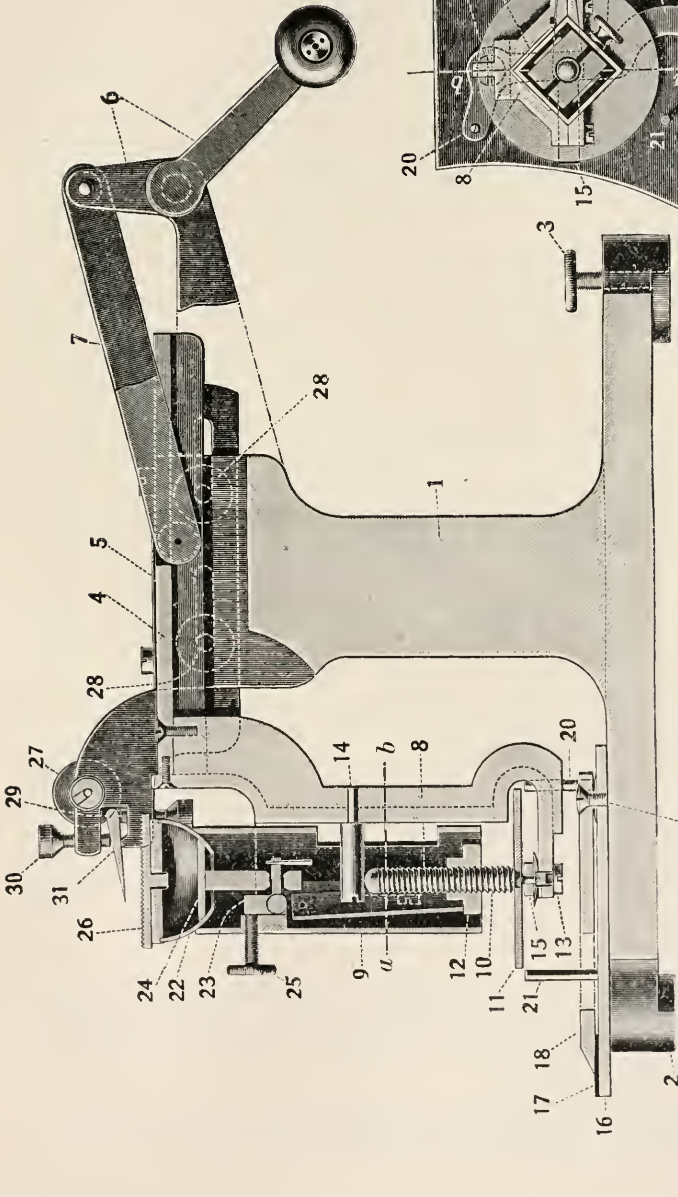


FIG. 136.

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

(4) Staining and Injecting.

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

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

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

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

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 219.
† Zeitschr. wiss. Zool., lxxxix. (1908) pp. 242–307 (11 pls. and 7 text figs.).
‡ Proc. Roy. Soc. Medicine (Odontological Section) i. (1908) pp. 45–60 (7 figs.).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Metallography, etc.

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

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

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

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

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

(2) At 462° C.: liquid with 3 p.c. Ni + Ni Bi ? $\rightleftarrows$ $NiBi_3$

At 269° C. the eutectic Bi – $NiBi_3$ forms.

Bromine water was used as an etching reagent.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

PROCEEDINGS OF THE SOCIETY.

MEETING

Held on the 17th of June, 1908, at 20 Hanover Square, W.
A. N. Disney, Esq., M.A., B.Sc., in the Chair.

The Chairman said they had received a letter from the President, regretting that in consequence of his absence in the country he would be unable to be with them that evening.

The Minutes of the Meeting of May 20, 1908, were read.

Mr. J. W. Gordon said, before the Minutes were confirmed, he should like to suggest an addition to them, as he ought to have mentioned at the last Meeting that the lantern slides of the instruments sent to the Franco-British Exhibition, which were shown on that occasion, were lent for the purpose by Mr. C. Baker. He regretted the oversight, and tendered his apologies to Mr. Curties.

The addition proposed by Mr. Gordon was then made, and the Minutes, as so amended, were confirmed, and were signed by the Chairman.

Mr. J. W. Gordon exhibited a new lens for high-power Microscopy, which had been devised by himself and Mr. H. F. Moulton, the construction of which was described with the aid of a sectional diagram shown upon the screen. This lens had been designed to obviate the use of the oscillating screen introduced some time since, the substitute for the oscillating screen being an opaque white screen placed within the objective itself. The optical result of introducing the screen is to produce a large emergent pencil of light the full size of the pupil of the eye. The lens under proper conditions of illumination was capable of producing perfect images in the highest obtainable scale of amplification. As exhibited at the Meeting, it produced a picture of a *Podura* scale under a magnifying power of 8000 diameters.

The thanks of the Meeting were unanimously voted to Mr. Gordon for his communication.

Mr. Arthur Skinner exhibited a small simple Microscope by Cary. This was only 4¾ in. high, with a square pillar mounted on a very heavy cylindrical brass stand. It was provided with a plane mirror, 1 in. diameter, and a mechanical stage which worked up the pillar by a focusing rackwork, the teeth of which were set obliquely, as in many modern Microscopes. The stage had movements of 0·4 in. horizontally and 0·5 in. vertically, and provision was made for the use of condensers

The lens was fixed in position. There were two similar instruments in the Society's collection, one by Dollond and the other by Tully.

The thanks of the Society were voted to Mr. Skinner for his exhibit.

The Chairman called attention to a number of slides of sections illustrating the development of the chick, which were exhibited under Microscopes in the room—for which the thanks of the Society were unanimously voted.

Some stereo-photomicrographs sent by Mr. Dollman were also exhibited, and were passed round for the inspection of the Fellows present, the thanks of the Meeting for these very beautiful objects being voted to Mr. Dollman.

Mr. E. Heron-Allen read a paper—the joint production of himself and Mr. A. Earland—on "*Cycloloculina*, a New Generic Type of Foraminifera," which they had found on the shore of Selsey Bill ; a map of the district was exhibited, on which the points where the specimens were collected were pointed out, and a number of lantern slides in further illustration of the paper were shown upon the screen.

Mr. Earland said that it had been a great pleasure to him to have been associated with his friend in the description of a very interesting type, and he thought Mr. Heron-Allen was entitled to much credit for the perseverance with which he had pursued his investigations into the source of its origin. He believed they would eventually trace the specimens to some Eocene deposit which was not exposed above low-water mark. The specimens which had been discovered in the Pleistocene deposits were probably derived from the denudation of this undiscovered bed during Pleistocene times, for the Pleistocene deposits were of cold water or even arctic origin, whereas *Cycloloculina* was by its affinities a sub-tropical type. Of one thing he was convinced, the source of origin could not be very far away from the place of discovery, for the specimens were too fragile to travel any considerable distance after they were washed out of their native bed.

The thanks of the Society were unanimously voted to Mr. Heron-Allen and Mr. Earland for their communication.

Mr. J. W. Gordon gave a résumé of his paper on "An Illuminating Apparatus for the Microscope," in which the light from a Nernst lamp was conveyed to the stage through a glass rod—the intensity of the light being regulated by the distance of the lamp from the end of the rod. This apparatus was exhibited in the room, and a demonstration of its utility was given at the close of the Meeting. He added, that Mr. Conrady had been good enough, having read a proof of his paper, to write him a letter on the subject, in which he mentioned that a glass rod, bent to a curved form, had been used as a speculum for transmitting the light from a Microscope lamp to a point close beneath the sub-stage condenser by Dr. Kochs twenty years ago, and was at one time produced commercially by the firm of Zeiss, of Jena.

The Chairman said that the principle of illuminating through a glass rod was not new, as it was shown before that very Society some twenty years ago ; but in that case the rod was bent from an iron screen in front of the lamp to the under side of the object, the light being transmitted through the rod by internal reflexion.

The thanks of the Society were voted to Mr. Gordon for his paper.

Mr. E. M. Nelson's paper on "*Corethron criophilum*," was read by Dr. Hebb; and the thanks of the Society were voted to Mr. Nelson for his communication and to Dr. Hebb for reading it.

Mr. J. W. Gordon said he wished to announce to the Meeting that the Council had made arrangements by which it would be possible for the Fellows of the Society to combine in sectional groups for the pursuit of the particular branch of microscopical study in which they were most interested. As a beginning, it was proposed to form three groups: one for the "brass and glass" section, one for Bacteriology, and another for Pond-life. Mr. Scourfield was practically in charge of the matter, and if Fellows who desired to work in either of these sections would put themselves into communication with him, or with either of the Secretaries of the Society, they would be able to start work at the beginning of the next Session. The meetings would take place on Wednesday evenings, other than those of the Ordinary Meetings of the Society, and it was earnestly hoped that the sections mentioned would be joined by a sufficient number of the Fellows of the Society, to enable a good start to be made when their meetings commenced in the autumn.

It was announced that the next Meeting of the Society would take place on October 21, and that the rooms of the Society would be closed on and from Friday, August 14, and re-open on Monday, September 14.

New Fellows.—The following were elected *Ordinary* Fellows:—Messrs. Daniel Davies, Theodore W. Smith, Joseph Wilson.

The following Instruments, Objects, etc., were exhibited:—

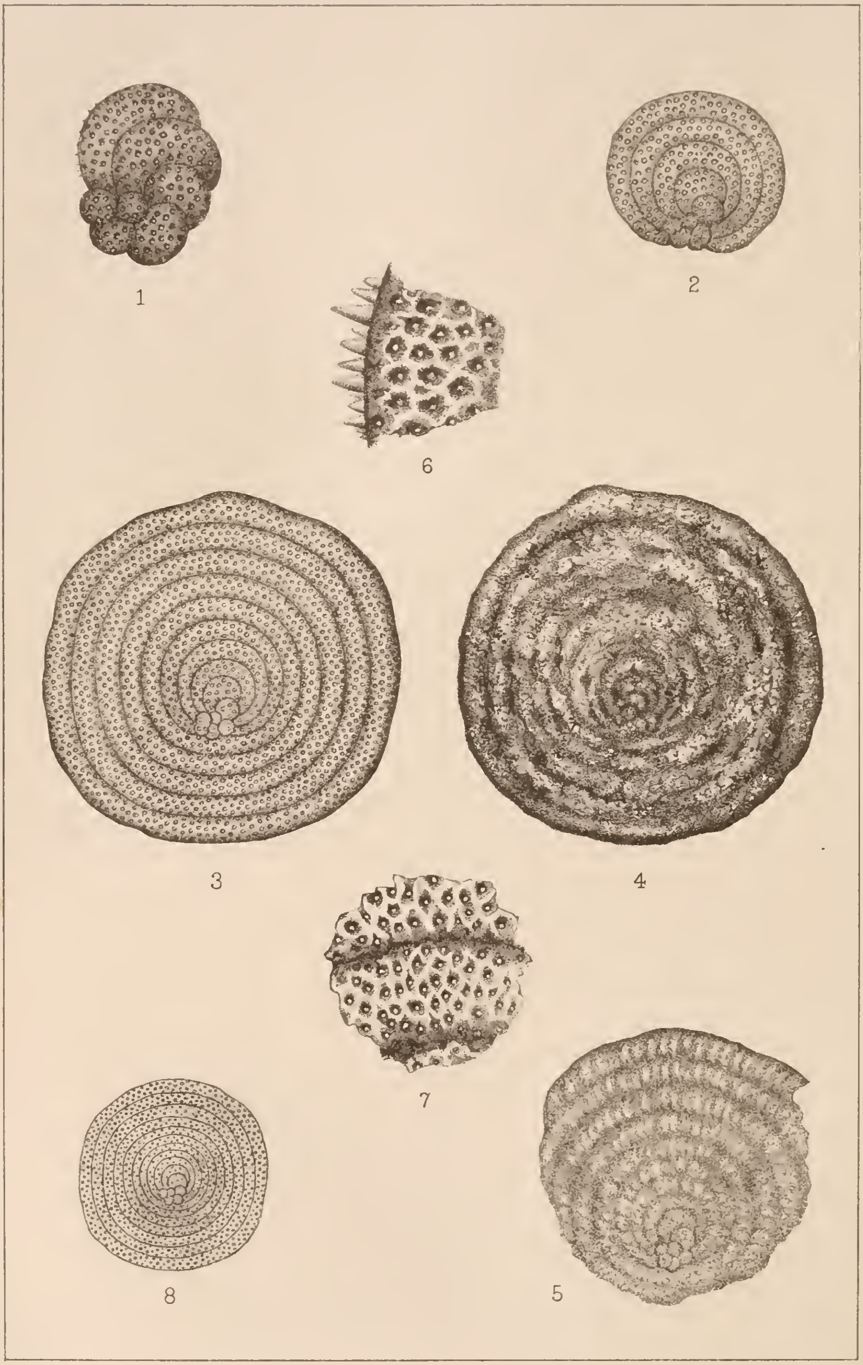
Mr. J. W. Gordon and Mr. Fletcher Moulton:—A New Lens for high-power Microscopy, with diagrams of the same shown upon the screen.

Mr. J. W. Gordon:—Illuminating Apparatus for the Microscope, in illustration of his paper.

Mr. E. Heron-Allen and Mr. A. Earland:—Twelve slides under Microscopes; Lantern slides shown upon the screen; Foraminiferous material, and a Map of Selsey Bill in illustration of their paper

Dr. Hebb:—Micro-slides lent by Mr. A. Flatters—10 slides illustrating the structural parts of the chick at various stages of its development from about 2 to $4\frac{1}{2}$ days, and 9 slides of transverse sections of the same; Stereo-photomicrographs, by Mr. W. P. Dollman, of *Alveolina oblonga*, × 6; Fungus in Horse's Eye, × 300; Statoblast of Fresh-water Polyzoon from Bombay, × 350; *Biddulphia antediluviana* from Baltic mud, × 350.

Mr. Arthur Skinner:—An Old Simple Microscope by Cary.



J.A.Lovegrove del. West.Newman lith.

Cycloloculina.

④ JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

OCTOBER, 1908.

TRANSACTIONS OF THE SOCIETY.

XV.—*On Cycloloculina, a New Generic Type of the Foraminifera.*

With a Preliminary Study of the Foraminiferous Deposits and Shore-sands of Selsey Bill.

By Edward Heron-Allen, F.L.S. F.R.M.S., and Arthur Earland.

(*Read June* 17, 1908.)

Plate XII.

Introductory Note by Edward Heron-Allen.

I opine that if there might be a special heaven for Rhizopodists, it would be one whose leading feature would be a calm sea, in the surface waters of which a record number of living, pelagic Foraminifera might be gathered in the terminal bottle of a common tow-net. If this may be postulated as the Walhalla of the student

EXPLANATION OF PLATE XII.

Fig. 1.—*Cycloloculina annulata* sp. n. 1st or discorbine stage. × 96. Balsam mount.
,, 2.—Ditto. 2nd or pavonine stage. × 60. Balsam mount.
,, 3.—Ditto. 3rd or annular stage. × 48. Balsam mount.
,, 4.—Ditto. 3rd or annular stage. × 48. Coarse specimen. Opaque mount.
,, 5.—Ditto. 3rd or annular stage (fragment). × 48. Hyaline specimen. Opaque mount. To show the crenulated surface of chambers.
,, 6.—Ditto. Detail showing spines on septal face of chamber. × 290.
,, 7.—Ditto. Detail showing areolated structure round the tubuli. × 290.
,, 8.—*Cycloloculina polygyra* sp. n. 3rd or annular stage. × 48. Balsam mount.

of the Foraminifera, his Niffelheim may certainly be found in the material which, for the past year, has occupied my leisure moments, and the appellate jurisdiction of my friend and collaborator, Arthur Earland. I refer to the material which may be scraped at any time, between tide-marks, from the surface of the shore sand of Selsey Bill, which extends from the point of the Bill north-westwards, through Bracklesham Bay, to the brackish waters of Chichester Harbour, opposite Hayling Island and the Isle of Wight. When first I suggested devoting my attention to this material to Mr. F. W. Millett, he returned me a highly characteristic answer, and one which would have seriously damped the ardour of a beginner. He said: "The specimens of Foraminifera are interesting, but I cannot quite see how you are to make a useful monograph out of this jumble of fossils washed out of uncertain beds from unknown localities."

In the beginning I found Mr. Earland at one with him, but as I continued doggedly upon the quest, Mr. Earland came round to my view that this is, perhaps, the most remarkable and suggestive foraminiferous deposit to be found in the British Islands. The completed study of the Foraminifera of the locality, we hope to lay before the Society at a future date, but it has seemed good to us to introduce the subject, with a paper upon a most interesting form continually recurrent in the material, which, at first, we were disposed to regard as a new species of *Planorbulina*, but which we have gradually been forced to recognise as a new genus, for which we propose the generic name of *Cycloloculina*, and which we have the honour to lay before you in two species, named respectively *Cycloloculina annulata* and *C. polygyra*.

It will not be impertinent to the consideration of the genus to devote a few moments to the history of its discovery. Selsey Bill is the peninsula resembling, as it were, an "uvula" dependent from the extreme south-west of Sussex, a few miles only from the borders of Hampshire; and there is probably no locality upon the coast lines of Great Britain which has attracted in a greater degree the earnest attention of geologists. It may be said at once that the whole of the district under consideration, forms part of the most noteworthy of the raised beaches which occupied the attention of Professor Prestwich, and were so learnedly and lucidly described and discussed by him in the 'Quarterly Journal' of the Geological Society in 1892.* For the purpose of this paper, the geological interest of this shore commences at Bracklesham Farm, which is situate just beyond the western boundary of the Geological Survey's Map, Sheet 332, and opposite which lies the great bank of Eocene fossils which is exposed at low tide, and is composed of agglome-

* This raised beach extends from Brighton on the east, to Portsmouth on the west, and includes the whole district south of a line drawn from Portslade through Arundel to Havant (Postscript, No. 11).

rated masses of *Cardita* (*Venericardia*) *planicosta* and *acuticosta*, digging through which, one finds an equally rich bed of the large *Cypræa tuberculosa*. This bed reappears on the eastern side of the Bill, opposite the now reclaimed Pagham Harbour, where cockles have been gathered from time immemorial, and have achieved a reputation to which testimony was borne by Izaak Walton, who records that there are four good things in Sussex, "a Selsey cockle, a Chichester lobster, an Arundel mullet, and an Amberley trout."* Proceeding south-eastwards, we arrive at the *Turritella* beds of Earnley, beds which dip under the peninsula, and (like the *Cardita* beds) reappear on the eastern side of the Bill, opposite Park Farm. Further on, just before we reach Thorney Farm, we find the shore, at low tide, literally strewn with the little disks of *Nummulites lævigatus*, whilst, opposite Thorney Farm, we find Eocene deposits at the extreme limit of low tides in which the gigantic shells, often two feet in length, of *Cerithium giganteum* are not uncommon. The next, and, to us, a most interesting deposit, is found immediately in front of Medmerry Farm, now ruined by the encroachment of the sea, where a spit of Post-Pliocene mud (a Pleistocene, or Post-Tertiary deposit), runs out to sea, which can easily be examined at spring tides, and is extraordinarily rich in fossil Foraminifera. The question as to whether these are *in situ*, or derived, or partly derived and partly *in situ*, we must leave for discussion when we present to the Society the completed results of our work upon the Selsey shore sands. Between Medmerry Farm and the Thorney Coastguard Station, a high bank of recent shingle, heaped up against the Raised Beach and the Coombe Rock, Mr. Clement Reid's section of which (Postscript No. 9, p. 355) has been so often reproduced in works and papers dealing with Tertiary and Post-Tertiary deposits, keeps the sea (not always successfully) from inundating the low-lying marshes that lie between the disused oyster beds of Medmerry Farm and the Windmill, which, at this point, forms a feature of the landscape. "Passing Thorney Coastguard Station" (we quote, for the sake of convenience, from Mr. Clement Reid's 'Memoir' upon the Sheet No. 332, Postscript No. 13), "we reach the highest Eocene deposits represented in the Selsey peninsula. These consist of clays and sandy rock-beds full of Foraminifera, such as *Nummulina variolaria*, and *Alveolina sabulosa*, etc.† The Mixon

* The Complete Angler. By I. Walton and C. Cotton. London, 1653, Chap. IV. Third Day.

† It must be borne in mind that the locality identified in the early geological memoirs as "Thorney Coastguard Station" is very misleading. The erosion of the coast having practically washed away the old Thorney Coastguard Station, the name has been transferred to the newer Coastguard Station two miles south-east, so that in any memoir prior to 1863 Thorney Coastguard Station means Bracklesham Bay, whilst in later memoirs (as, for instance, Mr. Reid's Geological Memoir, Postscript, No 13) "Thorney" means the Coastguard Station heretofore known as "Danners," which is at the end of West Street, Selsey.

Rocks opposite Selsey yield the *Alveolina* limestone, of which so much of the village is built. It is no longer quarried, as its removal led to a more rapid wasting of the coast." The whole of these Tertiary and Post-Tertiary deposits (which will receive our careful consideration when the time arrives for presenting our completed work to the Society) are overlaid by the Coombe Rock and brick-earths which Mr. Clement Reid has made the subject of significant study and observation (Postscript, Nos. 6 and 9); and, as we pursue our way round the Bill, we meet again, cropping out upon the eastern coast, the *Nummulite* bed, and the *Cardita* and *Turritella* beds, before we reach the broad expanse of marsh clay, overlaid with recent shingle, that shelves from Pagham harbour into the sea, just beyond the long spit of heaped-up shingle that stretches seaward opposite Park Farm. It must be borne in mind that the coast of Selsey Bill has been, and is, subject to a degree of annual erosion, unsurpassed on the British coasts. It was our intention to show, by means of a map, the old coast-lines as shown upon survey maps, dating from 1570 until the present time; but we have been unable to complete this work for the present occasion (for which, perhaps, it would have been premature), but the map will be completed in this particular for the illustration of our later paper. By that time, also, we shall have completed a series of carefully measured sections which we are preparing, showing the strata of the brick earth, torrent gravels, marine gravels, and drift all over the Selsey peninsula. And, with a view to giving more complete data for the micro-geologist, we shall present an analysis of some thirty-six samples of strata, reaching from the 16-foot level to the 100-foot level, taken from two artesian borings that I have made through this Coombe rock and the underlying strata in the centre of Selsey village in a fruitless search for an underground water supply.

I little knew when, as a new settler in Selsey at the commencement of 1907, I determined to make a systematic study of the Foraminifera of the Selsey shore-sand—fired by Arthur Earland's exhaustive study of the Foraminifera of Bognor (Postscript, No. 17) and my own earlier and desultory studies of the same sand, and of that at Littlehampton—what I was undertaking. It seemed to me that, to arrive at a complete catalogue of the species to be found between tide-marks, all that was necessary was to make an extended gathering and wash, float, and elutriate the contained forms. Accordingly, in the course of some half-dozen walks at low tide from the foreshore of the extreme point, slightly to the east of the Marine Hotel, up to Bracklesham Bay (Thorney Farm), a distance of about $2\frac{1}{2}$ miles, I collected exactly 1000 cubic centimetres of foraminiferal scrapings, which, after treatment, gave the following results:—

	c.cm.
Coarse siftings left on the $\frac{1}{30}$-in. sieve	22·5
Pure Foraminifera (skimmed from the surface) ..	5·0
Floatings left on the $\frac{1}{90}$-in. sieve	24·5
,, ,, $\frac{1}{180}$-in. silk	9·5
Elutriated material left on the $\frac{1}{30}$-in. sieve ..	6·0
,, ,, ,, $\frac{1}{90}$-in. sieve ..	63·0
,, ,, ,, $\frac{1}{180}$-in. silk ..	15·5
Residue	854·0
	1000·0

Within a year of the incipience of the task of examining the material, I had compiled a catalogue of over 200 species, both recent and fossil, but very soon upon the query slide I found I had three or four discoidal shells of a highly friable nature, in very imperfect condition, that I had never seen before. I submitted them to my collaborator in this paper, who recognised as a fact, what I had by that time tentatively advanced, viz. that the shell was, at any rate, a new species, perhaps related to the *Planorbulina costellata* or *flabellum* of Terquem.*

Once, however, mounted in balsam, we recognised that we were dealing with a Foraminifer, not only new as regards species, but having an entirely new plan of growth and development, and consequently a new genus. The determination and description of the shell is as follows:

Précis of Origin.

The specimens on which the genus is founded are fossils, and were found in company with many other fossil Foraminifera derived from Secondary and Tertiary strata. A large proportion of the fossils are such as would occur in Tertiary beds of the period of the "Calcaire Grossier" (Eocene), and it is therefore probable that the specimens have their origin in the submarine denudation of strata which are not exposed above low-water mark. It is hoped to settle this point by dredging in the neighbourhood, but in the meantime it is thought desirable to publish this description of the most interesting form yet met with in the gatherings.

Family IX. **Rotaliidæ.**

Sub-family 2, ROTALINÆ.

Genus, *Cycloloculina* Heron-Allen and Earland.

Definition of the Genus.—Test free (or perhaps sometimes adherent in the later stage of growth), complanate, discoidal, con-

* Les Foraminifères de l'Éocène des Environs de Paris. By M. O. Terquem, Mém. Soc. Géol. de France, sér. 3, ii. (1882).

sisting of three distinct series of chambers arranged in one plane representing three distinct life-periods, of each of which we have been fortunate enough to secure perfect and typical examples. These three life-periods are as follows :—

1. An initial series of seven or eight chambers arranged in one plane in a compressed and evolute spiral, all the chambers being visible on both faces of the test. The chambers grow rapidly in thickness, so that a young shell at the period of the completion of this first or "Discorbine" stage of growth is somewhat wedge-shaped in vertical section.

2. An intermediate or "Pavonine" stage, consisting of two or three chambers, which, rapidly increasing in width (as opposed to depth, which from the completion of the first or Discorbine stage remains pretty constant during the remaining growth), overlap and infold the initial or Discorbine series.

3. A final series of narrow annular chambers arranged concentrically round the earlier stages.

The completed test is usually symmetrical and roughly circular in outline, but is sometimes more or less irregular both in outline and in superficial appearance, as though it had grown in contact with an irregular surface. No attached specimens have, however, been found as yet.

The test is distinctly and somewhat coarsely perforated. As the test increases in growth and age, the walls become thickened by a deposit of shell substance between the tubuli, and the surface then assumes a rough, or areolated appearance, distinctly visible in balsam mounts, due to the cup-shaped depressions left round the perforations (plate XII. fig. 7). The edges of these cups appear to have been produced into minute spines, which are especially noticeable round the perforations on the oral faces of the chambers, where they have been included and protected from injury by the growth of the succeeding chambers (plate XII. fig. 6).

The continual deposition of this shell-substance causes the older shells to assume a crenulate, or even warty, superficial appearance, which masks the sutural lines. The plan of growth then becomes very obscure, but is still readily observable in balsam mounts.

Aperture.—There is no special oral aperture in any of the stages of growth. The only communication between the successive chambers consists of the ordinary tubuli, which are equally distributed over the septal face of the chambers, as well as over the outer sides. The septal tubuli do not differ in any way from the other perforations.

This absence of special aperture is one of the most marked features of the genus, and has no parallel in the perforate Foraminifera outside the Tinoporinæ, of which sub-family the absence of a special aperture is a characteristic feature.

The genus *Cycloloculina* will be placed in the second sub-family

Rotalinæ of Brady's ninth family, the Rotaliidæ, and between the genera *Discorbina* and *Planorbulina*, which are its nearest allies, although the absence of special aperture might lead one to suppose that its affinities were with the Tinoporinæ. The earliest chambers however, which are on the Discorbine plan of growth, mark its affinity to that genus. It differs from *Planorbulina*, to which it bears a superficial resemblance externally, in the construction and arrangement of its later chambers, and in the absence of definite oral apertures. In *Planorbulina* the chambers succeeding the early spiral portion are arranged in more or less concentric order, but the method of arrangement rapidly becomes obscure, and one portion of the periphery often grows more rapidly than another, owing to the accretion of chamberlets. *Planorbulina*, moreover, is more or less an adherent form, and the later chambers grow to some extent over their predecessors, so that the initial spiral portion is only visible on the under, or attached, surface of the test. This overlapping reaches its fullest development in *P. acervalis* (Brady), in which the chamberlets are irregularly heaped together.

In *Planorbulina*, moreover, the oral apertures are very well defined, consisting of minute arched slits, with everted lip, placed

FIG. 138.—Diagrammatic Section of a Portion of *Planorbulina*.
A, oral apertures.

on each side of the chamberlet at the points of attachment to the previous whorl.

Our type bears a somewhat superficial resemblance to a species which was described by d'Orbigny under the name of *Planorbulina vermiculata*, but which was transferred by Brady to the genus *Pulvinulina* on grounds which do not appear very convincing to us. It may be noted that Brady assigns Terquem's *Planorbulina Eocæna* to this species, but we think incorrectly, as specimens which are undoubtedly referable to Terquem's species are of frequent occurrence at Bognor and Selsey, and they bear but little resemblance to *Pulvinulina* (*Planorbulina*) *vermiculata*, of which we have excellent specimens from the Mediterranean.

The undivided tubular chambers which are the characteristic feature of the genus *Cycloloculina*, have no parallel in the Foraminifera. D'Orbigny's second order, the Cyclostega, was created to include those forms in which the test was discoidal and composed of concentric segments, but in *Orbitolites*, and its isomorph *Cycloclypeus*, these annular chambers are subdivided by partitions into chamberlets, as is also the case in *Orbiculina*, which in its variety *compressa* (*O. compressa* d'Orbigny), bears a remarkable resemblance to our form.

Terquem in his celebrated monograph * figures and describes several abnormal *Planorbulinæ*, most of which occur among the Selsey fossils. One of his species, viz. *Planorbulina flabellum* (Terquem),† bears a strong resemblance to the Pavonine stage of *Cyclolocalina*, and is indeed probably referable to this genus, though apparently not to either of the Selsey types. Terquem's figure differs from our form in the shape of the later chambers, which are arcuate instead of being tubular and of horseshoe form.

Terquem's figure does not, however, tally very accurately with his description of the species, which is stated to be very variable in shape and in the number of chambers. In this respect it differs again from our form, in which the chambers are remarkably constant in shape and nearly always ten in number, up to the completion of the Pavonine stage.

Cycloloculina annulata sp. n. Plate XII. figs. 1–7.

Definition of Species.—Test free, complanate, discoidal, consisting of the three series of chambers arranged more or less irregularly in one plane. Peripheral edges of the chambers rounded. The entire surface of the shell, including the peripheral edge, somewhat coarsely perforate. No aperture to the test other than these perforations, which represent the sole means of communication between the successive chambers of the test.

The surface of the test varies greatly in individual specimens. It is occasionally almost smooth, clear, and distinctly hyaline, and in these specimens, which are always regularly complanate, the peculiar arrangement of the chambers is tolerably apparent even when the shell is viewed as an opaque object, the concentric sutural furrows being clearly marked. In the majority of specimens, however, the test is irregularly complanate, and the surface is so distorted by the irregular crenulated growth of the chambers, and so roughened by the depositions of secondary shell deposit round the edges of the perforations, that the sutural furrows are only visible at intervals. The real structure of the test is thus masked, and such specimens might easily be overlooked or regarded as abnormal *Planorbulinæ* of the "*larvata*" group. The transference of these thick and coarsely built specimens to balsam is, however,

* Les Foraminifères de l'Éocène des Environs de Paris. By M. O. Terquem, Mém. Soc. Géol. de France, ser. 3, ii. (1882).

† Tom. cit., p. 92, pl. xi. fig. 19.

sufficient to disclose their identity with the smooth and regular specimens which possibly represent individuals which had lived in deeper and more undisturbed water, or under conditions less favourable for exuberance of shell growth.

A series of radial crinkles or undulations, which are more noticeable in the thin-walled specimens than in the coarser shells, might at first sight give the impression that the annular chambers are divided by radial partitions into small chamberlets; but these markings are purely superficial, and the examination of numerous balsam specimens has proved that the tubular chambers are undivided throughout (plate XII. fig. 5).

Mode of Growth.—The initial or "Discorbine" stage commences with a primordial chamber, which is followed by about six other chambers, crescentiform in shape, and arranged as in *Discorbina biconcava* (Parker and Jones), to which species the shell, at the completion of its first stage, bears some resemblance (plate XII. fig. 1). With the seventh chamber, the second, or "Pavonine," stage may be said to commence. Owing to its great breadth, as compared with its diameter, it commences that overlapping of the preceding chambers, which, continually increasing in the eighth and ninth chambers, usually reaches its culminating point in the tenth chamber, which completely infolds all its predecessors, its opposite extremities meeting at the base of the shell. The test, which had been more or less fan-shaped, or, rather, Pavonine (peacock-tail shape) at the eighth and ninth chambers, is now practically circular, only a slight flattening at the base showing where the encircling edges of the tenth chamber have met (plate XII. fig. 2).

The third, or "Annular" stage of growth, now begins, and the animal adds several tube-like undivided chambers, each of which completely surrounds. all its predecessors (plate XII. figs. 3, 4). The number of these chambers varies considerably. The largest specimen which we have found shows six of these concentric annular chambers. The specimen is imperfect, but it probably marks the approximate limit of growth, as the average number of annular chambers in the third stage does not exceed four.

From the ninth or tenth chamber to the completion of the shell, there is but little variation in the diameter of the tube-like chambers, the average diameter of the chambers being about 0·05 mm. This means that the tubes, though very nearly circular in section, are rather broader than they are deep.

In the next species, however—*Cycloloculina polygyra*—the variation is in the other direction, the depth being, if anything, greater than the breadth.

One abnormal specimen was found in which the shell showed signs of fracture and repair during the third stage of the animal's life. A considerable piece of the test has been broken away, and the gap filled up, not by the restoration of the broken annular chambers, but by the insertion of irregular chamberlets, which fill the space and complete the circular outline of the shell.

The species varies considerably in size, but the following measurements may be taken as approximating to an average of the various stages:—"Discorbine" stage: length, 0·26 mm.; breadth, 0·20 mm. "Pavonine" stage: length, 0·5 mm.; breadth, 0·6 mm. Adult, or "Annular" stage: diameter, 1–1·1 mm. The concentric annuli average 0·05 mm. in diameter.

The thickness of the specimens is approximately the same in all stages of growth after the first few chambers, and an average for a moderately flat specimen would be 0·046 mm.

Cycloloculina polygyra sp. n. Plate XII. fig. 8.

Definition of Species.—Test free, complanate, discoidal, consisting of the three series of chambers arranged symmetrically in one plane. Peripheral edge nearly square. Perforations finer than in the type, and without any secondary deposit of shell substance between the pores. Sutural lines either very slightly depressed, or flush, or even slightly limbate. Number of chambers in the first two stages, usually eight. Average number of chambers in the third, or "Annular" stage, about five. The annular chambers increase regularly in diameter, instead of remaining of practically constant diameter, as in *C. annulata*, and this gradual increase gives a false impression of a closely coiled spiral, whence our specific name "*polygyra*." As the thickness of the test is practically the same in all stages, it follows that the internal section of the chambers varies at different stages of growth, the early chambers being almost ribbon-like, while the later ones are nearly square in section.

The species is founded on certain specimens which are found associated with *C. annulata* in several of the gatherings. It is of very infrequent occurrence as compared with the type, and all the specimens hitherto found are adults. There is, however, no doubt from their structure, that the test passes through the same three stages as does *C. annulata*, from which it differs in several essential features.

The chief differences are:—

A. In size, the species is considerably smaller than *C. annulata*. Our largest specimen of *C. polygyra* measures 0·5–0·6 mm. in diameter, which is less than the average size of *C. annulata*. The shell is altogether smaller, neater, and more finished in appearance than the type.

B. The peripheral edge is square, not rounded, as in *C. annulata*, and the sutural lines are only slightly depressed, and sometimes flush or limbate.

C. The secondary shell deposit between the perforations is entirely wanting, and the test, consequently, never acquires the coarse and weathered appearance which marks many specimens of *C. annulata.*

D. The annular chambers vary in diameter and in sectional shape.

The genus being thus established, and its two distinctive species having been determined by the examination of recurrent specimens, we had reached a point at which it became imperative that some organised effort should be made to determine the exact locality, if not the precise geological stratum, from which this interesting fossil is derived. We therefore made the following series of gatherings of a strictly localised character, taking whenever possible, not only a sample of the shore-sand, but of the rocks and other deposits exposed at low spring tides, and of the sea-floor by means of dredging.

1. Shore-sand. From a small sand-bay, or pocket, in the shelter of the spit of shingle that runs out to sea opposite Park Farm, on the eastern side of the Bill. (It may be observed that this is the only spot on the eastern shore which is not covered at all states of the tide with a greater or lesser depth of shingle, derived apparently from the raised beach or Coombe Rock.)

2. Mud. A green plastic clay (? Tertiary) dredged in five fathoms outside the Mixon Rocks.

3. Rock detritus. The indurated and *Pholas*-bored Tertiary clay. Pebbles, and small boulders, dredged in five fathoms outside the Mixon Rocks, locally known as "The Clibs."

4. Rock detritus. The *Alveolina* limestone forming the Mixon Rocks proper, of which most of the old houses in Selsey are built. Dredged with Nos. 2 and 3.

5. Rock detritus. The muddy sand found in the pools under the boulders upon the highest point of the Mixon Rocks, piled round the Mixon Beacon and uncovered at low tide. This consists of the detritus of Nos. 2 and 3 mingled with recent Foraminifera.

6. Shore-sand. From the commencement of the "sands" opposite the Marine Hotel, extending slightly eastward towards the extreme point, off which are the Mixon Rocks.

7. Shore-sand. From the same point, extending about a quarter of a mile westward, opposite "The Bungalows."

8. Mud-deposit. Opposite Thorney (New) Coastguard Station, called by Mr. C. Reid the "Selsey Beds." A brown loamy (Pleistocene) mud, with much detritus of derived fossil Mollusca.

9. Mud-deposit. A Post-Tertiary estuarine clay, of deep indigo blue colour, about three feet thick, separating No. 8 at this point from No. 10.

10. Bracklesham Beds. The *Pholas*-bored Eocene belt that

surrounds the peninsula. Sample taken below Nos. 8 and 9, opposite Thorney Coastguard Station.

11. Shore-sand. From the sands midway between No. 7 and No. 12 above the "Selsey Beds" (No. 8).

12. Shore-sand. From the shore opposite the oyster-beds and Windmill, slightly north-west of the present Thorney Coastguard Station.

13. Shore-sand. From the shore opposite Medmerry Farm, between the Coombe Rock and the spit of Pleistocene mud described by Mr. C. Reid (Postscript, No. 9; also Nos. 8 and 10).

14. Mud-deposit. Dug from the Pleistocene mud ("Clibs") exposed at spring-tide (Laminarian zone) opposite Medmerry Farm.

15. Shore-sand. From the shore of Bracklesham Bay opposite Thorney Farm, and the now abandoned (old) Thorney Coastguard Station.

16. Eocene-sand. From the interior of large and perfect shells of *Cardita planicosta*, from a depth of two feet in the Bracklesham Beds, uncovered at low water of spring tides in Bracklesham Bay.

Besides the foregoing samples of material, we possess, and shall examine systematically in due course, the thirty-six Artesian-well samples of the strata of the Selsey peninsula to which reference has been made.

The presence of a large number of purely chalk Foraminifera in the Selsey shore-sand is accounted for by the continual throwing up and shattering upon the shingle, of hollow flints (Spongidæ) from the upper chalk (probably from the Isle of Wight), and a description of the contents of some of these will form a necessary termination to our completed study of the Foraminifera of the locality.

It will readily be gathered from a glance at the foregoing catalogue of material, that an exhaustive study of the Foraminifera of Selsey Bill must occupy all the leisure that we can devote to it for some years to come. Meanwhile we have made a preliminary and necessarily somewhat cursory examination of the twelve samples composing the above catalogue, with a view to ascertaining, as far as is at present possible, the precise origin of the genus *Cycloloculina*.

The result of such examination is as follows:—

1. Park Farm. Almost entirely the detritus of recent shells. A few *Nummulites*, but practically no Foraminifera, recent or fossil.

2. Mixon Mud. The coarse siftings gave *Nummulites* and *Alveolina Boscii* in quantity, with small Eocene Mollusca, often full of pyrites. The *Nummulites* frequently encrusted with Polyzoa (*Hydractinia*, etc.), showing that they have been washed out of the matrix for some time. Large casts, in glauconite and quartzose, of *Miliolina alveoliniformis*, *Biloculina*, *Discorbina* (? *parisiensis*). One

Cycloloculina was found among the finer siftings looking very much out of place, and probably washed by the current from the point of the Bill. A feature of the finer siftings were robust sponge-spicules and fragments of a gem-mineral not yet identified.

3. "Clibs." Principally *Nummulites*, with a disconcerting mixture of recent forms, evidently washed out of the *Pholas* borings.

4. *Alveolina* limestone. Large casts in yellowish silica of various *Miliolinæ*, and perhaps some large *Polymorphinæ*.

5. Under the Mixon Rocks. The same casts as in No. 4, with a large proportion of recent arenaceous forms (*Verneuilina polystropha* and *Haplophragmium canariense*, with large recent *Miliolinæ* (*Massilina secans*).

6. Opposite Marine Hotel. Suspending judgment as to the single test dredged in 5 fathoms (No. 2), *Cycloloculina* makes its first appearance here, where it is fairly plentiful.

7. Opposite "The Bungalows." Here *Cycloloculina* is an increasingly recurrent shell.

8. Selsey Beds. A brown clay, full of derived Eocene fossil Foraminifera, but no *Cycloloculina* found *in situ*.

9. Blue Band. No sign of *Cycloloculina*, but many Estuarine forms, such as *Nonionina*, *Trochammina*, etc., all filled with iron pyrites. This band is full of vegetable detritus and fragments of pyrites.

10. Bracklesham Beds. An Eocene clay, very rich in fossil Foraminifera, but no sign of *Cycloloculina* at present.

11. Above the Selsey Beds. Here *Cycloloculina* is more plentiful than anywhere else, the specimens being, for the most part, delicate and perfect.

12. Opposite the Oyster Beds. Here *Cycloloculina* is a recurrent form, though generally somewhat battered.

13. Opposite Medmerry Farm. Here *Cycloloculina* is about as common as in No. 12, but more battered as a rule.

14. Pleistocene mud deposit. In the first small lump of this mud which we washed we found a perfect *Cycloloculina annulata* and a perfect *C. polygyra*, but many hours' patient search since then have failed to produce a further specimen of either. The utmost care is taken to use clean sieves and new muslins, but until more specimens are washed out we must suspend judgment as to this sample.

15. From the shore of Bracklesham Bay. In this we have failed to find any trace of *Cycloloculina*. The gathering consists almost entirely of Eocene fossils, shell-detritus, with *Nummulites*, and a striking collection of large glauconite casts of Foraminifera, but few tests, either recent or fossil. We have, however, found in this sample several specimens of the rare *Polymorphina complanata* figured by d'Orbigny in his "Foraminifères fossiles du Bassin Tertiaire de Vienne" (Paris, 1846).

16. Interior of *Cardita*, Bracklesham. A green sandy clay in which we have found no trace of any Foraminifera whatever.

It will therefore be seen that within the time limits of our researches up to the present, the genus *Cycloloculina* is found as a derived fossil only, in the shore-sands of the western side of Selsey Bill, from the extreme point opposite the Marine Hotel, up to Medmerry Farm, growing more scarce as one proceeds north-westward. The shell is extremely delicate and friable, and we are of opinion that it is incapable of travelling far in a perfect condition, or of withstanding the wash of the tide for more than a short while. It is found by us in its best state in elutriated rough material, the process of washing appearing to damage it almost beyond recognition, whilst its weight renders it almost entirely absent from "floatings." It would appear therefore to be washed from some Post-Tertiary mud stratum near that which Mr. C. Reid has named the "Selsey Beds," where it occurs no doubt to-day as a derived fossil, having been washed there from some hitherto undiscovered soft band in the Eocene clays of the *Pholas*-bed which fringes the shore at this point. It appears furthermore to be one of Nature's failures, existing probably in great quantity *in situ* wherever it came into existence, but the exact geological stratum or deposit in which it had its origin is for the present purely conjectural, and must remain so until we can make a more extended and localised series of dredgings.

Note.—In the completing paper which we propose to lay before the Society shortly, we shall endeavour to trace the relationships between the sub-marine and the sub-aerial geology of the peninsula of Selsey, and, in giving a list of the Foraminifera both recent and fossil which we have identified in our gatherings, we shall make the attempt to ascribe to each species its correct, or at any rate probable, origin.

Postscript.

In the preparation of this paper it has been found necessary to consult many authorities, and we think it desirable to give the following list of works, in chronological order, to which we have had recourse for the purpose of verifying our researches into the origin of the Foraminifera of the Selsey peninsula.

1. Trimmer, J.—On the Agricultural Geology of England and Wales. Journ. Roy. Agric. Soc. England, xii. (1851) p. 445.
2. Godwin-Austen, R.—On the Newer Tertiary Deposits of the Sussex Coast. Quart. Journ. Geol. Soc., xiii. (1855) p. 40. (1857 Postponed Papers.)
3. Fisher, O.—On the Bracklesham Beds of the Isle of Wight Basin. Op. cit., xviii. (1861) p. 65.

4. Bell, A.—Contributions to the Fauna of the Upper Tertiaries. I. The "Mud-deposit" at Selsey, Sussex. Ann. Mag. Nat. Hist., series 4, No. 43 (1871) p. 45.
5. Wood, S. V.—The Newer Pliocene Period in England. Quart. Journ. Geol. Soc., xxxvi. (1880) p. 457 (part 1); and xxxviii. (1882) p. 667, (part 2).
6. Reid, C.—On the Origin of Dry-chalk Valleys and of Coombe Rock. Op. cit., xliii. (1887) p 364.
7. Gardner, J. S., H. Keeping, and H. W. Monckton.—The Upper Eocene, comprising the Berton and Upper Bagshot Formations. Op. cit., xliv. (1888) p. 578.
8. Bell, A.—Notes on some Post-Tertiary Marine Deposits on the South Coast of England. Op. cit., xlvii. (1891) p. 172.
9. Reid, C.—The Pleistocene Deposits of the Sussex Coast, and their Equivalents in other Districts. Op. cit., xlviii. (1892) p. 344.
10. Bell, A.—Notes on a Post-Tertiary Deposit in Sussex. Yorkshire Phil. Soc. Report for 1892, p. 58. (Reprinted York, 1893.) Supplementary Note (leaflet) by F. W. Millett, The Foraminifera of a Post-Tertiary Deposit in Sussex.
11. Prestwich, J.—The Raised Beaches and "Head" or Rubble-drift of the South of England: their relation to the Valley Drifts, and to the Glacial Period; and on a late Post-Glacial Submergence. Quart. Journ. Geol. Soc., xlviii. (1892) p. 263.
12. Reid, C.—A Fossiliferous Pleistocene Deposit at Stone, on the Hampshire Coast. Op. cit., xlix. (1893) p. 325.
13. Reid, C.—The Geology of the Country around Bognor (Explanation of Sheet 332, London, 1897). Memoirs Geological Survey, 1898.
14. Mill, Hugh Robert—A Fragment of the Geography of England: South-west Sussex. Reprinted from Geographical Journal, March and April, 1900
15. Reid, C.—The Geology of the Country near Chichester (Explanation of Sheet 317, London, 1903.) Memoirs Geological Survey, 1903.
16. Elsden, J. V., and W. Whitaker—Excursion to Selsey and Chichester. Proc. Geol. Assoc., xviii. (1904) p. 475.
17. Earland, A.—The Foraminifera of the Shore-sand at Bognor, Sussex. Journ. Quekett Micr. Club, series 2, ix. (1905) No. 57, p. 187.

XVI.—*On Dendritic Growths of Copper Oxide in Paper.*

By James Strachan.

(*Read April* 15, 1908.)

Plate XIII.

I. Introduction.

The occurrence of dendritic growths in paper has been observed for a long time, but it is only within recent years that their precise nature has been determined. They were mistaken at first for vegetable or fungoid growths, and were designated by such names as *Conferva dendritica* (Agardh and Lyngbye) and *Dematium olivaceum* (Schumacher).* In the year 1872, however, Liversidge † established the fact that the dendritic growths in paper contain copper, and are purely inorganic in their composition. There appears to have been some doubt at this time as to the nature of the copper compound composing the dendrites, whether sulphide or oxide, and Tait ‡ was among the first to point out that these growths are probably derived from the *oxidation* of metallic particles imbedded in the paper during manufacture. Tait estimated, from an examination of various books containing dendrites, that it required a period of at least twenty years for the development of these growths. Doubts concerning the true nature of dendrites persisted for a number of years, until in 1901 the whole subject was reviewed and gone into by Scales,§ who came to the following conclusions, from a careful microscopical and micro-chemical examination of dendrites in various kinds of paper :—

1. That the dendrites in paper are composed of copper oxide with a central metallic nucleus.

2. That the metallic particles from which the dendrites grow

* *Vide* Carrington's remarks on this subject in Science Gossip, i. (1895) p. 268.
† Journ. Chem. Soc., x. (1872) p. 646.
‡ Crystals Bred in Books. Science Gossip, i. (1895) p. 85.
§ Dendritic Spots in Paper, by F. S. Scales, F.R.M.S. Science Gossip, vii. n.s. (1901) p. 258, et seq. (2 photomicrographs).

EXPLANATION OF PLATE XIII.

Fig. 1.—Dendritic growth of copper oxide in paper, containing 70–75 p.c. wood cellulose fibres ; fourteen months' growth. × 20.
,, 2.—Dendritic growth of copper oxide in paper, composed purely of wood cellulose; about five years' growth. × 12.

Fig. 1.

Fig. 2.

are derived most probably from the paper-making machinery, in the process of paper-making.

3. That the growth of the dendritic crystals of copper oxide follows the lie of the fibres in the paper, and along the fibres; the ramifications of the dendrites depending entirely upon the fibres of the paper.

4. That dendrites seem to grow more readily upon fibres having a large central canal, such as cotton; practically all the papers examined contained cotton fibres.

5. That the oxidation of the metallic nuclei is a slow process.

The only subsequent paper on this subject was written by Simon * in 1903, and in it the author gives merely a recapitulation of the "Science Gossip" articles, with further chemical evidence confirming facts already clearly established. Having satisfied himself as to the reality of three points settled definitely by Scales (viz. 1. Composition—copper oxide; 2. Growth by oxidation from a central metallic nucleus; 3. Growth along the fibres of the paper), the present writer set about the solution of the following questions, answers to which were as yet doubtful :—

1. Are the dendritic growths of copper oxide confined to any particular kind of fibre, such as cotton ?

2. What is the rate of the oxidation of the metallic nucleus, and consequent growth of the dendrite ?

3. Why do dendrites occur in some classes of paper and not at all, or very rarely, in others ?

4. Why are dendrites of less frequent occurrence in modern papers than in papers made towards the middle of the nineteenth century ?

II. Results of New Investigations.

Evidence was carefully collected for about six years from various sources, including writing and printing papers of all ages, especially modern papers the ages of which were definitely known. After examining many hundreds of dendrites, and the nature of the papers in which they were found, I arrived at definite answers to the above questions, thus clearing away several doubtful ideas.

1. With regard to the nature of the fibres upon which the dendritic growth takes place, it is quite evident that dendrites grow indiscriminately upon all of the fibres commonly in use for the manufacture of various kinds of paper, viz. cotton, linen, esparto, straw, and various kinds of wood cellulose. The growth of the dendritic copper oxide upon the fibres is purely a superficial phenomenon, and does not proceed at all along the central canal

* Dendritic Forms in Paper. Trans. Manchester Micr, Soc., 1903, pp. 92–5 (1 pl.).

of any fibre. Indeed, in most cases by removing the sizing (either rosin or gelatin) and washing the fibres gently with the aid of a rather stiff brush, the greater part of a dendrite can be removed from the surface of the paper in which it occurs, leaving in many instances nothing but the metallic nucleus surrounded by fibres stained slightly by a yellowish tinge of colour. The growth of a dendrite is affected to some extent by the nature of the fibres, being most vigorous upon softer cellulose such as that of cotton and certain woods, and least active upon harder cellulose, such as that of linen, esparto, and straw.

2. The rate of growth of a dendrite in paper is very variable, according to its guidance by variety of circumstances, both internal and external. We have seen that early writers on the subject regarded the growth as an extremely slow process—as long as twenty years being allowed as an estimate by Tait. From observations of papers, of which the exact date of manufacture was known in each instance, I have ascertained that the oxidation of the metallic nucleus, and consequent growth of the dendritic oxides, is in many cases a comparatively rapid phenomenon; under favourable circumstances a dendrite may develop appreciably in a period as short as six months. The chief external factor favouring the growth of dendrites in paper is the presence of atmospheric moisture, without which oxidation could not proceed. Cellulose absorbs from 9–12 p.c of natural atmospheric moisture, and its moisture-content varies according to the amount of moisture in the atmosphere, and the temperature of the latter. The internal circumstances governing the rate of growth are, the nature of the fibres themselves, and the presence of materials other than cellulose in the fabric of the paper. From numerous observations it appears that dendrites grow most rapidly upon wood and cotton celluloses, less rapidly upon linen, and least rapidly upon esparto and straw fibres. Dendrites grow more readily and rapidly in rosin-sized papers than in papers sized with gelatin (tub-sized), which is due probably to the fact that the gelatin layer on the surface of the latter forms a more complete protection to the fibres, from atmospheric influences, than the rosin-sizing, which latter is chiefly in the interstices of the paper as particles, and to a much less extent as an actual coating upon the fibres themselves. The presence of filling and loading materials such as kaolin and satin-spar is not favourable to the growth of dendrites, and they are consequently rare in heavily-loaded or coated papers. As an example of rapid growth under favourable circumstances, I quote the example of a paper composed of wood cellulose 70 p.c., straw cellulose 30 p.c., rosin-sized, 10 p.c. loading, which was made in December 1906. Dendrites were first observed in this paper in May 1907, and continued to develop to the present date. The nuclei consisted of small particles of bronze, 0·2–1·5 mm. in diameter, derived from the bars or

knives of the refining engines. In this paper a nucleus of bronze 0·8 mm. in length became a dendrite 3·2 mm. in length, during a period of twelve months, and even then the nucleus was not much reduced, but merely coated over with oxide of copper.

3. The occurrence of dendrites in certain classes of paper, and their absence in others, admits of a very simple explanation. For example, dendritic growths are more common in certain fine writing-papers, such as ledger-papers, because the stuff from which the latter are prepared undergoes a prolonged treatment in the beating and refining engines, thus presenting greater opportunity for the contamination of the paper-stuff with particles of bronze ground from the bars and blades of the reducing machinery. Many of these particles are caught in the sand-traps of the paper-machine, but the lighter fragments are carried into the paper-web, thus forming the nuclei of future dendrites. Dendrites are also more common in light, porous cartridge-papers, and light printing-papers, in which the pores of the fabric are not filled to excess with loading materials. In short, dendrites occur most frequently in papers which have undergone either prolonged or severe milling, and in papers which present favourable internal circumstances for their growth.

4. Several reasons are apparent for the less frequent occurrence of dendrites in recently-made papers than in papers made about the middle of last century. It was formerly supposed that their non-appearance in recent papers was due to their slowness of growth, but that is not the case. An evident reason is the substitution of steel for bronze in modern beating-engines. Particles of iron are extremely common in the cheaper papers made to-day, but these never develop into true dendrites; they give rise, on oxidation, to mere red stains, having no apparent crystalline structure. Another reason for their less frequent occurrence is that most modern printing-papers are more heavily loaded and filled than formerly, in answer to the demand for a printing-paper having a smooth surface suitable for half-tone illustrations. As already pointed out, dendritic growths do not flourish in a heavily-loaded or coated paper.

III. The Size and Mode of Growth of Dendrites.

Dendritic growths in paper vary much in size according to their age and size of nucleus, the ultimate size of a dendrite depending entirely upon the size of the central nucleus from which it grows. From less than 1 mm., I have found them up to 12 mm. in greatest diameter, which in machine-made papers is usually parallel to the "machine-direction" of the paper. Simon records them "up to say 15 mm. in diameter," but dendrites of copper oxide of that size in paper must be rather rare.

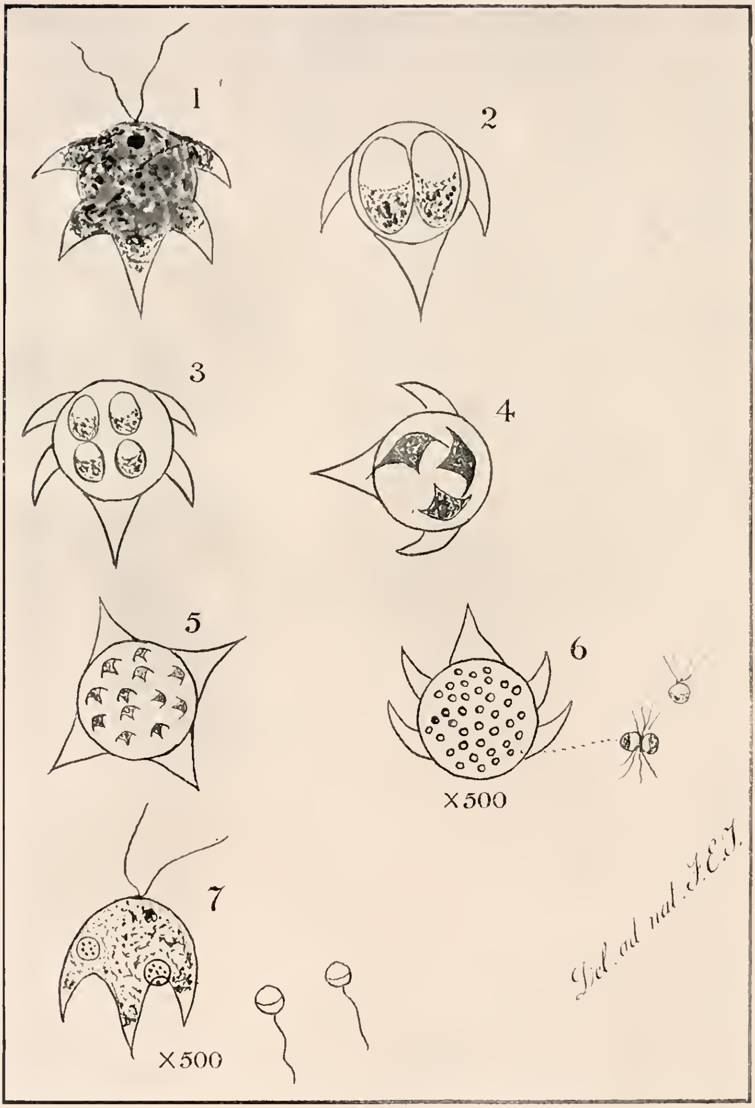
A dendrite appears to continue its growth as long as the nucleus remains in part unoxidised. A dendrite in a cotton paper, from a book dated 1850, showed neither increase in size nor change in contour during a period of five recent years, for the simple reason that the nucleus had become completely oxidised, probably many years ago. It would appear from this, that after the central nucleus of a dendrite is completely oxidised, the oxides produced do not of themselves spread to any appreciable extent on the fibres. The growth of a dendrite is more active and rapid in its initial stages, before the nucleus becomes thickly coated with oxide. The dendritic growth creeps along the various fibres in characteristic fashion. The more or less cylindrical fibres of straw, esparto, and linen, become sheathed in copper oxide, the deposit upon linen being usually thick and rather patchy. The wider, tubular fibres of cotton cellulose, become coated in a similar manner to those of linen, but when the cotton fibres are more flat and riband-like, the dendrite often spreads out laterally from fibre to fibre in beautiful fern-like traceries. The latter habit is typical also of almost all dendrites found in papers composed of wood cellulose, the flattened fibres of which seem to present an ideal surface for the dendritic growth, the oxide of copper spreading and branching from fibre to fibre in a beautiful and delicate crystalline pattern. As pointed out by Scales, the ramifications of dendrites generally depend upon the lie of the fibres in the paper. This is true for straw, esparto, linen, and some cotton papers; but in the case of wood cellulose papers, and some papers composed of flattened cotton fibres, the crystalline energy of the growth asserts itself, allowing of frequent lateral growth in a direction often at right angles to the lie of the fibres. This fact appears to be due partly to the flat shape of the fibres, and partly to their comparative softness, which allows of a more vigorous growth.

Most dendrites, especially old ones, are composed almost wholly of black cupric oxide, but in many cases, especially in recent dendrites, I have observed the formation of dark-red, translucent cuprous oxide, and of a yellowish substance similar in appearance to a partially hydrated cuprous oxide. From a careful consideration of many dendrites during various stages in their growth, I have come to the conclusion that the copper is conveyed along the pores of the cellulose in a hydrated cuprous condition, possibly in chemical union with the cellulose, and that it crystallises in the form of capillary-aggregates of cuprous oxide upon the surface of the fibres, the red cuprous oxide being subsequently oxidised to the black cupric form. I have not at any time observed the characteristic green colour of cupric carbonate in dendrites, but, nevertheless, it is most probable that the minute quantities of carbonic acid, and perhaps, of ammonia, present in the atmosphere, play an important part in the oxidation of the metallic nucleus, as catalytic agents in the presence of water and oxygen. The whole process is a chemical one, in which the cellulose plays an important part as a physical conveyer of the means of oxidation, and as a physical and chemical carrier of the products of oxidation, to and from the metallic nucleus. The superior crystalline energy of cuprous oxide, the porous nature of the cellulose surface, and the presence of minute traces of oxidised copper in the fibres themselves (derived from the milling engines), are most probably all factors in the activity of dendritic growth.

IV. Microscopical Examination of Dendrites.

Dendrites in paper may be mounted dry for examination under the Microscope. This is convenient for examination with low powers by reflected light, especially when it is desired to observe their growth, in which case, of course, they must not be sealed up air-tight. For examination with medium and high powers by transmitted light, I have found mounting in a waxy medium an admirable and convenient plan. The refractive index of Canada balsam renders it unsuitable, and glycerin has a solvent action on the dendrite. Pure spermaceti wax, or white paraffin melting at 130° to 135° F., may be utilised for the purpose, preferably the former. The fragment of paper containing the dendrite is first treated with hot distilled water and hot alcoholic ether to remove sizing, then dried thoroughly and soaked in the melting wax for a few minutes. It is then mounted on a glass slip with a drop of melted wax, the cover-glass being applied with moderate pressure until perfectly cold. If sufficient pressure be applied to the cover-glass during mounting the waxy medium shows good detail even with fairly high powers, and brings out very well the translucent nature of the red crystalline cuprous oxide. Particles of kaolin stand out very clearly in the paper thus mounted, and it may be observed how the dendritic growth avoids such obstacles. The fibres may be stained before mounting, and aniline green will be found a suitable colour. If a finer mounting medium be desired, refined paraffin oil (sp. gr. 0·900) may be used for this purpose.

In the micro-chemical examination of metallic particles in paper, a delicate method of distinguishing between extremely minute particles of iron, and of copper, is sometimes required. This may be done as follows:—A small fragment of the paper including the suspected particle, is placed upon a glass slip, covered with a drop of dilute (20 p.c.) hydrochloric acid, and warmed gently over a small flame. After a few minutes a drop of a pure solution of potassium sulpho-cyanide is added. If iron be present the characteristic blood-red colour of ferric thio-cyanate shows at once. If iron be absent, the examination is continued for copper, the fragment of paper being dried and ignited carefully in a platinum dish, or upon foil of that metal. When the paper is reduced to white ash, if the particle be metallic it will appear as a black speck in the ash. The latter is then placed upon a glass slip, a drop of dilute hydrochloric acid added, and warmed. To this is added, when cold, a drop of starch solution containing potassium iodide. If copper be present, an intense blue or black coloration results; iron gives the same reaction, but, in the absence of iron, copper is indicated, these two metals being the only ones found, as a rule, in paper.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NOTES.

Brachiomonas submarina, Bohlin.

By the Rev. Eustace Tozer.

Plate XIV.

Since reading my paper at the meeting of the Royal Microscopical Society, February 1908, I have seen the note on this form published by Mr. G. S. West, of Birmingham, in the Linnean Journal for January. Mr. West kindly refers to my find, and after some correspondence with him I have come to the conclusion that it would be inadvisable to dissociate this alga I described from Bohlin's *Brachiomonas submarina* in spite of certain differences.

My observations will be seen to agree with Mr. West's up to a certain point. Bohlin's description I have not seen.

The alga then was found by me four years ago in brackish water at Sheerness. My son also found it in rain-water in an old boat. It is probable that the boat brought in the alga from the sea, and the rain-water, becoming saturated with salt, provided a suitable medium for development.

The alga consists of a sphere arising from the surface of which are five firm processes somewhat curved. These processes are hollow, opening at the base into the sphere (plate XIV. fig. 1). The outlines of the sphere are clearly seen when the contents divide.

A rich green chlorophyll fills the sphere. It is somewhat granulated and contains a fairly conspicuous nucleus.

A remarkable fact with regard to the chlorophyll is that when the alga is kept a few hours in the dark it contracts to the sphere, leaving the processes quite clear. When the alga is exposed again to strong light, the chlorophyll is seen extending into the processes until only the tips are clear.

It may be of interest to say that I have observed similar expansion and contraction of the protoplasmic contents in the cells of *Melosira* and *Pleurosigma* under similar conditions. In *Melosira* the protoplasm curls up and auxospore formation may thus be induced.

Brachiomonas is bi-flagellate, the flagella being thick, long, and very active. The alga swims with a "trembling" motion, and a crowd of the forms resemble the flight of a flock of swallows. The five processes (four of which are of equal size, the fifth at the tail of the sphere being slightly longer) assist in swimming like the leaves of a paddle-wheel, the alga turning a somersault by their aid.

It is found in the ditches all the year through, but has two "swarming" periods—February, just after the keen frosts, and again in early October. At such periods it may be collected "pure" as it migrates in the water, as it were, in the form of clouds. At other times it mixes freely with *Euglena.*

In size, apart from the processes, it approaches *Sphærella nivalis.*

Multiplication proceeds by the chlorophyll contracting to the sphere and dividing into two large oval portions. In these two portions the chlorophyll contracts to the base of each, leaving the fore end almost clear (plate XIV. fig. 2).

Division goes on to four portions which evolve into the parent form (zoogonidia). (Plate XIV. figs. 3, 4).

In other spheres the chlorophyll divides up into smaller portions which likewise assume the parent form (gametes). (Plate XIV. fig. 5.)

After prolonged active movements in the cell these forms break through and swim in pairs, and I noticed a constant exchange of partners. This is doubtless a form of true conjugation, though I was not fortunate enough to trace results.

There are further phenomena which I have frequently observed and which appear to me to be referable to multiplication.

The chlorophyll splits up in many cells into minute green spherules, as far as I could count about sixty-four in number. These spherules escape and are provided with four flagella apiece. These likewise swim in pairs (plate XIV. fig. 6).

In correspondence with me, Mr. West would refer this phenomenon to a pathological condition, and he states that such a condition may often set in before the organism as a whole is really dead. This did not appear to me to be such a condition. The collection was pure. As the alga swims about in "clouds" or "colonies" it is easy to obtain it quite pure, and the peculiar 4-flagellated zoospores arising from this division preclude this supposition of pathological condition.

Another phenomenon which I referred to at the meeting as formation of "bud cysts" is very common with this alga. A pellucid sphere forms in the chlorophyll, then another, sometimes three or four. By-and-by zoospores, uniflagellate, can be clearly made out within these pellucid spheres (plate XIV. fig. 7).

These spheres become somewhat pear-shaped and penetrate the envelope of the alga and are detached. They burst, and the zoospores escape, having a remarkable resemblance to the spermatozoon of Homo.

I at first took this to be a stage in the evolution of the alga, but since these zoospores or spermatozoa attach themselves to the alga, it may possibly be a case of parasitism.

Very frequently the four bodies of chlorophyll formed by division do not immediately evolve into the parent type, but escape and rest in masses of jelly.

Occasionally three zoogonidia are found in a cell instead of four (plate XIV. fig. 4).

On the Optical Properties of Contractile Organs.

By Doris L. Mackinnon, B.Sc., and Fred Vlès.

Within the last half century quite a number of writers have treated of the optical properties of contractile organs (muscles, cilia, flagella, etc.), and have shown that these elements are illuminated between the crossed nicols of a polarising Microscope. This optical reaction has been considered as due to birefringence, and a certain number of physiologists, among whom special mention must be made of Engelmann, have believed that they could base certain very important theories concerning contractility on the general fact of the birefringence of contractile organs. But it is far from having been strictly demonstrated that the illumination of *all* contractile organs between crossed nicols is identical with a phenomenon of birefringence; as early as 1862 Rouget expressed his belief—in a completely hypothetical fashion, and without demonstration in support — that, in the case of muscle fibres, phenomena of "depolarisation" by diffraction might easily simulate apparent birefringence. This opinion, however, appears scarcely to have been submitted afterwards to thorough examination.

One of us recently undertook (1908) the experimental investigation of depolarisation phenomena in contractile organs, and attempted to demonstrate that, while the illumination of muscle fibres between crossed nicols is certainly due to birefringence, that of vibratile cilia is of quite a different nature, and arises from a phenomenon of partial depolarisation of the light by reflection or refraction. The method for distinguishing between the two optical phenomena consisted mainly in observing whether the illumination of the object disappeared (depolarisation) or not (birefringence), when this object was immersed in a liquid having the same index of refraction as itself. The physical theory of depolarisation states, in fact, that the illumination of a depolarising body varies with the refractive index of the surrounding medium; this illumination disappears completely when the exterior index is the same as that of the object (at that moment there are no longer any phenomena of reflection or of refraction on its surface); and it reappears whenever the ratio of the two indices is greater or less than unity. To demonstrate depolarisation, then, one must mount the object in a series of liquids of gradually increasing refractive index, and ascertain whether its illumination diminishes, reaches a minimum, nil (when its index is equal to that of the liquid), and then gradually increases again.

We have continued, on various contractile organs, and by the same immersion method, the comparison of the phenomena of birefringence and depolarisation, as begun by Vlès. Our observations were carried out on (1) various motor elements of Protozoa (cilia and myonemes of ciliate Infusoria); (2) flagella of spermatozoa; (3) swimming-plates of Ctenophora; (4) the body, and that much-discussed structure, the undulating membrane of *Trypanosoma balbianii* Certes.

The several experiments were made on preparations either mounted separately in each of the liquids of the series and then compared together, or else passed through all the series in succession, first in one direction and then in the reverse. The two methods gave comparable results.

Concerning the latter method, however, it is necessary to point out here that if one follows one of these "reversible" preparations first in one direction and then in the other through the ascending series of indices, the intensity of the illumination of the same object in the same liquid is not always exactly of the same degree on the outward as on the return journey; there is a sort of retardation, a "hysteresis" of the illumination, which, after all, is exactly what one might expect, seeing that the process has to be carried out under a cover-slip; the diffusion of the new reagent introduced, and the corresponding elimination of the old, is never quite perfectly effected, and there may well be traces of the preceding liquid left (of higher or lower index as the case may be). As a result, the numerical equivalent of the preparation-liquid is in reality a little higher or a little lower than its true value, according to the direction of the progression through the series. Moreover, these differences become less and less with the length of time that one allows for the diffusion of the liquids.

A. Cilia of Protozoa.

Our experiments were carried out on the adoral cilia of large *Stentors* (*Stentor polymorphus* Ehrbg.) and *Vorticella*. The results are entirely in agreement with those obtained for the cilia of the gills of the mussel. The reaction is very near zero (so near, indeed, that very delicate methods of compensation alone are able to make it appreciable) in a zone of indices included between $n = 1\cdot49$ and $n = 1\cdot54$, with an absolute minimum—which is zero—about $1\cdot51$; the illumination reappears the further that one departs from this zone in either direction.

The following tables bring together the chief points in these experiments:—

1. Adoral cilia of *Stentor polymorphus*:—

Index N_L of the Liquid.	Liquid employed.	Degree of Illumination of the Object.	Comparison of the Indices of the Liquid N_L and of the Object N_0.
1·33	Water.	Very distinct.	
1·36	Ethyl-alcohol.	Very distinct.	
1·37	Water and glycerine.	Fainter, but still distinct.	
1·47	Glycerin.	Very faint.	
1·49	Castor-oil.	Extremely faint.	
1·51	Cedar-oil.	Nil.	$N_L = N_0$
1·53	Oil of cloves.	Extremely faint.	
1·54	Creasote.	Extremely faint.	
1·60	Creasote + monobromide of naphthaline.	Faint, but more distinct.	
1·66	Monobromide of naphthaline.	Distinct.	

2. Reversible preparation: the same *Stentor* was followed through a series of liquids:—

N_L	Liquid.	Illumination.
1·36	Ethyl-alcohol.	Distinct.
1·53	Oil of cloves.	Practically nil.
1·66	Monobromide of naphthaline.	Distinct.
1·53	Oil of cloves.	Extremely faint.
1·36	Ethyl-alcohol.	Faint, but distinct.

3. Reversible preparation: *Vorticella*:—

N_L	Liquid.	Illumination.
1·36	Ethyl-alcohol.	Very distinct.
1·53	Oil of cloves.	Nil.
1·66	Monobromide of naphthaline.	Distinct.
1·53	Oil of cloves.	Practically nil
1·36	Ethyl-alcohol.	Very distinct.

4. Desiccation has the same effect on the cilia of Protozoa as on epithelial cilia—the illumination is quite destroyed; this again confirms the depolarisation hypothesis.

B. Myonemes.

After having looked in vain for illumination of the myonemes in *Stentor*, *Spirostomum*, *Dileptus*, and *Vorticella* (probably too small), we were able to detect a faint, but distinct, illumination in the stalk of a large *Carchesium*.

The immersion experiment failed to show any noteworthy variation in the illumination, either for the sheath of the stalk or for the contractile filament that it incloses. These elements must, therefore, be considered birefringent, in contradiction to Rouget's hypothesis, but in agreement with the opinion of Engelmann.

C. Flagella of Spermatozoa.

The faint, but yet distinct, illumination of the large spermatozoa of *Triton cristatus* Laur. must be regarded as a phenomenon of depolarisation. It is to be noted that the refractive index of the liquid in which these organs become "extinguished" is a little higher than that for the cilia: $N_L = 1 \cdot 56$ instead of $1 \cdot 51$. This difference, which is quite evident, seems to be rather an important argument in favour of certain recent theories, which would tend to separate these two elements from one another:—

N_L	Liquid.	Illumination.	N_L and N_0
1·33	Water.	Distinct.	
1·36	Ethyl-alcohol.	Distinct, but fainter.	
1·47	Glycerine.	Very faint.	
1·49	Castor-oil.	Very faint.	
1·51	Cedar-oil.	Practically nil.	
1·54	Creasote.	Practically nil.	
1·56	Various mixtures of creasote and bromide of naphthaline	Nil	$N_L = N_0$
1·58		Nil	
1·60		Very faint, but distinct.	
1·66	Bromide of naphthaline	Distinct.	

D. Swimming-plates of *Ctenophora* (*Cydippe plumosa* Chun.).

The illumination here is also due to depolarisation. The extinction occurs in an index slightly higher than that for ordinary epithelial cilia: between $N_L = 1 \cdot 53$ and $1 \cdot 54$:—

N_L	Liquid.	Illumination.	N_L and N_0.
1·34	Sea-water.	Very distinct	
1·36	Ethyl-alcohol.	Fainter.	
1·49	Castor-oil.	Faint, but still distinct.	
1·51	Cedar-oil.	Practically nil.	
1·53	Oil of cloves.	Nil	$N_L = N_0$
1·54	Creasote.	Nil	
1·66	Bromide of naphthaline.	Distinct.	

F. *Trypanosoma balbianii* Certes.

The body of *Trypanosoma* (*Spirochæta*) *balbianii* and its undulating membrane (especially the "bordering filament") give a feeble reaction between crossed nicols. This illumination is due to depolarisation, and disappears in a liquid with an index $N_L = 1 \cdot 56$:—

N_L	Liquid.	Illumination.	N_L and N_0.
1·34	Sea-water.	Distinct.	
1·36	Ethyl-alcohol.	Less distinct.	
1·47	Glycerine.	Fairly distinct.	
1·51	Cedar-oil.	Very faint.	
1·53	Oil of cloves.	,, ,,	
1·56	Creasote + bromide of naphthaline.	Nil	$N_L = N_0$
1·66	Bromide of naphthaline.	Very faint.	

That the illumination of *T. balbianii* should be of this kind is not without interest, in view of a recent discussion on the nature of the "strengthening striations" of its membrane. These striations were regarded by Vlès (1906) as of a ciliary nature—an opinion which was rejected by Borrel and Cernovodeanu (1907), and finally by Fantham (1908), who would have them to be myonemes. The optical properties that we have just described seem rather in favour of the first theory; their illumination being due to depolarisation, removes these elements from among the myonomes; further, their "index of extinction," close to 1·56, possibly places them nearer flagella than cilia.

Conclusions.

The results of all these experiments, as well as of the former experiments by Vlès, may be summed up thus: the reactions of contractile organs between crossed nicols permit of their being divided into two groups, of which one is characterised by true birefringence, and the other by phenomena of depolarisation. These two groups are indicated by the following table:—

Illumination due to	Birefringence	Muscle-fibres.
		Myonemes of Protozoa.
	Depolarisation	Epithelial cilia.
		Cilia of Protozoa.
		,, Ctenophora.
		Flagella of spermatozoa.
		Body and undulating membrane of *Trypanosoma balbianii*.

In the latter group, the "index of extinction" gradually increases from the first element to the last; thus :—

	Index of extinction.
Epithelial cilia	1·51
Cilia of Protozoa	1·51
Swimming-plates of Ctenophora	1·53
Flagella	1·56

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Fantham — *Spirochæta* (*Trypanosoma*) *balbianii* and *Spirochæta anodontæ.* Quart. Journ. Micr. Sci., lii. (1908) pp. 1–73 (3 pls).

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„ Sur la biréfringence apparente des cils vibratiles. Comptes Rendus, cxlvi. (1908), pp. 88–9.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Text-book of Heredity.‡—J. Arthur Thomson has supplied an introduction to the study of heredity, which gives prominence to the modern results which have been reached by the microscopic study of the germ-cells, by the application of statistical methods, and by experiment. The chapters are as follow:—Heredity and inheritance, defined and illustrated; the physical basis of inheritance; heredity and variation; common modes of inheritance; reversion and allied phenomena; telegony and other disputed questions; the transmission of acquired characters; heredity and disease; the statistical study of inheritance; the experimental study of inheritance; the history of theories of heredity and inheritance; heredity and development; heredity and sex; social aspects of biological results. There is a copious bibliography of fifty pages and a useful subject-index to the bibliography.

Transmission of Coercively Acquired Reproductive Adaptations.§ P. Kammerer has made very interesting and important experiments with Salamanders. In *Salamandra maculosa* high up the mountains the viviparous condition obtains. The animal produces numerous (up to 72) larvæ, 25–30 mm. in length, with four legs and short gills. In warmer conditions the ovo-viviparous condition obtains. The animal lays large eggs which hatch in a few minutes into larvæ similar to those produced viviparously, but a little smaller (23–25 mm.). The larvæ and

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Heredity. London: Murray; New York: Putmans, 1908, xvi. and 605 pp., 49 figs. (some coloured).

§ Arch. f. Entwickel., xxv. (1907) pp. 7-51 (1 pl.).

eggs in these two cases—which are quite normal—are deposited in the water, and metamorphosis takes place after some months into land salamanders 45–56 mm. in length. In the case of *S. atra*, the two larvæ have very long gills *in utero* and no fin to the tail; when they are born they are 38–40 mm. in length.

What Kammerer sought to do, was to simulate alpine conditions in the case of *S. maculosa*, by keeping the animals at a low temperature and without water. The latter condition was sufficient by itself. He found that the action of the changed surroundings was cumulative. After a few pregnancies, 2–7 young are produced, 39–43 mm. in length, with short gills or without gills, and, to begin with, black in colour. Finally, a stage is reached where only two young ones are produced, as in *S. atra*.

Secondly, Kammerer sought to simulate for *S. atra* the conditions normal to *S. maculosa*. He kept the salamanders at a higher temperature (25°–30° C.), and in shallow water or with abundance of water beside them. When the full result was reached, 3–9 larvæ, 35–45 mm. long, were produced, with gills at most 8 mm. in length (in contrast to the very long normal gills of *S. atra*), with a fin 2–3 mm. in breadth, and of a coffee-brown colour instead of the usual black. These larvæ were more adapted to the water than larvæ at the corresponding stage cut out from the uterus of an ordinary pregnant *S. atra*.

The offspring of the salamanders experimented with were kept for $2\frac{1}{2}$ years in vivaria indoors, but did not become sexually mature until they were put in large vivaria in the open air where conditions were more normal. They became mature when $3\frac{1}{2}$ years old.

1. The offspring of those specimens of *S. maculosa* that had been subjected to cold and want of water gave birth to (*a*) very advanced large-headed larvæ, 45 mm. long, with much reduced gills, which underwent metamorphosis several days after, or moderately advanced larvæ, 40 mm. long, with large gills (both sets laid in water), or (*b*) to small larvæ, 26 mm. long, with rudimentary gills. The latter were laid on land; they were unable to live in water; they underwent metamorphosis after 4 weeks, and were then 29 mm. long.

2. The specimens of *S. atra* which were born as larvæ, bore in the water 3–5 larvæ of two sizes, 33–40 mm. or 21–23 mm., light in colour, with gills 8 mm. long, and with a fin 3 mm. broad.

In the case of (1) it should be observed that the conditions were normal for *S. maculosa*; in the case of (2) the conditions were to a certain extent a continuation of the experimental conditions under which the parents were born, for, as is well-known, *S. atra* lives at high altitudes, where the temperature is low and where water is scarce.

3. Specimens of *S. maculosa* born as salamanders, showed under repetition of the experimental conditions an augmentation of the effects. Their offspring were very like normal offspring of *S. atra*.

As to the general interpretation of these very interesting results, Kammerer admits that there is possibly a direct action of the environmental conditions on the germ-plasm, but he considers that there is, nevertheless, a true transmission of an acquired mode of reproduction.

He does not accept Weismann's limitation of the concept "acquired characters" to purely somatogenic characters. That is, he alters the basis of discussion. It is of minor importance, he says, whether the change produced in the germ-plasm is brought about "physically" (i.e. by direct action of the stimulus), or "physiologically" (i.e. by action of the modified soma on the germ-plasm). It is sufficient to note the fact that there are characters which can be experimentally established in one generation and appear in the next generation in the absence of the modifying conditions. Since the controversy as to the transmission of somatic modifications began, there have been few experiments, and we have therefore peculiar pleasure in recording Kammerer's very important work.

Parthenogenetic Segmentation in Fowl.*—A. Lécaillon maintains against Barfurth and others, that the unfertilised eggs of the fowl may exhibit "a special segmentation which one can hardly designate otherwise than as a parthenogenetic segmentation. The cells which result from this segmentation may possess a nucleus of normal appearance and capable of exhibiting the phenomena of mitosis." Very soon, however, the cells degenerate and development stops.

Early Stages in Development of the White Mouse.†—Ar. Anikiew describes and figures the early stages of segmentation in the ova of the white mouse. He found some with two polar bodies and some with one. In the maturation and fertilisation stages there is a marked polar differentiation, but this seems to disappear later on. It may be indicated by the position of the large pronuclei and of the nuclear figures. In the stage of the segmentation-spindle the protoplasm is marked by a special grouping of the nutritive particles in a sort of annular layer around the mitotic figure, as is sometimes seen at an earlier stage.

A fine account ‡ of the phenomena of maturation and fertilisation in the ovum of the white mouse has been given by H. Lams and the late J. Doorme.

Very Young Human Ovum.§—L. Frassi gives an account of a young ovum in situ, discussing the decidua and its vessels, the leucocytic infiltration, the limitation of fœtal and maternal elements, and the epithelial remains of the wall of the egg-chamber. He regards the following as belonging to the embryo: (1) the cellular enveloping layer; (2) the cell-pillars; (3) the syncytium; (4) the layer of Langhans (four epithelial layers formed from the primary epiblastic trophoblast); and (5) the mesoblast of the chorion. The cellular enveloping layer retains the original trophoblast character and presses persistently upon the maternal tissue. The author's bibliography takes the form of a table showing what the various observers have said as to Langhans' layer, the syncytium, the intervillous spaces and the villi, the mode of fixation, the decidua, the giant-cells, the glands, vessels, fibrin, size of ovum, etc.

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 647–9.
† Anat. Anzeig., xxxii. (1908) pp. 320–30 (7 figs.).
‡ Arch. Biol. xxiii. (1907) pp. 259–365 (3 pls.).
§ Arch. Mikr. Anat., lxxi. (1908) pp. 667–94 (1 pl. and 17 figs.).

Origin of Sex-cells in Rana pipiens.*—B. M. Allen finds that in this frog the sex-cells arise, in a large proportion at least, from the endoderm, from which they pass into the root of the mesentery at the time when the latter is formed by the approximation of the lateral plates of mesoderm. The same is true in the turtle (*Chrysemys*).

Studies on Spermatogenesis.†—Jacques van Mollé describes the spermatogenesis of the squirrel. The fine filaments which appear at the beginning of the development of the spermatocyte associate together in pairs during the synapsis. The nucleoli seen in the first "leptotene" stages are resolved into chromosomial filaments. The synapsis stage includes three phases, and the conjugation of chromosomes occurs in the middle or "amphisynaptene" phase.

Development of Vertebrate Nerve-cord.‡—Ch. van Bambeke has studied this in *Pelobates fuscus*, where the process is peculiar. He notes that, apart from *Amphioxus*, there are two modes of formation in Vertebrates: the sides of the medullary groove may close to form a medullary canal, or the axis may be a solid keel, which secondarily becomes tubular. In *Pelobates* the medullary plate does not form the walls of the medullary groove; the closure of the groove is due to the enveloping membrane (*Deckschicht* of Goette); after this is closed the medullary plate gives rise to the true medullary canal. The details of this peculiar mode of origin are described and figured. The author points out that in *Hylodes martinicensis* the neural plate was found by Sampson to be solid, recalling the condition in Teleosts and bony Ganoids. More cases should be examined before it is affirmed that the primarily solid or the primarily tubular foundation of the neural axis is the more primitive condition.

Development of the Head.—D. Filatoff § has studied the metamerism of the head of *Emys lutaria*.

W. Sippel ‖ discusses the structure and development of the roof of the mouth in Birds and Mammals.

A. Brachet¶ concludes his study of the development of the head of Amphibians, as regards sensory structures, nervous system, musculature, and skeleton.

Gill-cleft Region of Gymnophiona.**—Harry Marcus has studied embryos of *Hypogeophis rostratus* and *H. alternans*. One of his general conclusions is that the Gymnophiona are the most primitive living Amphibians. Some of the reasons are the following. There are seven visceral clefts; the "ultimobranchial body," developed from the last, is directly homologous with that of Selachians and *Ceratodus*; the lung-primordium may be compared with the diverticulum from the eighth gill-pouch of the lamprey; a second aortic arch is formed; the spiracle

* Anat. Anzeig., xxxi. (1907) pp. 339–47 (5 figs.).
† La Cellule, xxiv. (1907) pp. 259–76 (1 pl.).
‡ Arch. Biol., xxiii. (1908) pp. 523–39 (1 pl.).
§ Morphol. Jahrb., xxxvii. (1907) pp. 289–96 (3 pls. and 4 figs.).
‖ Tom. cit., pp. 490–524 (1 pl. and 12 figs.).
¶ Arch. Biol., xxiii. (1907) pp. 193–257 (3 pls.).
** Arch. Mikr. Anat., lxxi. (1908) pp. 695–774 (4 pls. and 12 figs.).

breaks through and remains open for a considerable time; the first rudiment of the gills consists of paired protrusions, as in *Polypterus*; there are rudiments of spiracular and opercular gills; as in Selachians, each visceral cleft has a thymus rudiment, though only from the second to the fifth (as Bryce has shown in *Lepidosiren*) are the primordia separated off as independent bodies. Another general conclusion is that the gills in all Amphibians are purely ectodermic structures.

Influence of Lecithin on Determination of Sex.*—C. Basile has experimented with rabbits, into which he injected lecithin. There seems to be an increase in reproductivity, the general nutritive conditions being improved by the lecithin injections. But the lecithin treatment seems also to increase the mortality of the young germs and the frequency of abortive development. The treatment does not seem to increase the number of female offspring.

Interstitial Cells in the Ovary of Mammals.†—P. Aimé publishes an account of his investigations on the interstitial cells of the ovary of some Mammals. He finds that the interstitial tissue is a very inconstant structure, and that it is, therefore, not an essential organ comparable in importance to the corpus luteum. The interstitial cells arise from the cells of the embryonic connective-tissue. They develop either at the expense of the embryonic mesenchyme cells, or at that of the Graafian follicles. In the majority of Mammals they are absent altogether. Where they occur, their evolution usually begins after birth, but in the horse they are characteristic of the embryonic period. Their glandular function is evident. They do not divide, they are closely connected with the capillaries, and they present all the cytological characters which indicate glandular activity. Their resemblance to the interstitial cells of the testis is purely morphological. In the horse young interstitial cells and xanthochromous interstitial cells are found in the fœtal ovary as well as in the testes, but there are no interstitial cells in the ovary of the adult. The only internal secreting gland in the ovary of the adult horse is the corpus luteum. The hypothesis that the interstitial cells have a trophic role in relation to the sexual cells has some probability if it be based on the time of their appearance, which precedes that of the Graafian follicles. But this role is difficult to explain in view of the fact that a great many animals in which the ovary is absolutely crowded with ovocytes have no interstitial cells at any period of their lives. The author admits that the function of the interstitial cells is still unknown, but he suggests, with regard to the horse, the theory that there is an equilibrium between their internal secretion in the fœtus, and the internal secretion of the maternal corpora lutea during the first half of gestation.

Compensatory Hypertrophy in the Ovary.‡—E. S. Carmichael and F. H. A. Marshall have experimented with rabbits, testing Bond's con-

* Atti R. Accad. Lincei Roma, xvii. (1908) pp. 643-52.
† Arch. Zool. Expér. et Gén., vii. (1907) pp. 95-143 (3 pls.).
‡ Journ. of Physiol., xxxvi. (1908) pp. 431-4.

clusion that after one ovary has been removed compensatory hypertrophy occurs in the other, but only if the animal is allowed to become pregnant, or at least to have sexual intercourse. The authors find that not only is sexual intercourse unnecessary for the purpose of inducing compensatory hypertrophy in the ovary, but that ovulation is not essential. Moreover, if one ovary be removed at a very early stage of pregnancy, abortion does not necessarily follow, the remaining ovary being apparently sufficient for the continuance of pregnancy until full time.

Passage of Ether from Mother to Fœtus.*—Maurice Nicloux has proved in guinea-pigs that ether, like chloroform and alcohol, can pass from mother to fœtus. As with chloroform, the quantity found in the fœtal liver is greater than that in the maternal liver, which probably means that the former is proportionately richer in lecithin.

Infundibular Gland and Choroid Plexus.†—L. Gentes shows that the mode of development (in the Torpedo) is in favour of the interpretation which regards the infundibular gland as a ventral choroid plexus.

Abnormalities in Hind Limbs of Rana esculenta.‡—E. Reichenow reports on a number of abnormalities observed in a collection of several thousand young frogs. One had one hind leg, another had three, and a third had four. He refers to some similar cases recently reported by Woodland, and suggests that a collection should be made of what are certainly not great rarities.

Vitalistic Theory of Evolution.§—K. C. Schneider, a thoroughgoing vitalist, who believes in a specific vital energy of a psychical nature, gives an outline of a vitalistic theory of evolution. He combines what seems to him sound in various existing theories. Thus he is in many ways in agreement with Weismann, but replaces his idea of determinants by an idea of potencies, and he maintains that of all biological factors the psychical is the most important. He does not find any warrant for believing in the transmission of somatic modifications, but he accepts another piece of the Lamarckian theory, namely, that great importance must be attached to the independent responses of the organism which is above all things a creative agent. He lays stress on mutations, but still more on what he calls "descensions," that is to say, great changes in organisation, such as the acquisition of a notochord or gill-clefts. To account for these "big lifts" in evolution, he invokes the aid of a self-assertive entelechy or soul or formative principle.

Inheritance of Manner of Clasping the Hands.‖—Frank E. Lutz discusses data concerning the manner in which the different members of families put the right-hand or left-hand thumb uppermost in clasping the

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 329–31.
† Tom. cit., pp. 687–9.
‡ Zool. Anzeig., xxxii. (1908) pp. 677–82 (4 figs.)
§ Versuch einer Begründung der Descendenztheorie. Jena: Fischer, 1908, viii. and 132 pp.
‖ Amer. Nat., xlii. (1908) pp. 195–6.

hands, with the fingers alternating. His conclusions are based on data for about 600 supplied by J. Arthur Thomson.

The mode of clasping the hands is inherited; it does not follow Mendelian law; neither position breeds true. There is no significant sexual dimorphism, nor hint of assortative mating. It has apparently no relation to right- or left-handedness.

There are a number of somewhat similar problems. Thus, the males of the common black cricket (*Gryllus*) usually keep the right tegmen over the left.

b. Histology.

Essentials of Cytology.*—C. E. Walker has written a very useful introduction to cytology. It is terse and up-to-date, and very lucid. The chapters deal with the structure and parts of the cell, cell-division, the meiotic phase (the whole period during which reduction is taking place), the post-meiotic divisions, the male sexual elements, the maturation of the ovum, fertilisation, the probable individuality of the chromosomes, the morphological aspect of the transmission of hereditary characters, and cytological methods.

Histological Studies.—N. Van der Stricht † gives a detailed account of the histogenesis of the constituent parts of the auditory neuro-epithelium, the maculæ acusticæ, and the organ of Corti.

N. Loewenthal ‡ has made a study of the very heterogeneous submaxillary salivary gland of hedgehog and white rat.

August Schuberg § gives an account of the connections between epithelial cells and connective-tissue cells in the skin of Amphibian larvæ (Axolotl, Salamander, etc.). They do not represent the persistence of primary conditions; they may be present or absent on the same area in different specimens; they may appear *de novo* without requiring pre-existing intercellular connections.

E. Holmgren ‖ describes the trophospongia or intracellular network of cross-striped muscle in Arthropods and Mammals, and discusses its physiological importance.

J. Duesberg ¶ discusses the mitochondrial apparatus in the cells of Vertebrates and Invertebrates, dealing with its varied form, its state in the resting cell, its behaviour during division, its role in the structure of spermatozoa, and its reaction to stains.

Neurological Studies.—K. Schilling ** gives a detailed account of the brain of the lamprey (*Petromyzon fluviatilis*).

C. V. A. Kappers †† describes the brain of *Amia calva* and of *Lepidosteus osseus*.

* The Essentials of Cytology: an Introduction to the Study of Living Matter, with a chapter on Cytological Methods. London: Constable and Co., Ltd., 1907, 139 pp., 49 figs.

† Arch. Biol. xxiii. (1908) pp. 541–693 (5 pls.).

‡ Arch. Mikr. Anat., lxxi. (1908) p. 588-666 (2 pls.).

§ Zeitschr. Wiss. Zool., lxxxvii. (1907) pp. 551–602 (4 pls., 1 fig.).

‖ Arch. Mikr. Anat., lxxi. (1907) pp. 165–247 (8 pls., 6 figs.).

¶ Tom. cit., pp. 284–96 (1 pl.).

** Abh. Senckenberg. Nat. Gesell., xxx. (1907) pp. 425–46 (1 pl., 2 figs.).

†† Tom. cit., pp. 449–500 (1 pl., 6 figs.).

Ciro Barbieri * has studied the development of the cranial nerves in the trout, and finds that it conforms generally to what has been described in other Vertebrates.

A. J. P. van den Broek † begins a series of investigations on the structure of the sympathetic nervous system in Mammals, dealing first with that of the neck.

R. Burckhardt ‡ has made a profound study of the brain of *Scymnus lichia* in particular and of Selachians in general, and proposes to work on to an elucidation of the phylogeny of the Vertebrate brain.

Double Refraction Phenomena in Muscle.§—Fred Vlès has made some interesting studies on the "birefringence" of muscle in frog and bird, crayfish and beetle, muscle and snail. The degrees of birefringence were measured, and the action of physical and chemical agents was studied. Desiccation, alcohol, glycerin, chloroform, ether, formol, xylol, have no effect on the muscular birefringence; heating to $+50°$, and water at $+100°$, produce partial attenuation of the birefringence; heating to $+170°$, acids, bases, chloride of mercury, and pepsin destroy it altogether.

There is no use in studying the phenomena on tissues fixed with Flemming's fluid and the like. The birefringence has not to do with hydration, nor with the presence of birefringent fats, and several other possibilities are excluded. It is probably due to some albuminoid or albuminoids, which can stand a high temperature.

c. General.

Introduction to Study of Natural History.||—F. W. Gamble has supplied an admirable short introduction to the study of animal life. It is distinguished by its freshness, its suggestiveness, and its fine style. The author deals with "the fulness of the earth," the organisation of animal life, the movements of animals, the quest for food, "the breath of life," the senses of animals, the colours of animals, the welfare of the race, and the life-histories of insects. The work is written in the first instance for those who wish to learn or teach such a survey of the animal pageant as can ally itself with observation and experiment; and, in the second place, for those who wish to organise their knowledge of animal life. It is not exactly the kind of scientific contribution which is usually recorded in this Journal, but it is a book of so much distinction that we do a service in helping to make it well known.

Habits of the Short-tailed Shrew.¶—A. F. Shull has made a study of the habits of the short-tailed shrew, *Blarina brevicauda*. He finds that it feeds, at least in winter, on snails of the genus *Polygyra*, which it hoards and moves to the surface as the temperature falls, and into its burrow as it rises. Empty shells are not carried back into the burrow.

* Morphol. Jahrb., xxxvii. (1907) pp. 162–201 (2 pls.).
† Tom. cit., pp. 202–88 (26 figs.).
‡ Abh. k. Leop. Carol. Akad. Halle, lxxiii. (1907) pp. 241–450 (5 pls. and 64 figs.).
§ Arch. Zool. Expér., viii. (1908) Notes et Revue, No. 2, pp. xl.–li. (2 figs.).
|| Animal Life. London: Smith, Elder and Co., 1908, xviii. and 305 pp. (63 figs.).
¶ Amer. Nat., xli. (1907) pp. 495–522 (5 figs.).

Other principal foods are voles, mice, insects, and earthworms. Vegetable foods, except nuts, are not eaten. The burrows of *Blarina* are similar to those of *Microtus pennsylvanica*, but are of greater depth, and the openings are farther apart. The smell, hearing, and tactile sense of *Blarina* are acute; its sight serves merely to distinguish light from shadow. Experiments in feeding a captive *Blarina* show that its economic importance may be considerable, since, unlike the other common shrew, *Sorex personatus*, it is almost exclusively carnivorous.

Imitative Tendency of Rats and of Cats.*—C. S. Berry finds that when "two rats were put into the box together, one rat being trained to get out of the box, and the other untrained, at first they were indifferent to each other's presence, but as the untrained rat observed that the other was able to get out, while he was not, a gradual change took place. The untrained rat began to watch the other's movements closely; he followed him all about the cage, standing up on his hind legs beside him at the string, and pulling it after he had pulled it. He also saw that when he was put back the immediate vicinity of the loop was the point of greatest interest for him, and that he tried to get out by working at the spot where he had seen the trained rat try." In cats Berry found similar and more marked cases of "imitation." It seems like imitation in the making, but the animal that does not know learns by paying attention to its comrade, and in an indefinite way doing the same sort of thing itself.

Intelligence of Raccoons.†—L. W. Cole has followed Thorndike's methods, and improved on them, in studying the behaviour of raccoons. The experiments consisted largely in allowing the animals to learn to open boxes closed by fastenings of various degrees of complexity. The learning was largely by trial and error, but it did not seem to be confined to this. Sometimes a raccoon seemed to "catch the idea," sometimes it learned by being "put through" an act, sometimes it seemed to learn by watching the experimenter. Some ingenious experiments suggest that some animals hold mental images. They fought against being put into boxes with complex fastenings, from which they had some time before had difficulty in escaping, though they willingly went into similar boxes whose fastenings they had found simple. To raise a green signal meant food, a red one meant nothing. They learned to raise these signals by clawing at the standards, but they could not see beforehand which sign would come up by clawing at a certain standard. When the red one came up they clawed it down again, then clawed up the green one, and prepared to receive food.

Unusual Type of Reaction in Dog.‡—G. van T. Hamilton has studied the behaviour of a dog which learned that in order to escape from a pen and get food he must press, out of a number of levers, the one that bore the same sign as was found on a general signboard elsewhere in the pen. He inspected the signboard, passed in review the

* Journ. Comp. Neurol. Psychol., xvi., pp. 333–61; xviii. (1908) pp. 1–25. See also Amer. Nat., xlii. (1908) pp. 212–13.
† Op. cit. xvii. (1907) pp. 211–61. See also Amer. Nat., xlii. (1908) pp. 213–14.
‡ Tom. cit., pp. 329–41. See also Amer. Nat., xlii. (1908) pp. 215–16.

four levers till he found the one with the same sign, and pressed it. Afterwards, being a clever dog, he discovered that a simpler way was to begin at one end and press the levers till he came to the one that worked. When electric shocks were attached to the "wrong" levers, he decided not to play any more.

Ear of Hungarian Blind Mouse.*—Julius Szakáll gives a full account of the auditory organ in *Spalax hungaricus*, and shows that it has a very high development in compensation for the degeneracy of the eye. Although there is some hint of retrogression even in the ear, e.g. in the absence of the musculus tensor tympani and the musculus stapedius, the greater part of the structure is very highly developed. Indeed, the author shows that in some respects the internal ear of *Spalax* is more perfect than that of any other Mammals hitherto studied.

Quagga of Turin Museum.†—L. Camerano discusses this specimen, which seems to be intermediate between *Equus quagga greyi* and *Equus quagga lorenzi*, which may therefore equally deserve a sub-specific name, *trouessarti* being proposed.

Tobacco-poisoning in Rabbits.‡—L. Richon and M. Perrin gave eight rabbits subcutaneous injections of infusion of tobacco; there was a very marked retardation of growth; and in two cases, after the cessation of the poisoning, there was a renewal of growth.

Prozeuglodon atrox.§—C. W. Andrews regards it as settled that the Zeuglodonts are descended from Creodonts, and that Odontoceti are derived from Zeuglodonts. There is a series of forms linking the Zeuglodonts to the terrestrial Creodonts; the earliest of these is *Protocetus atavus* from the Middle Eocene of Cairo, and somewhat later is *Prozeuglodon atrox*, which has many Creodont features. It seems to have been with great rapidity that both Cetaceans and Sirenia became completely adapted to an aquatic life. They diverged from a terrestrial stock during the Lower Eocene, and were completely adapted long before the close of the Middle Eocene. The great marine reptiles had vanished from the seas, and that gave the newcomers free scope. The limbs ceased to support the weight of the body, and many changes followed from this. The body is subjected to pressure on its anterior end, and some of the peculiarities of the skull are associated with this. Abundant food and the floating of the body may have made the large size possible. "No doubt the various changes above noticed may be regarded as entirely the result of selection acting on variations in the necessary direction, but the rapidity with which these changes took place, and the apparent uselessness of some of them, at least, suggest that in spite of the generally accepted doctrine that acquired characters are not inherited, in some cases complete change of the conditions acting throughout the life of each individual for generations does actually give rise to and direct the modifications undergone."

* Math. Nat. Ber. Ungarn, xxi. (1907) pp. 135–58 (8 figs.).
† Atti R. Accad. Sci. Torino, xliii. (1908) pp. 562–5.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 563–5.
§ Geol. Mag., v. (1908) pp. 209–12 (1 pl.).

Chalicotheres.*—O. A. Peterson gives a preliminary account of the splendidly preserved remains of *Moropus* in the Carnegie Museum. The skeleton presents a unique combination of characters. The phalanges are highly modified, terminating in cleft ungues which were, no doubt, covered by heavy claws; otherwise the skeleton is distinctively of an Ungulate type, most closely resembling the Perissodactyla. The fore limbs are longer than the hind limbs; they, together with the clawed feet, must have given the animal a very peculiar appearance. Some species are as large as an African rhinoceros, or even larger. Cope put them in a separate order, Ancylopoda; they are now referred to the Chalicotherioidea, an aberrant super-family of the Perissodactyla. In Miocene times they extended over Europe, Asia, and America. There are about twenty individuals of *Moropus* represented in the Carnegie Museum.

Reptiles of Eastern Island.†—Samuel Garman discusses two species of small lizards—a gecko, *Lepidodactylus lugubris*, and a skink, *Cryptoblepharus pœcilopleurus*. It appears that these lizards were not originally derived from the nearer islands to the westward, in the direction of Samoa and the Fijis, but from the Hawaiian Islands, to the far north-westward. The possibilities of transport to the isolated volcanic island are discussed. Some marine Chelonians and a marine snake are also recorded, but they are obviously of less interest as regards distribution.

Independent Bony Epiphyses in Sauropsida.‡—Hugo Fuchs has found true epiphyses in the humerus, radius, ulna, and some other bones of *Varanus griseus*, in the femur of *Uromastix acanthinurus*, in the humerus of *Phrynosoma harlanii*, and in some other cases. He notes that Gegenbaur and Dollo both refer to epiphyses in lizards, and that Huxley pointed out the epiphysial nature of the tip of the cnemial process in the *Rhea*.

Variation in Length of Frog's Intestine.§—Emile Yung finds that *Rana fusca* has a shorter intestine than *R. esculenta*, that in both species the males have a shorter intestine than the females, and that in the same species and sex the larger individuals have a relatively longer intestine. In spring the intestine is relatively shorter than in autumn, this difference having to do with the rest or activity of the digestive tract in the period before measurement.

Autostylic and Protostylic.‖—J. Graham Kerr points out that two very different modes of suspension of the jaw are confused under the term autostylic. In *Heterodontus* the palato-pterygo-quadrate cartilage is firmly adherent to the cartilaginous cranium; in *Chimæra* complete fusion has occurred. But in Dipnoi the suspension of the lower jaw from the skull is more primitive. It is through the upper part of the mandibular arch itself. This may be called protostylic.

* Amer. Nat., xli. (1907) pp. 733–52 (26 figs.).
† Bull. Mus. Comp. Zool. Harvard, lii. (1908) pp. 1–14 (1 pl.).
‡ Anat. Anzeig., xxxii. (1908) pp 352–60 (4 figs.).
§ Comptes Rendus, cxlv. (1907) pp. 1306–8.
‖ Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) p. 169.

Swim-bladder and Lungs.*—J. Graham Kerr supports the hypothesis of Sagemehl that the condition in which there exists a pair of lungs with a mid-ventral glottis is the primitive one. Sagemehl supposed that with increasing predominance of the hydrostatic function of the lungs in fish-like forms, one was lost, and the other passed up dorsally. The author shows that this is supported by various facts in the development of Crossopterygians and Dipnoans.

Function of Spleen in Fishes.†—R. Blumenthal has studied the role of the spleen in skate, dogfish, conger, sole, sand-eel and other fishes. He finds evidence that it is the normal place for the destruction of red blood-corpuscles.

New Sub-order of Fishes.‡—E. C. Starks defines a new sub-order, Atalaxia, for the reception of the Stylephoridæ, a family represented by *Stylephorus chordatus*. The first specimen of this remarkable fish was obtained about 1790, in the Western Atlantic between Cuba and Martinique; the second specimen—on which Starks' paper is based—was obtained by the Agassiz Expedition (1904–5), just south of the Galapagos Islands.

The vertebræ consist of centra only; the opposite halves of the hyoid are remote from each other; the palato-quadrate bar has atrophied; the ethmoid is far anterior to the vomer, and supported by a projection from the parasphenoid; there is no orbitosphenoid; the caudal fin is divided and part of the rays turned upward: the lower three are enlarged and produced backward into a long process.

This remarkable aberrant form has some, probably distant, affinities with the Tæniosomi (including Trachypteridæ) and Regalecidæ. Its affinity is shown, for instance, by the poorly ossified skeleton, the horizontal pectoral base, the upturned caudal fin, the absence of cross articulations in the dorsal rays, the reduction of the lower pharyngeals, the presence of four pairs of superior pharyngeals, and the ascending processes on maxillæ as well as on premaxillæ.

Copulatory Appendages of Læviraia oxyrhynchus.§—O. Huber describes the skeleton and musculature of this "clasper," which comes nearest to that of *Raia batis*. On the knife-like edge of one of the cartilages there is a saw-like row of eight sharp teeth, covered with chondrodentin. They are not separate pieces like denticles, but represent a marginal modification of the cartilage. No similar specialisation is known. Huber comments on the specific distinctiveness of the structure of these copulatory appendages, and on their individual variability.

Species of Trout.‖—A. Cligny points out that a young sea-trout cannot be distinguished from a young common trout, though the adult forms are readily distinguished. He gives evidence in support of the

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 170–4 (2 figs.).
† Comptes Rendus, cxlvi. (1908), pp. 190–1.
‡ Bull. Mus. Comp. Zool. Harvard, lii. (1908) pp. 17–22 (5 pls.).
§ Zool. Anzeig., xxxii. (1908) pp. 717–20 (4 figs.).
‖ Comptes Rendus, cxlv. (1907) pp. 1302–4.

conclusion of Knut-Dahl, that some of the progeny of the common trout descend to the sea and become sea-trout. In fact, sea-trout form a detached tribe of common trout, recently and imperfectly separated off.

Occurrence of Gobius orca in Clyde Sea Area.* — Alexander Patience has obtained this species, which is one of the smallest and rarest of European fishes, on three occasions in the Forth of Clyde. The closely allied *G. jeffreyssii*, which Günther recorded from three localities in the Clyde, is not uncommon.

Notes on Polyodon spathula.†—Charles R. Stockard makes some notes on the habits of this fish, which is abundant in some lakes bordering the lower Mississippi river. He was not successful in getting any embryos.

The fish may attain a length of about six feet, and often weighs over a hundred pounds. It frequents the deeper parts, and feeds chiefly on small Crustacea, chiefly Copepods. The snout is not essential, and its use is probably rather as a tactile organ than as foraging instrument.

Sensory Reactions of Amphioxus.‡—G. H. Parker has studied the West Indian Amphioxus, *Branchiostoma caribbæum* Sundevall, a close relative of the common European form, *B. lanceolatum* Pallas. It is only very slightly sensitive to light; it responds to a rapid increase, but not to a rapid decrease. The only known photoreceptors are the eye-cups in the wall of the nerve-tube. It is photokinetic and negatively phototropic.

Amphioxus is stimulated by water warmer than that in which it lives (31 C°.), and is killed in water at 40° C. or higher. It is also stimulated by water colder than 31° C., and is killed by lengthy exposure to water of 4° C. or lower. It is thermokinetic and negatively thermotropic.

The outer surface, especially the oral hood and the tentacular cirri, is sensitive to mechanical stimuli. Amphioxus is also sensitive to sound vibrations. It is thigmotropic, and slightly rheotropic and geotropic.

The outer surface of Amphioxus is sensitive to solutions of nitric acid, potassic hydrate, picric acid, alcohol, and to strong ether, chloroform, turpentine, oil of bergamot, and oil of rosemary, but not to solutions of sugar. It is also stimulated by diluted sea water and by fresh water. Amphioxus is negatively chemotropic.

The photoreceptors in Amphioxus are anatomically distinct from the receptors for thermal, mechanical, and chemical stimuli, and these three are at least physiologically distinct from one another.

To all stimuli that induce locomotion, Amphioxus responds by forward movements when the stimuli are applied to the tail, and by backward movements when they are applied to the middle or to the anterior end. The animal generally buries itself tail foremost, and in all probability usually swims tail foremost, though it may reverse both processes.

* Trans. Nat. Hist. Soc. Glasgow, viii. (1908) pp. 74–6.
† Amer. Nat., xli. (1907) pp. 752–66 (3 figs.).
‡ Proc. Amer. Acad. Arts and Sci., xliii. (1908) pp. 415–55.

When Amphioxus is cut in two, both halves lose much in sensitiveness, the posterior proportionally much more than the anterior. The anterior part of the nerve-tube is brain-like, the posterior part cord-like.

The skin contains tactile organs, but there are no derived organs such as lateral line organs or ears. The photoreceptors are the eye-cups of the nerve-tube, and these probably represent the elements from which the rod- and cone-cells of the lateral eyes of Vertebrates have been derived.

The rod- and cone-cells of the Vertebrate retina are inverted, not because they have retained a morphological position dependent upon an external origin, but because of their orientation, acquired as effective eye-cups in the nerve-tube of a primitive Vertebrate.

The chemical sense-organs of Amphioxus are located in the skin, and are chiefly important as organs for testing the character of the chemical environment, rather than for the selection of food. From these undifferentiated chemical sense-organs have probably been derived the organs of taste and smell, of which the former are apparently not present in Amphioxus, while the latter may be represented by the so-called olfactory pit.

Perforations of Marine Animals.*—W. C. M'Intosh discusses in a highly interesting manner the boring of shells by *Cliona*, of rocks by sea-urchins, of wood by *Chelura terebrans*, *Limnoria lignorum*, *Pholas*, *Teredo*, and the like. He has brought together many scattered observations, and he discusses impartially the various theories of the mode of perforation.

Differentiation of Faunas.†—K. Holdhaus discusses the various ways in which an area with homogeneous fauna may be divided into two or more areas with distinctive faunas. (1) An area may be divided, and the originally similar contingents may evolve on different lines, e.g. in the Galapagos islands with their species of *Tropidurus*, etc. (2) An area may be divided, and some of the constituents in one of the parts may be eliminated, e.g. in the contrast of Elba and Corsica in respect of *Pselaphus* and other small beetles. (3) Different migrants may be added to the two areas. Separation may be due to geographical isolation by some insuperable physical barrier, or to a diversity of vital conditions. Two faunas may become uniform by migration (resulting in fusion of the indigenous forms and the migrants or in extirpation of the indigenous forms) or by an elimination of the forms which distinguish the two. The author gives examples of the different possibilities.

Tunicata.

Japanese Appendicularians.‡—T. Aida describes *Kowalevskia tenuis* Fol., *Fritillaria haplostoma* Fol., *F. pellucida* Busch, *F. ritteri* sp. n., *Oikopleura longicauda* Vogt., *O. fusiformis* Fol., *O. megastoma* sp. n., *O. mikrostoma* sp. n., *O. cornutogastra* sp. n., *O. rufescens* Fol., *O. dioica*

* Zoologist, Feb. 1908, pp. 1–20.

† Zool. Anzeig., xxxiii. (1908) pp. 38–45.

‡ Journ. Coll. Sci. Univ. Tokyo, xxiii. art. 5 (1907) pp. 1–25 (4 pls.).

Fol., *Stegosoma magnum* Langhs. The commonest species are *O. longicauda*, *O. dioica*, *O. fusiformis*, which have been recorded from the coast of Chili—showing a wide range of distribution. Some, such as *Kowalevskia tenuis* and *Fritillaria haplostoma*, occur along with swarms of *Noctiluca*, and only then.

Regeneration of Test in Tunicates.* — Alice Fol has found that *Ascidiella aspersa* can sometimes re-grow its test. Experiments with *Phallusia* etc. did not succeed. The reasons for failure are discussed. Thus the test is needed as a basis for the muscular movements, and the animal dies if the test be removed. There may be fatal loss of blood, or the removal of a part of the tunic may induce a fatal hernia. The investigator does not explain why the removal of the test may be survived in some specimens of *Ascidiella*.

Musculature of Compound Tunicates.†—G. Daumézon finds in species of *Distoma* transverse bundles in the mantle and longitudinal bundles in the branchial region, in addition to the more primitive arrangements which run longitudinally in the mantle and transversely in the branchial region.

Development of Distoma tridentatum.‡—G. Daumézon compares the development of this compound Ascidian with that of *Distaplia magnilarva* as described by Davidoff. There are some notable differences which are probably due to the large quantity of yolk in *Distoma*. The mesoderm and notochord of *D. tridentatum* cannot be formed in the usual way—by folding of the wall of the enteron—for the enteric cavity is not formed until after their appearance.

Development of Notochord in Larval Ascidians.§—Louis Roule has studied the development of *Ascidia mentula*. He finds that after gastrulation the enteric primordium gives rise posteriorly to three enterocœlic diverticula, one median and two lateral. The latter form the musculature. The former gives rise to the notochord on its dorsal surface and sides, and ventrally to the endodermic cord (cordon endodermique)—a row of cells which extends under the notochord the whole length of the tail. At its end the notochord seems simply part of the wall of a median cæcum from the archenteron.

INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Female Gonads of Cuttle-fishes.‖—Walter Döring describes these in a number of species: *Sepia elegans*, *S. officinalis*, *Loligo vulgaris*, *L. marmoræ*, *Rossia macrosoma*, and *Sepiola rondeletii*. He gives a detailed account of the structure of the oviduct, the oviducal gland, the nidimental glands, and the accessory nidimental glands, and he

* Bull. Soc. Zool. France, xxxiii. (1908) pp. 79–81.
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 774–5.
‡ Tom. cit., pp. 776–7.
§ Comptes Rendus, cxlvi. (1908) pp. 357–9.
‖ Zeitschr. wiss. Zool., xci. (1908) pp. 112–89 (59 figs.).

discusses the development of these organs in *Sepia*, *Loligo*, *Sepiola*, *Illex*, and *Octopus*.

The chief results are the following. The oviduct of Myopsidæ, and probably of all dibranchiate Cephalopods, is a constricted-off part of the cœlom, and is therefore in close ontogenetic connection with the gonadial cavity. The genital ducts of Myopsidæ are in many respects between those of Oigopsidæ and Octopodæ. In the series of genera *Loligo*, *Sepia*, *Rossia*, *Sepiola*, there is a "differentiation-tendency" from Oigopsid to Octopod characters. There is phylogenetic interest in the fact that the oviducal gland of Myopsidæ (*Sepia*, *Loligo*, *Sepiola*) has a paired origin; the unpaired nature of its duct must be secondary.

Cephalopods from Sudanese Red Sea.*—W. E. Hoyle reports on a collection made by Cyril Crossland. Of the nine species, four (possibly five) also occur in the waters around Ceylon, and three at Zanzibar. The most interesting point is the occurrence in the collection of a complete specimen of *Sepia lefebrei*, which has hitherto been known only from a single shell, described and figured seventy years ago by d'Orbigny.

β. Gastropoda.

Defensive Glands in Tectibranchs.†—Rémy Perrier and Henri Fischer describe the minute structure of defensive pallial glands which occur in various Tectibranchs. To these they have previously applied the designation "Glands of Blochmann," after the zoologist who first noted analogous structures in Aplysiadæ. The glands in question occur in *Bulla striata*, *Acera bullata*, *Aplysia depilans*, *Scaphander*, and other forms. They lie at the level of the pallial opening, and each consists of a multicellular canal opening into the mantle cavity, and a muscular calyx surrounding a large glandular cell.

Physiological Action of Extract of Hypobranchial Gland of Dog Whelk.‡—Herbert E. Roaf and M. Nierenstein find that there is a substance in the hypobranchial gland of *Purpura lapillus* which is allied chemically and physiologically to adrenalin.

Chitons from Red Sea and East Africa.§—E. R. Sykes reports on a collection made by Cyril Crossland. It includes ten species, of which two are new, *Callistochiton crosslandi* sp. n. and *Acanthochites nierstraszi* sp. n. One feature of special interest in this collection is the representation of the genus *Cryptoplax* from the shores of Eastern Africa, the two species which occur, *C. burrowi* Smith and *C. striatus* Lamarck, being previously known from Australia and Eastern Seas.

δ. Lamellibranchiata.

Sense-organs of Cockles.‖—F. L. Weber discusses the two kinds of sense-organs found in cockles. Thus *Cardium edule* has on the

* Journ. Linn. Soc. (Zool.) xxxi. (1907) pp. 35–43 (7 figs.).
† Comptes Rendus, cxlvi. (1908) pp. 1335–7.
‡ Journ. Physiol., xxxvi. (1907) pp. 1–4.
§ Journ. Linn. Soc. (Zool.) xxxi. (1907) pp. 31–4.
‖ Arbeit. Zool. Inst. Univ. Wien, xvii. (1908) pp. 187–220 (2 pls.),

siphons (1) an "eye," consisting of pigment, lens, nerve, retina, and argentea ; and (2) another organ, consisting of sensory hairs. He describes the state of affairs in *C. rusticum*, *C. muticum*, and five other species. In all cases the "sensory hair organ" consists of an unsunk group of epitheloid sensory cells, with sensory hairs communicating with the exterior. The author's experiments show that cockles do not "see." Those without "eyes" react like those with "eyes." There is great sensitiveness to shadows—even of clouds overhead—but it is not dependent on the presence of "eyes." The sensory hair-organ is probably an organ of chemical sense.

Post-embryonic Development of Unio.*—W. Harms has studied *Unio pictorum* and *U. tumidus*. As Lillie observed, the glochidium of *Unio* is not so highly differentiated as that of *Anodonta*. The infection of fishes is oftener on the gills than on the fins. The parasitism lasted for 26–28 days at a temperature of 16–17° C. Nutritive protoplasmic processes from the larval mantle-cells enter into intimate union with the portion of branchial tissue to which the glochidium is fixed. The author compares the changes that occur during the parasitism with those that have been established in regard to *Anodonta*, and notes various differences. He shows that heart, pericardium, and kidney are all due to the ectoderm. The najad-stages are also described, and the changes they undergo. An interesting figure of a najad three weeks old shows the larval and the definitive shell.

Studies on Mussels.†—H. Chas Williamson discusses the development of the reproductive organs in *Mytilus edulis*, and the appearance in different months of the year. He records facts bearing on the growth of the mussel, and describes its movements. An account of the structure of the foot is given, with special reference to the byssus pit. The author has also some notes on the horse-mussel and the spout-fish (*Solen siliqua*).

Arthropoda.

α. Insecta.

Artificial Parthenogenesis in Silk-moth.‡—Vernon L. Kellogg notes that in a clutch of unfertilised eggs laid by a virgin silk-moth (*Bombyx mori*) there are almost always some (7–8 p.c. on an average) which begin to develop. In the Bagdad race 25–75 or even more begin to develop. The development extends to the formation of the embryonic envelopes or further. Some collapse within a few days, some in a few weeks, while a few persist for several months. The normal duration of the egg-stage—from laying to hatching—is about nine months.

Tichomiroff (1885 and 1902) found that by bathing the unfertilised eggs with concentrated sulphuric acid, or by rubbing them gently, he could increase the number that developed. He found that the development was somewhat abnormal. Verson (1899) used electricity as a stimulus, and Quajat used various chemical and physical stimuli also with success, but his report is not clear.

* Zool. Anzeig., xxxii. (1908) pp. 693–703 (5 figs.).
† Fishery Board for Scotland, 25th Ann. Rep., part iii. (1908) pp. 221–55 (5 pls.).
‡ Biol. Bulletin, xiv (1907) pp. 15–22.

Kellogg tried about a hundred experiments. Dry air, friction, heat, sulphuric acid, phosphoric pentoxide and glacial phosphoric acid were used as dehydrating agents, and these increased the proportion of parthenogenetically developing ova.

At the same time he tried other treatment, not dehydrating, and got hardly less favourable results. He thought that hydrogen ions might be the development-inciting factor, but other experiments did not bear this out. All that he can say at present is that a great variety of stimuli increase the usual proportion of parthenogenetic ova.

Mouth-parts of Solitary Bees.*—R. Demoll has made a comparative study of the mouth-parts in solitary Apidæ, and shows the gradual series of transformations from relatively simple conditions, as in *Halictus* and *Heriades*, to great specialisation. He discusses the adaptations of the mouth-parts to flowers, and the theoretical interpretation of the process by which these adaptations were wrought out. He is disinclined to allow that the parts were in any degree moulded by use. The memoir includes an interesting discussion of the rudimentary parts in parasitic bees, but here again the Lamarckian interpretation is considered and rejected.

Copulatory Organs of Solitary Bees.†—J. Strohl has studied the male copulatory organs in numerous genera. In the females there are, in solitary bees, no corresponding parts. Each genus has its distinctive peculiarities, except, perhaps, in some of the parasitic bees, and genera which resemble one another as regards copulatory organs, e.g. *Andrena* and *Biareolina*, have other evidences of relationship. The conditions as regards species are varied; the species of *Andrena*, or of *Halictus*, or of *Nomada*, are not very different (as regards copulatory organs), but those of *Osmia* are. The same is true, with the same examples, of individual variability. Closely related species are not usually very different in copulatory organs, and the constant varieties of *Nomada ruficornis* do not show marked differences as regards copulatory parts. Similarly *Halictus albipes* resembles *H. calceatus*, of which it is, perhaps, a variety. Parasitic bees seem to be relatives of their hosts; the copulatory organs of *Nomada* are like those of *Andrena*, those of *Sphecodes* like those of *Halictus*. The facts are against attaching importance to physiological isolation, as far as variations in the reproductive parts are concerned. The author believes in the origin of varieties by a continuation of the variations which germinal selection secures.

Development of Ovary of Polistes pallipes.‡—W. S. Marshall has studied this wasp in reference to the history of the cellular elements of the ovary. It begins as a syncytium with similar nuclei; cell-boundaries appear; ovarian tubules develop; these differentiate into three parts; oocytes and primitive nurse-cells become distinguishable; mitosis occurs in the epithelial and primitive nurse-cells; the latter are finally absorbed

* Zeitschr. wiss. Zool., xci. (1908) pp. 1–51 (2 pls. and 11 figs.).
† Zool. Jahrb., xxvi. (1908) pp. 333–84 (3 pls. and 2 figs.).
‡ Zeitschr. wiss. Zool., lxviii. (1907) pp. 173–213 (3 pls.).

by the oocytes. The oocytes pass through synapsis, out of which come long beaded threads; these break up, the contained chromatin-granules remaining together in small achromatin masses.

Development of Ovary of Phryganid.*—W. S. Marshall has studied *Platyphylax designatus* Walk. as regards the development of the ovary, tracing the history from homogeneity to the differentiated oocytes.

Development of Gonads of Tenebrio molitor.†—Th. Saling has followed the development in both sexes, starting from the extremely similar ovarian and testicular primordia, and working onwards to the differentiated organs.

Spermatogenesis of Hornet.‡—F. Meves and J. Duesberg have studied in particular the spermatocyte divisions of *Vespa crabro*, and find that the first division is practically the same as in the bee, including the formation of non-nucleated directive corpuscles. In regard to the bee, Meves has suggested that the nuclear division in the first spermatocyte division is suppressed because the drone develops from an unfertilised ovum which forms two polar bodies. All the cells derived from such an ovum should have reduced nuclei. The suppression of the nuclear division in the first spermatocyte division prevents further reduction of chromatin-mass and number of chromosomes. It is suggested that the males of wasps and ants are developed from unfertilised ova.

Spermatogenesis in Insects.—H. Otte § gives a detailed account of the spermatogenesis in *Locusta viridissima*; the spermatogonium has 16 pairs of chromosomes; the spermatozoon has 16 ordinary chromosomes (each probably half maternal and half paternal); in half of the spermatozoa there is an accessory chromosome.

G. Wilke ‖ gives an account of the spermatogonia, tetrad-formation, and two maturation-divisions in *Hydrometra lacustris*, one of the Hemiptera.

W. D. Henderson ¶ has studied the spermatogenesis of *Dytiscus marginalis*, and has followed the changes of the chromosomes from the spermatogonia to the end of the second maturation division, his results agreeing in the main with those of A. and K. E. Schreiner.

Friedrich Schäfer ** has made a detailed study of the spermatogenesis of *Dytiscus*, with special reference to the chromatin-reduction. In the spermatogonia there are 36 normal and 2 accessory chromosomes; the reduction in number occurs in the synapsis stage of the spermatocytes by apposition and conjugation of two homologous chromosomes. In the metaphase of the first and second maturation-division, there are 18 normal bivalent chromosomes, plus one accessory chromosome. There is no reduction-division in Weismann's sense; both maturation-divisions

* Zeitschr. wiss. Zool. lxviii. (1907) pp. 214–37 (2 pls.).
† Tom. cit., pp. 238–303 (2 pls. and 14 figs.).
‡ Arch. Mikr. Anat., lxxi. (1908) pp. 571–87 (2 pls.).
§ Zool. Jahrb., xxiv. (1907) pp. 431–520 (3 pls. and 2 figs.).
‖ Jen. Zeitschr. f. Naturw., xlii. (1907) pp. 669–720 (3 pls. and 19 figs.).
¶ Zeitschr. wiss. Zool., lxxxvii. (1907) pp. 644–84 (2 pls. and 5 figs.).
** Zool. Jahrb., xxiii. (1907) pp. 535–86 (1 pl. and 7 figs.).

are "differential equation-divisions." But there is reduction in number and quantity, for the spermatid has 18 bivalent, quantitatively reduced chromosomes, plus an accessory chromosome.

Observations on Glossina palpalis.*—E. Roubaud has studied specimens of this fly kept individually in separate glass tubes (closed in with muslin), and fed with blood every 48 hours. Like its relatives, the fly is "larviparous." The first laying may be looked for in about three weeks; the others follow every nine or ten days. A young larva is hatched out of the egg immediately after the larva which preceded it in the uterus has attained its full-grown form. The larval life lasts nine or ten days; the females, probably, live on an average about three months, and reproduce 8–10 times.

The pupation (in dry places) is described. Abortion and intra-uterine pupation are not infrequent. The average duration of the pupal life is 33 days, but it may be modified by external conditions. Heat is very fatal. Indeed the pupæ cannot accommodate themselves to a temperature about 25° C. In this there is suggested a practicable way of waging war against the bearer of the germs of sleeping sickness.

Life-history of Thrypticus smaragdinus.†—H. Lübben has been successful in working out the life-history of this rare Dolichopid fly. The larvæ were found in the root-stocks of the reed, *Arundo phragmites*, and they pupate there. The pupæ have a very remarkable head armature or boring apparatus, and the abdominal tracheal "horns" are much longer than the prothoracic pair. Attention is called to the convergence between the *Thrypticus* pupæ and that of some Cecidomyids, e.g. *Lasioptera inclusa*, which have a similar head-armature.

Luminosity of Tropical Lampyridæ.‡—O. Steche notes that the intermittent character of the light is not due to periodic covering of the luminous organ, for he observed the phenomenon in absolutely motionless forms. After paralysis with spider-poison the normal luminosity continues, which is against the idea that the respiratory movement of air in the tracheæ is a decisive factor in the illumination. Some intracellular oxidation-process is suggested. If the connection with head and breast be broken, the luminosity stops, and as the importance of respiratory movements and blood-circulation does not seem to be great, judging from the spider-bite experiment, the author infers that the influence of the central nervous system is of moment. Even after the nerve connection is cut, chemical or mechanical stimulation of the cells results in luminosity, but the light is weak, somewhat different from the normal, and not discontinuous.

Pink Katydids as Mutants.§—W. M. Wheeler calls attention to the sporadic occurrence of pink individuals among the usually leaf-green katydids (Locustidæ belonging to the sub-families Phaneropterinæ and Pseudophyllinæ). They are well known in *Amblycorypha*, which have

* Comptes Rendus, cxlvi. (1908) pp. 362–5.
† Zool. Jahrb., xxvi. (1908) pp. 319–32 (1 pl. and 6 figs.).
‡ Zool. Anzeig., xxxii. (1908) pp. 710–12.
§ Amer. Nat., xli. (1907) pp. 773–80.

also a brown phase, and similar aberrations occur in certain Homoptera. The author suggests that the pink individuals are mutants, but breeding experiments are necessary. On the sport or mutation hypothesis we should expect pink individuals mated *inter se* to produce only pink individuals, and the same should result *mutatis mutandis* in the case of the brown forms. Pink or brown individuals crossed with the common green form may be expected to give offspring in the Mendelian proportion, with the pink and brown characters acting as recessives.

Chromosomes of Anasa tristis and Anax junius.* — George Lefevre and Caroline McGill confirm E. B. Wilson's results as regards the chromosomes in the spermatogenesis of *Anasa tristis*. They find the number to be 21, and they observed the presence of an accessory or heterotropic chromosome, which behaved as Wilson described. Their results are quite at variance with those of Foot and Strobell.

The behaviour of the chromosomes in the spermatogenesis of the dragon-fly, *Anax junius*, closely parallels the conditions in *Anasa*. In the differentiation of its chromosomes as *m*-chromosomes, macro-chromosomes, and chromosomes of intermediate sizes; in the occurrence of an odd number of chromosomes (27) in the male groups, and of this number plus one (28) in the female groups; in the presence of an accessory or heterotropic chromosome which persists as a condensed body throughout the growth-period and passes undivided at the second maturation-division into one of the spermatids, a strict parallelism may be recognised between *Anax* and those insects—of which *Anasa tristis* may be taken as a type—which possess a heterotropic chromosome. In at least one of the Odonata, therefore, a dimorphism of the spermatozoa occurs, and the theory of the determination of sex by differentiated sex-chromosomes receives additional support.

Wax-glands of Flata (Phromnia) marginella.†—E. Bugnion and N. Popoff give an account of the wax-glands of this Homopterous insect of Ceylon and India. The larvæ secrete remarkable silk-like ribbons, which are inserted in the end of the abdomen. In the adult there are no abdominal tufts, but the end of the body, the margins of the wings, etc., are usually covered with white flakes. The minute structure of the glands is described in detail.

Mouth-parts of Blattidæ.‡—Joseph Mangan finds that there is need for more careful investigation of the much-studied mouth-parts of cockroaches. He contributes some fine figures of the hard parts of *Periplaneta australasiæ* and their musculature, and discusses the theoretical interpretations suggested by Verhoeff and Hansen. He notes, for instance, that elongated plates at the free tip of the hypopharynx may represent a pair of maxillulæ fused with the tongue. Just below the tip of the lacinia there is a singular process, which is mentioned by Rolleston, but not recorded on any drawing known to the author. The maxillary palp is most plausibly homologous with an endopodite.

* Amer. Journ. Anat., vii. (1908) pp. 469–87 (5 figs.).
† Bull. Soc. Vaud. Sci. Nat., xliii. (1907) pp. 549–63 (7 pls. and 4 figs.).
‡ Proc. R. Irish Acad., xxvii., B, i. (1908) p. 1–10 (3 pls.).

Development of Caddis-worms.*—A. J. Siltala gives a very welcome study of the post-embryonic development of Trichoptera. In family after family he describes the two stages in larval development; he discusses in particular the chitinous integumentary processes, the mouth-parts and antennæ, and the respiratory organs; and he deals also with the physiological and ecological aspects: the locomotion, nutrition, respiration, moulting, and the making of the protective cases.

Regeneration of Segments in Ephemerid Larvæ.†—S. Oppenheim has experimented with larvæ of *Clœon dipterum*, removing the last segment. Most die in 3–5 days, but 12 out of 532 regenerated the lost segment. Between the second and third moult the regenerated piece approximated to the normal shape. In a few cases he succeeded in getting some regeneration after removing two and three segments.

Mallophaga of the Kea.‡—Vernon L. Kellogg finds that the *Kea* (*Nestor notabilis*) has some troubles of its own. It bears three species of Mallophagan parasites, *Lipeurus circumfasciatus* Piaget, var. *kea* Kellogg, *Colpocephalum setosum* Piaget (also found on the vulture), and *Menopon fulvofasciatum* Piaget var. *kea* Kellogg (the same species occurs on *Buteo vulgaris*). It is curious that two of the three parasites should have been previously recorded not from parrots but from birds of prey.

Germ-cells and Embryology of Aphids.§—G. W. Tannreuther describes the development of certain Aphids, with special reference to the behaviour of the two kinds of eggs during maturation, and the relation of the sexual to the parthenogenetic individuals. The life-history of two of the species chiefly studied, *Melanoxanthus salicis* and *M. salicicola*, is described in detail. In regard to the germ-cells, the author finds that the somatic number of chromosomes, six, is a generic characteristic. The chromosomes vary in size, four large and two small. This number and size of chromosomes is constant in both the sexual and parthenogenetic forms. In the male, the six univalent chromosomes unite end to end in pairs in the early prophase of the first spermatocyte division, and form two large and one small bivalent chromosome. There is a short resting period between the first and second spermatocyte division. Each spermatid receives three chromosomes, two large and one small. No accessory chromosome is present. The first division separates bivalent, and the second divides univalent chromosomes. The six chromosomes at the beginning of the growth-period in the sexual ova pass into the resting stage, and the reduced number, three—two large and one small—are found in the prophase of the maturation division. Both polar bodies are formed before the germinal vesicle breaks down. Fertilisation occurs at the time of deposition, and the male and female pronuclei unite shortly after the eggs are deposited. Both polar bodies remain within the egg-cytoplasm near the periphery, and disappear before the beginning of cleavage.

* Zool. Jahrb., ii. supp. 9 (1907) pp. 309–626 (5 pls. and 20 figs.).
† Zool. Anzeig., xxxiii. (1908) pp. 72–7 (6 figs.).
‡ Psyche, 1907, pp. 122–3.
§ Zool. Jahrb., xxiv. (1907) pp. 609–42 (5 pls.).

In the ova of the parthenogenetic females the six chromosomes are found in the prophase of the single maturation-division. No reduction occurs, and the chromosomes divide equally, as in the somatic mitoses. The polar body does not disappear immediately, as in the sexual ova, but remains within the egg near the periphery as a dark compact mass of chromatin, and does not disappear until after the fourth cleavage. There are no perceptible differences in the sexual and parthenogenetic ova at the beginning of the growth period. They originate from the follicular epithelium at the base of the end chamber.

Cleavage always begins in the centre of the egg. The plane of division for the subsequent divisions varies. Descendants from both daughter-cells of the first cleavage contribute to the formation of the blastoderm. The cleavage nuclei resulting from one of the daughter-nuclei form the germ-band. All the cleavage nuclei do not pass to the periphery in the formation of the blastoderm. Those that remain within the yolk area aid in the digestion of the yolk and prepare it for assimilation. The blastoderm begins uniformly over the entire surface of the egg. When the blastoderm is completely formed there is a short inactive period in the sexual embryo. The uninvaginated blastoderm becomes the serosa. The germ-band is completely separated from the uninvaginated blastoderm. The germ-band is of the completely immersed type. The parthenogenetic embryo is provided with yolk as needed in the process of development. In the sexual embryo the yolk is completely formed before fertilisation. The sexual males and females develop from parthenogenetically produced ova, while the first parthenogenetic generation develops from sexually-produced ova.

The primary yolk originates within the cytoplasm of the egg. The secondary yolk originates from the follicular nuclei without the egg. A definite number of parthenogenetic generations are produced before the sexual male and female appear. External conditions do not increase or decrease the number of parthenogenetic generations. The greatest number of winged forms appear in the second generation, especially when food is abundant. The parthenogenetic developing embryo within the winter or sexual egg passes through the winter in a half-grown condition. A distinct male and female line begins in the fifth parthenogenetic generation. The individuals of the presexual or last parthenogenetic generation produce either all males or all females. Only two generations contribute directly to the formation of the male and female, i.e. the fifth and presexual generations.

Head-glands of Thysanura.*—Jur. Philiptschenko discusses the various kinds of glands which occur in the head of Thysanura. Of special interest are the tubular glands of the last head-segment (the labial segment), which consist of a terminal vesicle and a coiled canal, and excrete through the walls of the vesicle injected ammoniacal carmine. They are *nephridia*, which occur also in Collembola and Diplopoda, though absent in Chilopoda and Insects. Besides these nephridial glands, there are anterior and posterior salivary glands: the posterior glands correspond to those of many insects; the anterior glands are represented in a few insects.

* Zeitschr. wiss. Zool., xci. (1908) pp. 93–111 (2 pls. and 2 figs.).

Collembola and Thysanura of Forth Area.*—William Evans continues the list published by G. H. Carpenter and himself in 1899. Including *Isotoma minuta* Tullberg, *I. bidenticulata* Tullberg, *Achorutes manubrialis* Tullberg, and a species of *Tetracanthella*—a genus not hitherto recorded from the British Isles—there are now sixty-six species of Collembola known from the Forth area.

Excretion in Thysanura.†—L. Bruntz finds that excretion is effected by nephrocytes and phagocytes. In *Machilis* the nephrocytes are like the adipose cells, and lie along the sides of the lobes of connective-tissue in the region of the pericardial sinus. In *Lepisma* the nephrocytes are very different from the adipose cells, but they occur again in the region of the pericardial sinus, or suspended on the fibres which connect the heart to the dorsal wall.

Phagocytosis is effected by the blood-cells, and, in some cases, by a phagocytic organ. This special organ occurs in *Lepisma saccharina* and *Ctenolepisma lineata* in the pericardial septum.

Structure and Habits of Acentropus niveus.‡—M. Nigmann gives a full anatomical and ecological account of this interesting aquatic butterfly, which he found in great abundance in Greifswald, on the right and left of the estuary of the Ryck. The caterpillar was found on various species of *Potamogeton* and other aquatic plants. The eggs are 0·5 mm. in length, furrowed on the surface, yellowish-green and opaque when freshly deposited, but becoming more transparent as development proceeds, till they are crystal-like when the larvæ emerge. They are deposited in clumps or packets on the food-plant, to which they are attached by a jelly-like substance. In regard to the two kinds of eggs reported by some observers, the author believes that these are fertilised and unfertilised, the latter kind being transparent from the first, and often deposited in an abnormal manner. The number of eggs in a clump varied from 56 to 117. The period of incubation varied according to temperature, usually from 14 to 21 days, but in two cases it reached 29 and 31 days respectively. The newly emerged caterpillar eats its way into the heart of the stalk, and there passes the first few days. On leaving the stalk the caterpillar makes a shelter by spinning longitudinal pieces of leaf loosely together with the ends open so that it is entirely surrounded by water. From this tube it stretches forth its head and feeds on the leaves within reach. Four moults were observed, but it is suggested that an earlier one may have taken place within the stalk. In regard to the much-discussed question of larval respiration, Nigmann demonstrates that the tracheal system develops very gradually, and that it is only in the later larval stages that the branches reach the skin and begin to be filled with air. He regards the blood as the means by which oxygen is conveyed to the tissues in the earlier stages.

For pupation a new leaf-shelter is made, this time closed at the end, and the true cocoon is spun within it. The author was able to confirm Müller's observation (in regard to another aquatic form) that the bubbles

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 195–200 (2 figs.).
† Arch Zool. Expér., viii. (1908) pp 471–88 (1 pl.).
‡ Zool. Jahrb., xxvi. (1908) pp. 489–560 (2 pls.).

of air spun into the cocoon are produced from the anterior end of the larva itself, probably from the thoracic stigmata. The imprisoned air-bubbles, which are so numerous that they give the whole cocoon a silvery appearance, make tracheal respiration possible throughout the period of pupation—about 25 days.

There are two kinds of females, a long-winged and a short- or rudimentary-winged type. Transition forms were not found. The long-winged females and the males live in the air, but never go far from water, and quickly die if they are removed from damp air. The short-winged females live entirely in the water, and move awkwardly if taken out of it. The author believes that there is a summer and a winter generation, and that the long-winged females belong exclusively to the latter. The caterpillar passes the winter in a more or less torpid state within its leaf-shelter at the bottom of the pond.

The short-winged females swim under water with the posterior end at the surface. The stigmata are here very minute, and the author regards this attitude as connected with reproduction rather than with respiration. Copulation takes place at the surface, the female turning round on the dorsal surface when approached by the male. Males may be occasionally dragged under water accidentally, and so have been supposed to enter the water in quest of the females. After copulation the female seeks a suitable twig, lays her eggs, and dies almost at once.

The last part of the paper contains a discussion of the anatomy of the imagines, with special reference to the difference between the sexes. Many of the secondary sexual characters of the female are shown to be connected with aquatic life : thus the different arrangement of hairs makes the leg of the female an effective swimming organ. The wing stumps are also used in swimming, and the sparseness of the scales on the ventral surface admits of respiration by endosmosis.

In regard to its systematic position, *Acentropus* agrees closely with *Hydrocampa* and other aquatic Pyralidæ so far as wing-venation, reproductive organs, and the aquatic life of the larva and pupa are concerned, and must therefore be ranked with them. But it stands alone as regards the remarkable modification of the female insect to aquatic life, and it also exhibits a greater degeneration of the mouth-parts than the other Pyralidæ.

γ. Prototracheata.

Distribution and Classification of Onychophora.*—Adam Sedgwick points out that the known species of *Peripatus* are referable to seven geographical groups :—(1) those of the neotropical region except Chili, *Neo-Peripatus* ; (2) those of tropical Africa, *Congo-Peripatus* ; (3) Malaya, *Eo-Peripatus* ; (4) South Africa, *Capo-Peripatus* ; (5) New Britain, *Melano-Peripatus* ; (6) Australasia, *Austro-Peripatus* ; (7) Chili, *Chilio-Peripatus*.

He gives the characters of each of these groups of species, and concludes from the survey—(1) that the geographical groups of species are natural zoological groups, the members of which are more closely related to each other than to those of other groups ; and (2) that the

* Quart. Journ. Micr. Sci., lii. (1908) pp. 379–406 (13 figs.).

distinguishing specific characters are distributed in an entirely haphazard manner in the different specific groups, so that it is quite impossible to show the phylogenetic affinities of the specific groups by any tree-like arrangements.

He infers that the present species of *Peripatus* are derived from a single widely-ranging species roughly extending within the limits of the present distribution, and that this species was highly variable, including within the range of its variation all the different characters at present exhibited by the whole genus.

δ. Arachnida.

Regeneration and Autotomy in Spiders.*—S. Oppenheim confirms some of the results recently reached by P. Friedrich. Terrestrial spiders can throw off their limbs at the trochanter; all the joints have a strong regenerative capacity, but it is strongest at the preformed trochanter plane. The regenerated limb, which differs from the normal only in being smaller and lighter in colour, has not at first the power of autotomy or of regeneration. Stimuli which would have provoked autotomy on a normal limb had no effect during the first four days after the moult which disclosed the regenerated limb. If during that time a joint was cut through, there was no regeneration at the line of amputation. At the next moult the (degenerated) remainder of the limb was thrown off down to the line of normal autotomy. Some time is necessary to allow the new limb to attain the full differentiation needed for normal autotomy and regeneration.

Friedrich † could not find evidence of autotomy or regeneration in *Argyroneta aquatica*, and he inferred that this was because there was no need for it. But Oppenheim, like O. Weiss,† finds experimental evidence of both autotomy and regeneration as regards the foremost and hindmost appendage.

British Spiders.‡—F. P. Smith records, from the Isle of Wight, *Toxeus formicarius*, one of our rarest, handsomest, and most interesting spiders, whose presence in Britain has hitherto been attested only by several isolated records extending over three-quarters of a century. The mature male might be mistaken for a red ant. A male and female of *Tarentula nemoralis*—now for the first time recorded from Britain—were taken in the Bexhill High Woods, and the very rare *Lycosa agrestis* was found in the Isle of Wight.

Notes on Pseudoscorpions.§—Edv. Ellingsen reports on a collection of pseudoscorpions, mostly British, made and partly determined by H. Wallis Kew. He notes that *Obisium* (*Roncus*) *cambridgii* has a galea, and should be referred to the genus *Ideobisium*. He describes *Chelifer kewii* sp. n. from Cape Colony, *Obisium maritimum* Leach from British coasts, and some other interesting forms.

* Zool. Anzeig., xxxiii. (1908) pp 56–60 (3 figs.).
† Arch. Entwickmech., xx. (1906). † Op. cit., xxiii. (1907).
‡ Journ. Quekett Micr. Club, 1907, pp. 177–90, 1 pl.
§ Tom. cit., pp 155–72.

New British Records of Water-mites.*—G. P. Deeley adds to the list of water-mites that occur in Britain—*Thyopsis cancellata* Protz, *Sperchon glandulosus* Koen., and *Lyania bipapillata* Sig. Thor.

Swiss Hydrachnids.†—Charles Walter has given a useful account of the Swiss water-mites, of which 156 species are now known. He has added 15 new species, and made 47 new records. He distinguishes cosmopolitan forms (with wide distribution both horizontally and vertically) and northern alpine forms, stenothermal inhabitants of cold mountain waters.

Metamorphosis of Species of Echiniscus.‡—F. Heinis finds that many species of *Echiniscus*, with four claws and numerous filaments and spines as adults, have a juvenile stage with two claws and only a few filaments.

Marine Tardigrada.§—F. Richters has some notes on *Echiniscoides sigismundi* M. Schultze, and describes *Halechiniscus guiteli* g. et sp. n., and two new species of *Macrobiotus*.

ε. Crustacea.

Abnormality in a Crayfish.‖—A. Briot describes a male crayfish with a peculiar second-last thoracic limb. The coxopodite and basipodite were normal, the ischiopodite showed two articular surfaces, the outer one bore four normal joints, the inner one bore four smaller joints curved in the opposite direction—as if it were a piece of a right-hand appendage.

Variation of Squilla investigatoris.¶—R. E. Lloyd finds that in 17 individuals the number of spinous teeth on the dactyle of the raptatorial claw varies from 10 to 18. Furthermore they show 11 different types of arrangement when the teeth on both claws are considered. This feature, so variable in this species, seems to be relatively stable in other species. The theoretical possibilities of interpretation are discussed. The facts of the case do not seem to be in favour of the "theory of gradual change."

Alimentary Canal of Schizopods.**—Charles Gelderd gives an anatomical and physiological account of the gastric mill, the mid-gut, the mid-gut glands, and the intestine in *Mysis*, *Siriella*, *Nyctiphanes*, and other forms.

New Species of Cirolana from a Spring in the Sahara.††—Robert Gurney describes *Cirolana fontis* sp. n., from a freshwater spring in the Algerian Sahara. The species is evidently of subterranean origin.

* Journ. Quekett Micr. Club, 1907, pp. 173–6 (1 pl.).
† Revue Suisse Zool., xv. (1907) pp. 401–573 (4 pls.).
‡ Zool. Anzeig., xxxiii. (1908) pp. 69–71.
§ Tom. cit., pp. 77–85 (4 figs.).
‖ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 777–8 (1 fig.).
¶ Records Indian Museum, ii. (1908) pp. 29–35 (2 pls.).
** La Cellule, xxv. (1907) pp. 7–70 (4 pls.).
†† Zool. Anzeig., xxxii. (1908) pp. 682–5 (5 figs.).

and it is of great interest as belonging to a group which is most characteristically marine. Like some other investigators, the author favours the idea that the subterranean Crustacean fauna has been derived not so much from the surface as directly from the sea itself. The Algerian species may perhaps have arisen from some deep water Mediterranean species such as *Cirolana cæca* Dollfus.

Locomotor Organs of Gyge branchialis.* — P. Lo Giudice has studied the changes in the locomotor organs of this marine Isopod when it becomes attached to *Gebia litoralis*, and he has also set the semi-parasite or commensal at liberty to see what individual adaptations are acquired by its reduced locomotor organs.

The young animals can move very quickly in the water, but the adults are fixed to their host and cannot move after they have been attached for a certain time.

But under certain conditions the commensal may be removed from its bearer and kept in life for as many as 23 days. The thoracic limbs undergo a slight increase in length and the animals are able to move about a little.

Maxillary Gland in Isopods.†—Alvis Rogenhofer has studied this in various types. The Bopyridæ have no antennary gland, but the maxillary gland is well-developed, and shows the characteristic parts—terminal vesicle, urinary canal, and efferent duct. In Oniscinæ the maxillary gland is not degenerate (as Nemec reported) but typical. The results reached by Bruntz as to the maxillary gland of Isopods are confirmed, as also is Vejdovsky's description of funnel-cells (Trichterzellen). In freshwater types the urinary canal of the maxillary and antennary gland is longer than in marine types.

Notes on Clyde Crustacea.‡ — Alexander Patience notes the occurrence of *Idothea neglecta* G. O. Sars and *I. viridis* Slabber within the Clyde sea area. He has also collected *I. pelagica* Leach, *I. emarginata* Fabr., *I. linearis* Pennant.

In another paper § the author discusses *Philocheras trispinosus* Hailstone, *P. bispinosus* Westwood, *P. echinulatus* M. Sars, *P. neglectus* G. O. Sars, *P. sculptus* Bell., *Pontophilus spinosus* Leach, *Crangon vulgaris* Linn., and *C. allmanni* Kinahan.

In another communication || the author deals with some terrestrial Isopods new to the Clyde faunal area, e.g. *Trichoniscus pygmæus* G. O. Sars, *Porcellio dilatatus* Brandt, and *Metoponorthus pruinosus* Brandt.

British Species of Trichoniscoides.¶— Alexander Patience distinguishes *T. sarsi* sp. n. from *T. albidus* Budde Lund, with which he had previously identified it. Both are British. The structure of the first and second pairs of pleopods of the male seems to afford practically constant specific distinctions. The author has some notes on

* Zeitschr. wiss. Zool., xci. (1908) pp. 52–80 (1 pl.).
† Arbeit. Zool. Inst. Univ. Wien., xvii. (1908) pp. 139–56 (1 pl.).
‡ Trans. Nat Hist. Soc. Glasgow, viii. (1908) pp. 42–6.
§ Tom. cit., pp. 64–71.
|| Tom. cit., pp. 80–6.
¶ Ann. Nat. Hist., ii. (1908) pp. 84–8 (1 pl.).

Trichoniscus pusillus Brandt, *T. pygmaeus*, *T. roseus* Koch, and other British forms.

New Terrestrial Isopod.*—Richard S. Bagnall describes *Philoscia patiencei* sp. n., a new Isopod which he secured along with a new spider, † *Ischnothyreus velox* Jackson, and a new Tartarid, *Trithyreus bagnallii* Jackson, from a hothouse at Kew. It bears a strong resemblance to *Trichoniscus pusillus*, and is nearly related to *Philoscia couchii*. It is of further interest on account of the small size (3 mm. by 1·2 mm.). Its colour is violet brown, marbled with white, with a broken median band along the back of the mesosome.

New Entoniscid. ‡—H. Coutière describes *Synalpheion giardi* g. et sp. n., from *Synalpheus longicarpus* Herrick, the first Entoniscid to be found infesting a Macruran. The others occur in crabs. The new form is closely allied to *Entoniscus* from *Porcellana*.

Dendrogaster.§—Otto le Roi describes *D. arborescens* le Roi from the body-cavity of *Dipsacaster sladeni*, and *D. ludwigi* le Roi from *Echinaster fallax*. He was fortunate enough to find the male of the former in the "mantle-cavity" of the female. The full account given is an important addition to our knowledge of these extraordinary Cirripedes, known as Ascothoracidæ. There are only four others as yet known — *Laura gerardiæ* Lacaze-Duthiers, *Petrarca bathyactidis* Fowler, *Synagoga mira* Norman, and *Dendrogaster astericola* Knipow.

New Cave Copepod.‖—E. Gräter describes *Cyclops crinitus* sp. n., a colourless hyaline Copepod, from the Höll-loch, the largest Swiss cave (Canton Schwyz), which extends for several kilometres into the mountain. He contrasts it with *C. viridis* and *C. capillatus*, and with another form, *C. teras* Gräter, which occurs in the same cave, and is blind. He also reports *C. unisetiger* sp. n. with a single furcal seta, from a Jura cave.

North American Caligidæ.¶—Charles Branch Wilson continues his account of North American parasitic Copepods belonging to the family Caligidæ. He establishes two new sub-families, Trebinæ and Euryphorinæ, and describes a new species, *Dysgamus ariommus*, besides figuring some important forms like *Alebion gracilis*. The larval stages of the latter and of others are given. The artificial keys include all the known genera and species.

Median Eye of Ostracods.**—M. Nowikoff has studied the eye of *Cypris virens*, *Eurycypris pubera*, and other species. He describes in detail the four component parts—the pigment-cup, the tapetum, the optic cells, and the lens.

* Ann. Nat. Hist., ser. 8, i. (1908) pp. 428–31 (1 pl.).
† Trans. Nat Hist. Soc. Northumberland, Durham, and Newcastle-upon-Tyne iii. (1907) pp. 49–78 (1 pl.).
‡ Comptes Rendus, cxlvi. (1908) pp. 1333–5.
§ Zeitschr. wiss. Zool., lxxxvi. (1907) pp. 100–33 (2 pls.).
‖ Zool. Anzeig., xxxiii. (1908) pp. 45–9 (3 figs.).
¶ Proc. U.S. Nat. Museum, xxxi. (1907) pp. 669–720 (6 pls. and 19 figs.).
** Zeitschr. wiss. Zool., xci. (1908) pp. 81–92 (1 pl. and 1 fig.).

Cambrian Trilobites.*—C. D. Walcott establishes Burlingidæ, a new family for *Burlingus* g. n., and describes *Albertella* g. n. in the family Paradoxidæ, *Oryctocara* g. n. in the family Olenidæ, and new species of *Zacanthoides*, *Neolenus*, and *Bathyuriscus*.

Annulata.

Thoracic Nephridia of Hermellidæ.†—Armand Dehorne describes in *Sabellaria* two thoracic nephridia, independent of one another, each provided with an internal vibratile funnel and a lateral external pore, and resembling the Cirratulid not the Serpulid type.

Epidermis of Travisia forbesii.‡—L. du Reau finds that the epidermis of this Polychæt consists of cubical cells covered by a thick cuticle, that this cuticle gives passage to papillæ which coalesce externally, simulating a second epithelium. This is an exaggeration of the free filiform papillæ of *Stylarioides plumosa*, the more swollen papillæ of *Flabelligera affinis*, and the short, swollen, appressed but not fused, papillæ of *Brada granulata*.

Polychæts of Amboina.§—A. Malaquin and A. Dehorne report on a collection made by Bedot and Pictet, including *Nereis picteti* sp. n., *Eupolyodontes amboinensis* sp. n., the new genus *Eucarunculata* (an Amphinomid with arborescent branchiæ, a strongly developed cordiform trilobed caruncle, a single dorsal cirrus to the parapodium, simple, never bifid setæ), with the species *E. grubei*.

Brain and Nuchal Organ of Notopygos labiatus.‖—A. Malaquin and A. Bedot give a description of these parts in this Amphinomid. Their study of the caruncle or nuchal organ in *Notopygos* (as also in *Eucarunculata*) shows a highly developed vascularisation, and within the cavity bathed by the vessels they find a large quantity of mesenchyme cells (amœbocytes, "Mastzellen," pigmented cells, etc.). They give strong reasons for believing that this sensory organ has been derived from a gill.

Artificial Parthenogenesis in Thalassema mellita.¶—G. Lefevre has given an account of an experimental study of artificial parthenogenesis in the Echiuroid *Thalassema mellita*, which is specially favourable for experiment, because of the ease with which the sexes can be distinguished. The investigator's main purpose was to study the morphological phenomena concerned in artificial parthenogenesis, and especially, by a careful cytological examination of the material, to compare, as far as possible, the development artificially produced with the normal events leading up to the formation of the larva. He finds that the unfertilised eggs may be induced to develop parthenogenetically into actively swimming trochophores by immersion for a few minutes in

* Smithsonian Misc. Coll., liii. No. 2 (1908) pp. 13–52 (6 pls.).
† Comptes Rendus, cxlvi. (1908) pp. 838–40.
‡ Tom. cit., pp. 840–2.
§ Revue Suisse Zool., xv. (1907) pp. 335–400 (9 pls. and 20 figs.).
‖ Tom. cit., pp. 372–400.
¶ Journ. Exper. Zool., iv. (1907) pp. 91–149 (6 pls.).

dilute solutions of acids, both inorganic and organic. After transfer from the acid solutions into normal sea-water, the egg throws off a typical fertilisation membrane, the germinal vesicle breaks down, and maturation and cleavage follow. In successful experiments, which were the rule, from 50–60 p.c. of the eggs developed into swimming larvæ that could scarcely be distinguished from normal trochophores of a corresponding stage. The parthenogenetic development, in the majority of cases, involves a strictly normal maturation, a normal cleavage, at least in the early stages, and the usual processes of differentiation that occur after fertilisation by sperm. Gastrulation takes place in the normal manner, and the parthenogenetic larva possesses a digestive tract, differentiated into mouth, œsophagus, stomach and intestine, and the prototroch and apical plate, bearing the normal arrangement of cilia. After maturation the egg-centre disappears, and the cleavage centrosomes arise *de novo*, probably without division of a single primary centre. When first seen, they lie on opposite sides of the egg-nucleus, which becomes the first cleavage nucleus.

Cell-division occurs mitotically throughout development, and division of the nucleus is usually accompanied by cytoplasmic cleavage. The number of chromosomes characteristic of the fertilised egg is not restored, but the reduced number (12) is retained, and has been counted repeatedly even in late stages. The rate of division is not so rapid, nor so regular as in normal segmentation, and the parthenogenetic larvæ, although swimming vigorously at the bottom of the dish, do not rise to the surface of the water.

After exposure of the eggs to acid solutions, the polar bodies may continue to divide mitotically and form a morula-like cluster of minute cells, thus exhibiting an attempt at parthenogenetic development. In some experiments the eggs extruded only one polar body, and in others neither polar body was formed. In such cases, either one or both maturation mitoses may take place within the egg, with the resulting formation of resting nuclei, which probably fuse to form a cleavage nucleus. In still other cases there is evidence for believing that the first maturation spindle may directly become the first cleavage spindle, across which the egg divides into equal or subequal cells. The numerical relations of the chromosomes in these cases have not been definitely determined. Eggs exhibiting these abnormalities of maturation give rise to larvæ indistinguishable from those of eggs which maturate normally. An endless variety of abnormal cleavages, similar to those described by others, have been observed. Such cleavages lead to the formation of ciliated cellular structures which depart more or less widely from normal embryos. Abnormalities of mitosis, as polyasters and monasters, are not infrequent, and when nuclear division is not followed by cleavage of the cytoplasm, chromosomes in excess of the usual number (12) may be found in a single cell. Cytasters are either absent or exceedingly rare, and cytoplasmic cleavage without preceding nuclear division has not been observed. Amœboid movements of the egg are rare, and, when they occur, are not extensive; "fusion phenomena" are lacking.

Cell-division would seem to be a fundamental and essential factor in differentiation, since in no instance was a differentiated, ciliated structure observed which was unsegmented : the parthenogenetic pseudo-trochophores which have been described for *Chætopterus* and other Annelids, are entirely absent.

Remarkable Echiuroids.*—Iwaji Ikeda describes *Bonellia miyajimai* sp. n., the female of which has numerous ventral hooks, a slender proboscis six times as long as the body, and branched anal glands with numerous stalked funnels. The male, found in the body-cavity of the female, is unusually large, nearly 30 mm. in length ; there is no ventral hook or nerve ring ; the alimentary canal is broken up into numerous vesicles. He also describes two new species of *Thalassema* : *T. tænioides*, the long proboscis of which has been known and misinterpreted for some years, and *T. elegans*, another very interesting form.

New Indian Oligochæt.†—J. Stephenson proposes to make a new genus, *Matla*, for one of the Naididæ, which was found on colonies of *Victorella* and other Polyzoa. The arrangement of the setal bundles is peculiar : there are two dorsal and two ventral bundles in all segments from the second onwards. The setæ are hook-setæ and needle-setæ ; the most anterior bundles, both dorsal and ventral, consist of needle-setæ ; the posterior consist of hook-setæ.

Studies on Leeches.‡—N. Livanow has studied the nervous system and the metamerism of the head-end of *Herpobdella atomaria* Carena. The head-region consists, as in *Hirudo medicinalis* and *Protoclepsis tessellata*, of the head-lobe and the five anterior somites. The head-lobe and the first two head-somites consist of one ring each, the third has two rings, the fourth has four, and the fifth has five. In each somite there is a well-developed neuro-somite, and the head-lobe is in no way confusible with a somite.

New Zealand Leeches.§—W. B. Benham describes *Placobdella maorica* sp. n., *Hirudo mauiana* sp. n., and *H. antipodum* Benham, giving in each case an anatomical account.

Growth and Asexual Reproduction in Stylaria lacustris.‖—Giuseppe Dalla Fior has studied the process of growth in this Annelid, which is also known as *Nais proboscidea*. The mesoderm grows at the free posterior end by the activity of primitive mesoblasts, of which there are two or three on each side of the hind end of the mesoderm streak. Before the division of the mesoderm into primary segments, the chorda-cells of Semper (neoblasts) arise between the two mesoderm plates. These elements always retain an embryonic character, and form a continuous strand to the most anterior segment.

In asexual multiplication the mesoderm in the trunk-zone (the tail of the anterior animal) is mainly regenerated by the neoblasts, and only to a slight extent by the mesodermic elements of the lateral lines. In

* Journ. Coll. Sci. Univ. Tokyo, xxi. (1907) pp. 1–64 (4 pls.).
† Records Indian Museum, ii. (1908) pp. 39–42 (4 figs.).
‡ Zool. Jahrb., xxiii. (1907) pp. 683–702 (1 pl.).
§ Trans. New Zealand Inst., xxxix. (1907) pp. 181–93 (2 pls.).
‖ Arbeit. Zool. Inst. Univ. Wien, xvii. (1908) pp. 109–38 (2 pls.).

the head-zone, in which four trunk-segments are formed anew behind the head, the mesoderm arises in all probability in the same way as in the trunk-zone. The mesoderm forms the longitudinal, pharyngeal, and setal musculature, the peritoneum, and the nephridia.

The ectoderm forms the circular musculature and the nervous system. At the posterior end the primordium of the nervous system coalesces with the ectoderm; the same is seen in the trunk-zone, where a new foundation for the nervous system is formed, uniting anteriorly with the old ventral nerve-cord; in the head-zone there is an elongation of the ventral cord, and the œsophageal commissure and brain arise by paired ectodermic proliferations on the lateral lines and on the ventral setal follicles.

The pharynx is a product of the endoderm. The new mouth rises by invagination of the ectoderm to meet the gut, and the new proctodæum is a simple coalescence of gut and epidermis.

Nematohelminthes.

Structure of Nematodes.* — Max Rauther has investigated the structure of the œsophagus in numerous free-living Nematodes, and has also studied the localisation of the excretory function. The indigo-carmin absorbed by the skin or taken with the food is not collected for elimination in any glands, but between the radial fibres of the œsophageal musculature and in the most anterior and most posterior region of the mid-gut. The excretion is thus indirect; the function of the œsophagus may be compared to that of a Mammalian glomerulus, and that of the mid-gut to that of the absorbing renal canaliculus. The author contrasts the excretion of free-living Nematodes with that of parasitic forms.

Development of Nematodes.†—E. Martini has studied *Pseudalius minor*, *Cucullanus elegans*, *Nematoxys ornatus*, and *Rhabdonema nigrovenosum*. Organ-forming areas or cells can be recognised very early in development, even at the 8-cell stage. Segmentation results in 450–500 elements. A primordium of the gut appears during or immediately after segmentation, and is separated from the outermost cell-layer by a groove open dorsally. The definitive epithelium of the surface of the body is produced by six longitudinal rows of cells in the middle and posterior part of the dorsum. The bodies and nuclei of these cells pass into the longitudinal lines, especially in the lateral areas. From the two lateral portions of the groove the four muscle-bands are differentiated.

Chætosomatidæ.‡—A. Schepotieff discusses these peculiar Nematode-like marine worms, and defines five species of *Chætosoma*. Among the peculiarities may be noted: the distinct head-region, the ventral rows of bristles, and the division of the body into an anterior narrower and a posterior broader region. The composite mobile setæ resemble those of Desmoscolecidæ, but the genus *Rhabdogaster* which Schepotieff has

* Zool. Jahrb., xxiii. (1907) pp. 703-40 (1 pl. and 7 figs.).
† Zeitschr. wiss. Zool., lxxxvi. (1907) pp. 1–54 (3 pls. and 2 figs.).
‡ Zool. Jahrb., xxvi. (1908) pp. 401–14 (2 pls.).

described is the nearest relative. Along with *Rhabdogaster* the Chætosomatidæ may perhaps be ranked as a group or sub-order of Nematodes, and the designation Nematochætæ is suggested.

Peculiar Free-living Nematodes.* — A. Schepotieff describes *Trichoderma oxycaudatum* Greef, a remarkable marine Nematode, which has been previously observed by Greef, Metschnikoff, and Panceri. The head has wing-like outgrowths, the posterior end is pointed and has two spicules. In these respects *Trichoderma* is like a Desmoscolecid, but it is excluded from the family by the thick covering of hair and the absence of setæ. It seems to require a special family, and the term Chætiferæ is suggested.

Schepotieff also describes *Rhabdogaster cygnoides* Metschn., previously observed by Metschnikoff, Greef, and Panceri. The body is divided by a narrow region into two expanded portions. The longitudinal musculature is weakly developed. It uses its buccal teeth in its peculiar locomotion. Probably its position is among the Chætosomatidæ.

Platyhelminthes.

Trematode in Hibernating Gland of Hedgehog.†—M. Athias describes a Distomid—which he has not yet been able to identify—from the interior of the hedgehog's hibernating gland. It seems to be quite different from *D. caudatum*, which has been recorded from this host.

Trematodes in Fishes.‡ — Marie V. Lebour has examined many different kinds of British fishes, and has added considerably to the British records of Trematode fish parasites. In her list she gives useful notes on the food of the fishes in question. The following are new :—*Prosorhynchus grandis* in cod and whiting ; *Steringophorus oracutus* in long rough dab ; *Lepodora elongata* in cod ; *Pharyngora retractilis* in whiting ; *Stephanochasmus rhombispinosus* in whiting ; *S. triglæ* in grey gurnard ; *Plectanocotyle caudata* on the gills of 50 p.c. of grey gurnards. These are new species, but *Pharyngora* is also a new genus.

Uncertain Species of Marine Triclads.§—J. Wilhelmi points out that *Planaria savignyi* Rüppell and Leuckart is a typical Polyclad, probably a species of *Prosthiostomum* ; *P. longiceps* Dugès is equivalent to *Monotus bipunctatus* ; *Bdelloura rustica* Leidy is a Monotid ; *Planoides fusca* Dalyell was probably not a Triclad ; and *Planaria hebes* Dalyell was probably *P. torva* Müll.

Planaria Wytegrensis.‖—H. Sabussow describes this new species from Lake Onega and compares it with the closely allied *Planaria gonocephala*, from which it differs in having peculiar sensory cells in the epithelium, in having more numerous sensory pits (on the ventral surface of the anterior end), and in various details of the genital system.

* Zool. Jahrb., xxvi. (1908) pp. 385–400 (2 pls.).
† Bull. Soc. Portugaise Sci. Nat., i. (1908) pp. 192–204 (3 pls.).
‡ Rep. Sci. Investigations for 1907, Northumberland Sea Fisheries Committee, 1908, pp. 23–67 (5 pls.). § Zool. Anzeig., xxxiii. (1908) pp. 33–7.
‖ Zool. Jahrb., xxiii. (1907) pp. 741–7 (2 pls.).

Peculiar Abnormality in Proboscis of a Nemertean.*—M. Caullery describes the occurrence in *Tetrastemma candidum* of a double proboscis. Within the same sheath they lie end to end in opposite directions, with the armatures turned toward the two ends of the animal.

Histogenesis of Cysticercus pisiformis.†—R. T. Young finds that this bladder-worm shows an extremely simple type of histogenesis, the various tissues being developed exclusively by modification *in situ* of a pre-existent undifferentiated parenchyma. In correspondence with its simplicity of development, *Tænia serrata* shows a very simple type of adult structure, the various tissues being comparatively little differentiated from one another.

It is very doubtful where there is any ectoderm or any process of gastrulation. The lack of a true epithelium and the simple character of its tissues and mode of nuclear increase are probably expressions of the degenerate character of this tapeworm.

"The role of the chromosomes in heredity is entirely lost; the nucleus is probably not a morphological, but a physiological unit; the fate of any cell is determined not by its morphological structure, but rather by its physiological environment." These are generalisations, but the paper gives a detailed account of the process of development.

Incertæ Sedis.

Larva of Pedicellina Echinata.‡—R. Czwiklitzer describes this interesting larva and shows how it may be interpreted as a modified Trochophore. He compares the Ectoproct and the Endoproct larva in detail, and shows the affinities between them in structure and in mode of fixation. It may be that the Phylactolæmata are derived from the Phoronidæ (their ganglion being, in that case, supra-œsophageal), and the Gymnolæmata from the Entoprocta (their ganglion being, in that case, sub-œsophageal).

Spermatozoa of Fresh-water Bryozoa.§—F. Braem describes the spermatozoa of *Plumatella*, *Pectinatella*, and *Fredericella* (three related Phylactolæmata), and shows that they differ markedly from those of *Paludicella* (a typical representative of the Gymnolæmata). It is interesting to find that the structural differences of the adult organisms have their counterpart in the spermatozoa.

Polyspermy in Membranipora.‖—Kristine Bonnevie finds that polyspermy occurs regularly in this Polyzoon. There is a coalescence of spermatozoa in groups in the spermatogenesis, so that a "sperm-zeugma" results. One spermatozoon only seems to form the male pronucleus, but the others may be useful in furnishing the necessary chromatin (and chromidial apparatus) to re-establish the disturbed nucleo-cytoplasmic relation in the ovum.

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 738–40 (3 figs.).
† Zool. Jahrb., xxvi. (1908) pp. 183–254 (4 pls.).
‡ Arbeit. Zool. Inst. Univ. Wien, xvii. (1908) pp. 157–86 (1 pl. and 2 figs.).
§ Zool. Anzeig., xxxii. (1908) pp. 671–3 (2 figs.).
‖ Jen. Zeitschr. Naturw., xlii. (1907) pp. 567–98 (4 pls.).

Bengal Polyzoa.*—Nelson Annandale describes a new Ectoproctous Polyzoon, *Victorella bengalensis* sp. n., from brackish ponds at Port Canning, Lower Bengal, and a new Entoproctous form, *Loxosomatoides colonialis* g. et sp. n. The diagnosis of the new genus is :—" Colonial, deciduous Entoprocta arising from a creeping stolon ; the calyx, separated from the stalk by a diaphragm, with a slanting or vertical lophophore and bearing on its aboral surface a chitinous shield, which is absent from the stalk." The closest affinities of *Loxosomatoides* are probably with *Myosoma*.

Echinoderma.

Habits of Starfish.†—Georges Bohn finds that starfishes (*Asterias rubens*) from the rocky regions of the Channel behave differently as regards light from those which live in sandy parts of the Arcachon basin. The former move away from the light into the shade ; the latter remain stationary in phototropic positions, the tip of each arm being turned towards the shade. When the former can find no shade they end by assuming phototropic positions, but they do this more slowly and less perfectly.

Parthenogenesis of Sea-urchins.‡—Yves Delage suggests that one reason why Loeb's experiments do not agree with his may be found in some constitutional difference between the *Strongylocentrotus purpuratus* of California and the *Paracentrotus lividus* of Europe. In Loeb's experiments with the eggs of the Californian form, pure saccharine solutions, in strong concentration, but without any reagent added, resulted in abundant parthenogenetic ova ; in Delage's experiments with the eggs of the Brittany form, it was always necessary to add some reagent, acid or alkaline, or tannate of ammonia, but without exceeding the concentration corresponding to an isotonic solution. The sea-water does not permit development except when the osmotic pressure of its salts has been much diminished by the addition of distilled water, and when it has been rendered isotonic by means of sugar. If Loeb had worked in Brittany he would have found that hypertonic solutions (whether alkalinised or not) and soluble fatty substances are ineffective, and he would have found the tannate of ammonia method, or something equivalent.

Littoral Holothurians of Indian Ocean.§—R. Koehler and C. Vaney report on a collection of 51 species, of which 15 are new, 3 of *Holothuria*, 2 of *Phyllophorus*, 8 of *Cucumaria*, and 2 of *Thyone*. It may be noted that *Cucumaria inflexa* has simple tentacles ; *C. bacilliformis* has a rod-like body and a rigid carapace of calcareous plates ; the limits between *Thyone* (with tube-feet not in regular rows) and *Cucumaria*, between *Pseudocucumis* and *Phyllophorus*, are vague ; *Holothuria glaberrima*, found in the Mergui Archipelago, has also been found on the east

* Records Indian Museum, ii. pp. 11–19 (7 figs.).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 633–5 (3 figs.).
‡ Comptes Rendus, cxlvi. (1908) pp. 262–5.
§ An Account of the Littoral Holothurioidea collected by R.I.M.S.S. 'Investigator.' Calcutta: printed by order of the Trustees of the Indian Museum, (1908) 54 pp., 3 pls.

coast of Africa and at Porto Rico ; and that *Cucumaria echinata* Marenzeller in this collection was previously known only from Japan.

Cœlentera.

Hydroid parasitic on Fish.* — R. E. Lloyd describes *Nudiclava monacanthi* g. et sp. n., growing on the side of an Indian Ocean surface fish, *Monacanthus tomentosus.* He compares it with the peculiar *Hydrichthys mirus* which Fewkes found growing on the Carangoid fish *Seriola zonata*, at Newport, U.S.A. The resemblance is only in habit. Alcock has also described a gymnoblastic hydroid, *Stylactis minoi*, attached to a rock-haunting Scorpænid, *Minous inermis.* In *Nudiclava* the hydrophyton is a compact plate-like structure, composed of an irregular labyrinthine cœnosarc with very poorly developed perisarc. The hydranths are claviform when retracted, totally devoid of tentacles ; their cavities are lined by a special layer of pavement epithelium, and they contain well developed muscle-fibres among the endoderm. The gonophores are closed sporosacs, without radial canals, tentacles, or ectodermal invaginations.

Atlantic Tima at Trieste.†—G. Stiasny reports the occurrence of *Tima flavilabris* Eschscholtz—an Atlantic species—in the Gulf of Trieste. In recent years this form has occurred frequently at Naples, and it is probably identical with *T. bairdii*, which is not uncommon on Scottish coasts.

Large Antipatharian from Faero Islands.‡—J. Arthur Thomson describes a large specimen, over a yard in height, apparently of *Parantipathes larix* Esper. A slight modification of the diagnosis of the species is suggested, but the chief point of interest is the great extension of the previously recorded range of distribution.

Revision of Nephthyidæ.§—W. Kükenthal discusses the genera *Eunephthya* Verrill and *Gersemia* Marenzeller. The former includes Nephthyidæ of branched tree-like habit ; with polyps singly or in bundles ; polyps retractile or non-retractile, without verruca or Stützbündel ; canal walls not thickly filled with spicules. The latter includes "Nephthyidæ without Stützbündel, with polyps neither in lobules nor bundles, but singly ; with tree-like habit, but the branches may remain rudimentary ; the polyps have a sharply defined, non-retractile calyx, into which the upper portion can be withdrawn."

He suggests that *Eunephthya* is at the root of the family and links it back to *Alcyonium ; Gersemia* is close beside *Eunephthya ; Neospongodes* and *Lithophytum* may be traced back to *Eunephthya*, and *Lemnalia* is near *Lithophytum.* From the Nephthyiform-stock the genus *Nephthya* has arisen, and parallel to it *Capnella ;* from *Nephthya* the genus *Dendronephthya* (*Spongodes* of most authors) has evolved, and it leads on to *Scleronephthya ; Nephthya* again has given origin to *Stereonephthya*, which leads to the Siphonogorgids.

* Records Indian Museum, i. (1907) pp. 281–9 (2 pls.).
† Arbeit. Zool. Inst. Univ. Wien, xvii. (1908) pp. 221–4 (1 pl.).
‡ Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 188–94 (1 pl.).
§ Zool. Jahrb., xxiv. (1907) pp. 317–90.

New Zealand Ctenophores.* — W. B. Benham describes *Beroe shakespeari* sp. n., which differs from the three species of the Northern hemisphere — *B. ovata*, *B. forskalii*, and *B. cucumis*, as also from *B. australis* (Fiji) and *B. macrostoma* (New Guinea). A second new form is *Euplokamis australis* sp. n.

New Dictyonine Sponge.†—R. Kirkpatrick describes *Eurete annandalei* sp. n., an elegant and remarkable form from the Indian Ocean. It has not the "beautiful network" of anastomosing tubes, characteristic of *Eurete*, but consists of a vertical hollow stem with hollow separate lamellæ.

Siesta of Spongilla in Tropics.‡—Nelson Annandale finds that for some hours in the middle of the day the currents cease and the oscular collars are somewhat contracted. It is by no means uncommon for Cœlenterates to remain in a state of quiescence during the heat of the day in the tropics and even in temperate climates, and it is not surprising that Sponges should follow the same course.

New Indian Fresh-water Sponges.—Nelson Annandale § describes *Spongilla reticulata* sp. n., and *S. crassior* sp. n., and distinguishes the characters of the gemmules in *S. decipiens* Weber, *S. fragilis* Leidy, *S. crassissima* Annandale, and *S. crassior*. He finds that there is considerable seasonal variation.

In a subsequent paper Annandale ‖ describes *Spongilla indica* sp. n. closely allied to *S. sumatrana* Weber, and *S. lapidosa* sp. n. allied to *S. loricata* Weltner. Of the last named species R. Kirkpatrick ¶ describes a new variety, *burmanica*.

Hydromedusan from Lake Qurun.¶—Charles L. Boulenger describes *Mœrisia lyonsi* g. et sp. n., from Lake Qurun, which communicates with the Nile by means of a network of canals which irrigate the Fayûm. The lake is the remains of the historic Lake Mœris, which was used as an artificial regulator of the Nile floods by the monarchs of the twelfth dynasty. It is about the size and shape of the Lake of Geneva, and except during high Nile receives very little water. There is no outlet, and the water is decidedly brackish. With the exception of *Mœrisia*, *Cordylophora*, and a Ctenostomatous polyzoan, resembling *Victorella*, the fauna seems essentially a fresh-water one, composed probably of such Nile animals as can accommodate themselves to the salinity of the lake.

The new form is referable to the Anthomedusæ, as is shown by the globular shape, four-rayed symmetry of the umbrella, manubrial gonads, and the absence of otocysts. The gymnoblastic hydroid stage confirms this position. Furthermore, the simple mouth, the four unbranched tentacles, and the narrow radial canals, exclude *Mœrisia* from the Tiaridæ, Margelidæ, and Cladonemidæ, and refer it to the Codonidæ, near *Sarsia*, in fact. The hydroid is unique in its hollow tentacles and trans-

* Trans. New Zealand Inst., xxxix. (1907) pp. 139-44 (1 pl.).
† Records Indian Museum, ii. (1908) pp. 21–4 (1 pl.).
‡ Op. cit., i. (1907) pp. 387–92 (1 pl.). § Loc. cit.
§ Op. cit., ii. (1908) pp. 25–8 (5 figs.).
‖ Tom. cit., pp. 97–9 (1 pl.).
¶ Quart. Journ. Micr. Sci., lii. (1908) pp. 357–78 (2 pls.).

verse fission; it approaches Bougainvilliidæ in having a single circlet of filiform tentacles and a cylindrical hypostome not constricted off from the body of the hydranth.

The new genus may be defined as follows:—Hydrocaulus consisting of long unbranched stems rising at short intervals from a small horizontal hydrorhiza, the latter invested by a delicate annulated perisarc continued on to the bases of the stems.

Hydranths claviform, with a small number (commonly four or five) of hollow filiform tentacles arranged in a circlet around the thickest part of the body.

Hypostome cylindrical, not constricted at its base. Asexual reproduction by budding and transverse fission.

Medusa developed from the body of the hydranth; when liberated, globular with four unbranched radial canals and tentacles. Mouth simple. Manubrium very short; the stomach region provided with per-radial pouches which in the adult are produced into finger-shaped diverticula extending down the sub-umbrella. Gonads developed on the whole surface of the stomach and its diverticula.

It is likely that *Mœrisia* is a relic of the fauna of the Pliocene sea which once covered the Fayûm depression.

Porifera.

Spicules of Leucosolenia.*—E. A. Minchin discusses the monaxon spicules and describes their origin—each arising from a dermal epithelial cell that divides into two, the "founder" and the "thickener." The triradiate systems are then dealt with; they arise from sextets of cells, two of which give rise to each ray of the spicule. The gastral rays and the derelict spicules in *Leucosolenia complicata* are then discussed. Conspicuous rounded cells, full of coarse granules, arranged in a superficial layer and in many cases appearing to be in process of being cast off, are described as excretory.

The author believes that the forms of monaxon spicules are not explicable in terms of the physical properties of the material or as the direct mechanical outcome of the conditions in which they develop. The monaxon spicules owe the peculiarities of their form chiefly (perhaps entirely) to their relations to the sponge-body, and are adapted to the needs of the organism. But while the forms of primary spicules are determined solely by their relation to the organism, and in no way by their crystalline structure, when primary spicules are joined to form secondary systems, crystallisation may be a condition determining the angles at which they join.

Encystation of Actinosphærium at Different Temperatures.†—Doris L. Mackinnon finds that at a low temperature, specimens of *Actinosphærium eichhorni* form small and numerous cysts, with nuclei scarcely below normal size, but markedly rich in chromatin.

At a high temperature, the cysts formed are large and few in

* Quart. Journ. Micr. Sci., lii. (1908) pp. 301–55 (5 pls. and 5 figs.).
† Tom. cit., pp. 407–22 (1 pl. and 1 fig.).

number, with nuclei scarcely larger than those of the cold cultures, but poor in chromatin.

Lowered temperature paralyses the cell-functions to some extent. Nuclear elimination is slow and incomplete, as indicated by (1) the large number of nuclei retained from the mother-cyst reduction to act as centres for primary cysts: (2) the superabundance of chromatin in these nuclei; (3) the occurrence of two nuclei in one primary cyst, and (4) the occurrence of occasional "dead" nuclei within the groups of primary cysts.

In many of the cultures, encystation set in during the oncome of a "depression" wave, and it was found that in an encystation culture of depressed individuals the nuclear elimination tends to be incomplete.

Haplosporidian of Flounder.*—Muriel Robertson describes a species of *Ichthyosporidium* from the liver, the wall of the stomach and intestine, and the mesentery of the flounder. It causes much disturbance of the tissues of the host and proliferation of the connective-tissue. It is compared with *I. gasterophilum*, described by Caullery and Mesnil, from which it differs in various respects. Thus a well-developed cyst-wall is generally present; the nuclei show fine rays between the karyosome and the nuclear membrane, plasmotomy occurs, the animal comes out of its cyst and breaks up into reproductive bodies which appear to be binucleate.

Protozoa.

Botellina.†—F. G. Pearcey discusses the remarkable Foraminifera referred to the genus *Botellina*, and describes *B. pinnata*, a new species from the Cape. It is conspicuous among Astrorhizidæ by its size (1 to $2\frac{1}{2}$ inches in height, with a diameter of $\frac{3}{16}$ to $\frac{3}{8}$ of an inch), and by its walls subdivided into chambers which communicate freely with a main tubular chamber running through the whole test. The arenaceous test is free, erect, pinnate, rising from a primordial chamber with pseudopodial openings situated at the extremity of the pinnate outgrowths. The author has had abundant specimens at his disposal and gives a full account of this remarkable type.

Archerina, Golenkinia, and Botryococcus.‡—E. Ray Lankester points out that Chodat's *Golenkinia radiata* (1894), and Lemmermann's *Richteriella botryoides* (1898), are the same as his *Archerina* (1885). He thinks, however, that *Archerina* is one of the simpler Protophyta, not a Protozoon. It occurs frequently in close association with amœboid protoplasm, probably belonging to a *Vampyrella*-like organism.

The author also gives an account of observations made nearly twenty-five years ago on what he called "cayenne-pepper growth," found floating on the surface of English lakes. His drawings are also published. The organism turns out to be *Botryococcus braunii* of Kützing, of which Chodat has published a full description and figure.

* Proc. Roy. Phys. Soc. Edinburgh, xvii. (1908) pp. 175–87 (2 pls.).
† Trans. S. African Phil. Soc., xvii. (1908) pp. 185–94 (1 pl. and 1 fig.).
‡ Quart. Journ. Micr. Sci., iii. (1908) pp. 423–30 (1 pl.).

Remarkable Adaptation in Onychodactylus Acrobates.*— A. Brodsky notes that this holotrichous Infusorian, which he has studied on the shores of the Black Sea, attaches itself to seaweed by a long resistant anchoring filament, which it secretes from its conical "foot." Whenever this foot or appendix touches a solid body it fixes a filament, and the Infusorian may ride like a ship at anchor. This is an interesting adaptation to littoral life.

Patagonian Protozoa.†—G. Entz, senior, reports on a collection of fresh-water Protozoa (23 species) from Patagonia. Most of them are represented in the European plankton, but the collection included numerous specimens of *Acineta tripharetrata* sp. n. Of this and of *Tocophrya cyclopum* a detailed account is given.

Tokophrya Cyclopum.‡—B. Collin has studied the short-stalked form of this Infusorian, which is common on the antennæ and appendages of *Cyclops*. He notes that the canal of the contractile vacuole opens into the base of an "embryonal cavity," much larger than the "embryo." The latter fixes itself by the pole which is anterior in swimming: this is the more pointed pole, furthest from the nucleus, inclosing the basal secretion of the future stalk; the other pole has a rudimentary adoral zone of cilia. The same phenomena were seen in another Infusorian found on *Cyclops*, namely, *Choanophrya infundibulifera* Hartog, which seems to be a *Tokophrya*. In unfavourable conditions *Tokophrya* becomes mobile, returning to an embryonic condition or undergoing a sort of moult.

Hæmogregarine of the Eel.§—C. França describes *Hæmogregarina bettencourti* sp. n. from the eel. It seems to be quite distinct from *H. lignieresi*, which Laveran described in eels from near Buenos Ayres.

Trypanosomes of the Frog.‖—C. França finds that the Invertebrate host of *Trypanosoma costatum* and *T. rotatorium* is a leech, *Helobdella algira*, which also transmits *T. inopinatum*.

Notes on Myxosporidia.¶—L. Mercier has studied *Hoferellus cyprini* in various stages which occur in the tubules of the carp's kidney. He finds a valve-nucleus in each of the two valves of the spore, and he finds that the peculiar "yellow bodies" found in the kidney along with *Myxobolus cyprini*, or in healthy fishes, are the residues of normal phagocytosis.

Parasite of Male Starfish.—Casimir Cépède** describes *Orchitophrya stellarum* g. et sp. n., an astomatous Infusorian which causes degeneration of some of the cells of the testes of the common starfish (*Asterias rubens*), causing partial parasitic castration.

* Arch. Zool. Expér., viii. (1908) Notes et Revue, No. 2, pp. li.–liii. (1 fig.).
† Math. Nat. Ber. Ungarn., xxi. (1907) pp. 84–112 (2 pls. and 7 figs.).
‡ Arch. Zool. Expér., viii. (1908) Notes et Revue, No. 2, pp. xxxiii.–xxxix. (2 figs.).
§ Bull. Soc. Portugaise Sci. Nat., i. (1908) pp. 165–8.
‖ Tom. cit., pp. 169–70.
¶ Arch. Zool. Expér., viii. (1908) Notes et Revue, No. 2, pp. liii.–lxii. (5 figs.).
** Comptes Rendus, cxlv. (1907) pp. 1305–6.

The author * has been able to keep this new parasite alive for half an hour in the testicular juice, and for sixteen days in a mixture of a small quantity of testicular juice and sea-salt solution. In the latter it exhibits an adaptation to what approaches a marine medium. It changes its mode of locomotion, twisting in a gyratory fashion on its longitudinal axis, its cilia beat much more rapidly, and the endoplasm becomes much clearer owing to the disappearance of accumulated reserve products.

Culture of Treponema pallidum in vitro.†— C. Lebailly has succeeded in keeping *Treponema pallidum* Schaudinn alive for some days *in vitro*, apart from the living organism. It continued to multiply in these conditions. This may lead to fruitful experiments in the way of acclimatising the micro-organism to controlled conditions.

* Comptes Rendus, cxlv. (1907) pp. 1435–7.
† Op. cit., cxlvi. (1908) pp. 312–14.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

including Cell-Contents.

Autolysis of Mitosis.*—A. Oes has studied mitosis in *Vicia Faba*, *Pisum sativum*, *Helianthus annuus*, etc., with the following results. Those cells where mitosis has just started, but where further development has been prevented by the addition of chloroform, toluol, or any similar substance, contain an enzyme which can dissolve chromatin. This enzyme is most rapid in action during meta-, ana-, and telophase, slower during prophase, and very slow indeed in the resting nucleus. In autolysis the spindle-threads can no longer be made out, while the nuclear membrane and nucleolus of the resting nucleus remain unchanged. Temperatures from 30–40° C. favour autolysis; at 80–90° C. it is completely destroyed. A dilute solution of substances like nitre favour it, while the reverse effect is produced by copper-sulphate, etc. The enzyme is readily destroyed by free acids, but is uninjured by strong alkalis. Nuclein is probably destroyed by it, and the diminution of chromatic material during telophase is probably due to its action. The experiments seem to oppose the view that hereditary characters are transmitted through the chromatin.

Cytology of Pollen-mother-cells of Agave attenuata.†—Er. de Lary, who has studied the pollen-mother-cells of several of the Amaryllidaceæ, contributes a note upon *Agave*. Prior to synapsis the nucleus is completely filled by a fine linin network, the filaments of which bear small chromatin corpuscles; but the author has been unable to find any association in pairs of either the corpuscles or the filaments. In the early synapsis stage there is no fusion in pairs of the chromatic corpuscles, and a little later the chromatin granules appear in a single row; at no time is there any sign of longitudinal splitting or of fusion of two filaments. It is probable that the chromosomes are formed by concentration of the chromatin, similar to the chromosome-formation of *Nymphæa alba* and *Nuphar luteum*. The author favours the view held by Mottier in regard to other Monocotyledons, viz. the formation of simple chromosomes by the transverse splitting of a double chromosome. Sometimes detached chromosomes form accessory nuclei during the early stages, but they disappear later, either through fusion with the main nucleus, or by absorption into the cytoplasm; and the author considers that this refutes the theory that supernumerary nuclei are specially characteristic of hybrids.

* Bot. Zeit., lxvi. (1908) pp. 89–120 (1 pl.).
† Comptes Rendus, cxlvi. (1908) pp. 833–6.

Structure and Development.

Vegetative.

Red Wood in Conifers.*—J. White has carried out a number of experiments upon Conifers in order to test the truth of the suggestion that the formation of red wood is "a morphogenic response to a gravitational stimulus." The plants used were grown in pots and rotated on a klinostat, and the results show that, while the formation of red wood is due to the stimulus of gravity, the thickness of its tracheids appears to be the result of a light-stimulus; the tracheid walls of strongly illuminated branches were always thicker than those under a less intense illumination. Under similar conditions, the walls of the tracheids of both red and white wood were of equal thickness. It is improbable that pressure and tension produced by forcibly curving the branches has any effect upon the thickness of the tracheids of either white or red wood, or upon the formation of red wood. The minimum time for response to the stimulus of gravity in the production of red wood is 2 hours.

Embryology in the Palmaceæ, Musaceæ, and Cannaceæ.† — C. L. Gatin contributes a note upon his recent studies of the anatomy and development of the embryo in the Palmaceæ, Musaceæ, and Cannaceæ. The embryos have several points in common, of which the following are the most important. They are all surrounded by an epidermis which is discontinuous opposite the radicle, where it gives place to irregular cells representing the remains of the suspensor. The central cylinder of the radicle is well-defined from the first, but its cortex and cap differ greatly in their degree of differentiation. In all cases the radicle is endogenous, being most markedly so in *Pinanga* and *Calamus*, which, in this respect, resemble the Grasses. There are two phases of development in germination: (1) the phase of preparation, (2) the phase of germination proper; in the former the seedling issues from the seed, while in the latter the various organs complete their development. In Palms the growth of the cotyledon is very great, but the shape is determined by the interior of the seed; in Cannaceæ and Musaceæ the growth is less, but the form more, primitive. As stated previously, when the plumule and radicle are in the same straight line, no ligule is formed, while if the angle between the radicle and plumule is less than 180°, a ligule is present.

Hibernation and Vegetative Reproduction of Stellaria.‡ — T. Holm has studied American species of *Stellaria*, and distinguishes three types of vegetative reproduction. The first type, represented by *S. pubera*, has no rhizome, but persisting aerial stolons. There are two kinds of shoots: floral, which die down when the fruit is mature, and vegetative, which arise as horizontal branches, and form new individuals. As soon as these vegetative shoots have formed roots, the internodes break down and produce separate plants, which hibernate

* Proc. Roy. Soc. Victoria (n.s.) xx. 2 (1908) pp. 107–24.
† Comptes Rendus, cxlvi. (1908) pp. 938–40.
‡ Amer. Journ. Sci., xxv. (1908) pp. 315–22 (6 figs.).

by perennial stem-bases. The second type, represented by *S. longipes* and *S. umbellata*, persists by "hibernating buds above ground and by subterranean stolons." This type is very characteristic of plants subject to extreme climatic conditions. The third type, represented by *S. Jamesii*, has a well-developed rhizome, but the aerial stems are annual. The rhizome is much swollen, and bears membranous, scale-like leaves; only those buds which are near the apex develop into aerial, floral shoots, other buds remain dormant. The third type appears to be rare in the Caryophyllaceæ.

Physiology.

Nutrition and Growth.

Transpiration.*—G. L. Clapp has studied transpiration with the view of discovering what plants are most suitable for purposes of class-demonstration. The results obtained are recorded in a series of graphs, which bring out the following facts. Transpiration is at its maximum when sunlight is most intense, moisture is least, and there is a good supply of water in the soil. The minimum is reached when temperature is low, atmospheric moisture is near the point of saturation, and darkness is complete. Transpiration is extremely sensitive to slight changes in external conditions, and points to the possibility that the relation between such conditions and the amount of vapour given off is not purely physical, but "involves the action of the conditions as stimuli." Of the plants examined, *Helianthus annuus* transpires most, but is unsuitable for class-demonstration. Among those most suitable for such purposes are *Tropæolum majus*, *Pelargonium domesticum*, and *Fuchsia speciosa*. The average amount of transpiration for ordinary green-house plants is 50 grm. per hour per square metre of surface in daylight, and 10 grm. in night-time.

Irritability.

Geotropic Sensibility of the Root.†—G. Haberlandt has investigated the statements of A. Piccards as to the geotropic sensibility of the root. Having repeated the experiments made by this investigator, the present writer is led to agree with his conclusions, which are briefly as follows: The geotropic sensibility of the root extends from the root-tip to the zone of growth, but is greater in the tip, especially at a distance of 1·5 to 2 mm. from the end. This greater sensibility of the root-tip corresponds to the larger number of statoliths in the root-cap. The sensibility in the zone of growth is due to the statoliths of the periblem. Usually the statoliths are deposited irregularly, but in the zone of most rapid growth in *Vicia Faba* they are in layers. By the application of a sufficiently great centrifugal force, the position of the statoliths in relation to the cell-walls may be changed, and the response to the force of gravity overcome. All the experiments performed favour the Statolith Theory.

* Bot. Gaz., xlv. (1908) pp. 254–67 (2 figs., 30 graphs).
† Jahrb. wiss. Bot., xlv. (1908) pp. 575–600 (2 figs.).

Influence of Light and Colours on Yeast.* — J. E. Purvis and G. R. Warwick have experimented with different species of *Saccharomyces* in order to show the influence of rays of light of different refrangibility upon the appearance and production of spores. Red, green, and blue screens were used, and the yeast was kept in an incubator at 24–25° C. In four series of experiments the results show that while blue and violet retard sporulation in a most marked manner, and green to a less extent, red rays produce the same effect as darkness. Ultra-violet rays produce the greatest retardation. The influence of radium was also tested, and found to destroy the vitality of the cell. In general, it is found that rays of low refrangibility accelerate spore formation, and *vice versa.* Experiments made on the influence of light and colours upon fermentation of hopped wort show that fermenting solutions are not seriously influenced by these factors.

Chemical Changes.

Effects of Poisonous Gases on Plants.†—W. J. V. Osterhout has made experiments on various plants, both wild and cultivated, in order to ascertain whether it is possible to distinguish the effects of poisonous gases from those due to drought, root-injury, and other natural causes. All the experiments confirm the opinion that, while drought and natural causes result in the fading of the leaves, beginning from the oldest, various poisonous gases, e.g. sulphur dioxide, cause the young leaves to fade long before the old ones. Also the young rind of stems is quickly injured by drought, but endures the action of sulphur dioxide for a considerable time.

Value of Sodium to Plants.‡ — The same author has experimented with plants grown in water-cultures and in soil, with the view of discovering whether sodium can be used as a protective agent to plants. Experiments were made with various flowering plants, liverworts, algæ, and fungi, and tend to show that sodium can protect plants against the toxic action of potassium, ammonium, magnesium, and calcium. The sodium has no nutritive function, but is only protective ; moreover, both chlorides and nitrates give similar results. These results show a striking similarity between the behaviour of plants and animals, and may prove of great value in agriculture.

General.

Origin of Parasitic Plants.§—C. A. White has studied parasitic Seed Plants with the view of discovering something as to their aggregate origin. He divides them into seven groups. Group I. includes partial parasites which prey upon the roots of host-plants for part of their nourishment. Group II. includes complete parasites, which, however, are nearly normal in structure, e.g. Mistletoe. Group III. contains

* Journ. Inst. Brew., xiv. (1908) pp. 214–33. † Tom. cit., pp. 339–40.
‡ Univ. Californ. Bot. Publications, iii. (1908) pp. 331–7.
§ Amer. Nat., xlii. (1908) pp. 98–108.

only *Lathræa squamaria*. Group IV. includes *Cuscuta* and *Cassytha*, Group V. the Orobanchaceæ, Group VI. *Rafflesia* and allied genera, while Group VII., represented by the Balanophoraceæ, shows the highest degree of modification. The method of parasitism of each group is shared equally by every member, and this method is distinct from that of each of the other groups. All parasitic habits and structures appear to be inherited. None of the types show any tendency to revert to normal conditions, and although the fruit and flowers show that these parasites were originally normal Phanerogams, no transitional types can be discovered. The author assumes that phanerogamic parasites have originated "by sudden and aggregate mutation from normal Phanerogams."

Ultramicroscopic Organisms.*—H. Molisch publishes the results of his observations made in the attempt to discover ultramicroscopic organisms. So far no such bodies have been made out with certainty, and the author is of the opinion that if they do exist, they are of little importance and relatively few. All bodies previously thought to belong to this class have proved, on further investigation, to be colonies of minute bacteria, and the present results confirm the opinion put forward by Errera, that any existing ultramicrobes cannot be much smaller than the smallest known organisms. Investigations made upon the mosaic disease of tobacco and the chlorosis of the Malvaceæ, make it probable that diseases hitherto ascribed to microbes are due to the toxic action of some assimilation-product.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A., F.L.S.)

Effect of Light upon Spore-germination.†—A. C. Life describes the effect of light upon the germination of spores and the gametophyte of ferns. The spores of *Alsophila australis* germinated a year after collection, those of other ferns germinated as soon as they were dry. Ordinarily the spores do not germinate in darkness. At temperatures above that of ordinary rooms the spores of *Alsophila* and *Aneimia* would not germinate. Germination was best in light of medium intensity, weaker light inducing filamentous or ribbon-like prothallia, while strong light induced heart-shaped prothallia. Strong light led to the production of only archegonia in *Alsophila*, but of both sex-organs in the other species. Weak light favours the production of antheridia and inhibits that of archegonia.

Ophioglossum simplex.‡—F. O. Bower publishes a further note on *Ophioglossum simplex* Ridley, a unique species from Sumatra described by

* Bot. Zeit., lxvi. (1908) pp. 131–9.
† Ann. Rep. Mo. Bot. Gard., xix. (1907) pp. 109–22. See also Bot. Gazette, xlv. (1908) p. 421.
‡ Ann. of Bot., xxii. (1908) pp. 327–8.

him in the same periodical four years previously. It is remarkable for the apparent absence of the sterile lamina, while the fertile spike is well developed. This may be attributed to the presence of mycorhiza, which facilitates the nutrition of the large spike in the dense wet forest, though the sterile assimilatory lamina is absent. He has received further Sumatran specimens from E. Rosenstock, and these possess a more or less pronounced outgrowth, which clearly represents a sterile lamina, thus linking the species closer with *O. intermedium* and *O. pendulum*, and justifying the view that *O. simplex* is a reduced and not a primitive form. He adduces other anatomical reasons for rebutting D. H. Campbell's views that the plant is a primitive form.

Production of Dwarf Male Prothalli in Sporangia of Todea.*—L. A. Boodle, when examining sporangia of filmy species of *Todea* (*T. Fraseri* and *T. hymenophylloides*), found antheridia in some of the closed sporangia, and gives an account of his observations. When plants of *T. Fraseri* are kept in a sufficiently damp atmosphere, sporangia do not dehisce, and a number of spores germinate *in situ*; among the simple few-celled prothalli produced being some that bear a single terminal antheridium. Similar intrasporangial germination takes place in detached sporangia if kept moist, antheridia being produced after three weeks. The prothalli do not burst the sporangial wall, but die. Free spores, placed under the same conditions as the sporangia, never produced dwarf male prothalli, but formed normal prothalli, which within the limits of the author's experiments never produced sexual organs. In *T. hymenophylloides* the spores germinate less readily, antheridiferous prothalli being found in closed sporangia in only one or two experiments. The formation of dwarf male prothalli in the sporangium is possibly due to the concentration of certain organic food substances, caused by pressure of the growing spores in the confined space. The concentration may lead to special nutrition of the protoplasm, resulting in precocious formation of sexual organs.

Water-storing Tubers of Nephrolepis.†—J. W. Harshberger gives a résumé of what has been written by Velenovsky, Heinricher, and others, about the tubers of various species of *Nephrolepis* and their function. He has himself investigated the tubers of two species, *N. cordifolia* and *N. davallioides*, and finds himself somewhat at variance with previous writers. The principal function of the tubers can definitely be stated to be water storage, and the amount of water stored is considerable. The tubers aid the plant in tiding over the periods of drought.

North American Pteridophyta.—A. H. Trundy‡ describes the method of growth of *Lycopodium sabinæfolium* in Maine, where it occurs in large circles (up to 150 ft. in circumference), ever growing outwards, the younger plants being situated on the outside margin of the belt, and the fruiting plants on the inside margin. The space within the circle is covered with *Cladonia rangiferina*. A similar circular manner of growth is noticeable in *L. inundatum*.

* Ann. of Bot., xxii. (1908) pp. 231–43 (1 pl.).
† Bull. Torrey Bot. Club. xxxv. (1908) pp. 271–6.
‡ Fern Bulletin, xv. (1907) pp. 70–1.

W. N. Clute* figures and names a new bipinnatifid form of the Christmas fern (*Polystichum acrostichoides*), and also gives a brief account of the sports of the so-called "Boston fern" of cultivation (*Nephrolepis exaltata*).

He also writes† about the wholesale destruction caused by the collection and sale of ferns and evergreens for decorative purposes.

He publishes‡ a series of notes under the title "Pteridographia," chiefly embodying items of information supplied by correspondents.

C. E. Waters§ publishes some details concerning the habit of *Aspidium cristatum*, on the vertically growing fertile fronds of which the pinnæ are turned into a horizontal situation, or so as to catch the maximum amount of illumination. He also points out that *Equisetum hyemale*, which is recorded as "fruiting in summer," discharges its spores in early spring.

J. A. Graves‖ states the simpler characters by which *Aspidium spinulosum*, its varieties *intermedium*, *dilatum*, and *A. Boottii*—may be recognised and distinguished from one another.

W. N. Clute¶ figures and describes *Doryopteris pedata*, a fern of tropical America which is included in *Pteris* by some authors.

He reports** a new station in Florida for the rare *Hypolepis repens*, only once found previously in the United States.

He calls attention†† to a hybrid between *Asplenium ruta-muraria* and *A. trichomanes*, found in Vermont in 1905. He discusses the application of the laws of nomenclature to the new *Struthiopteris germanica* f. *pubescens*. Much confusion existing between *Nephrodium patens* and *N. molle*, he shows how these two species can be distinguished from one another and from *N. stipulare*. Finally, he publishes a further portion of his checklist of the North American Fernworts, comprising the genera *Selaginella* and *Isoetes*.

C. F. Saunders‡‡ records the re-discovery of *Cheilanthes Parishii*, in the Colorado desert, after a lapse of twenty-seven years; and Parish's description of the locality in which it was originally found is reproduced.

J. Shepard§§ shows how a nature-print negative may be easily obtained from a fern or other plant, and used for making positive prints of the original.

South American Ferns.‖‖—G. Hieronymus publishes a third instalment of vascular cryptogams gathered by Alfons Stübel during his travels in Colombia, Ecuador, Peru, and Bolivia. It is an enumeration of 133 species, including 14 new species and several new varieties.

Descriptions of New Species of Ferns.¶¶—E. Rosenstock publishes descriptions of four new species and a variety of ferns from Sumatra, New Zealand, and South America.

The same author*** also publishes descriptions of twenty-one new

* Fern Bulletin, xv. (1907) pp. 71–4.
† Tom. cit., pp. 77–9.
‡ Tom. cit., pp. 82–9.
§ Tom. cit., pp. 79, 80, 82.
‖ Tom. cit., pp. 80–1.
¶ Op. cit., xvi. (1908) pp. 33–5 (pl.).
** Tom. cit., p. 38.
†† Tom. cit., pp. 46–57 (2 figs.).
‡‡ Tom. cit., pp. 35–7.
§§ Tom. cit., pp. 39–42 (2 figs.).
‖‖ Hedwigia, xlvii. (1908) pp. 204–49.
¶¶ Fedde, Repertorium, v. (1908) pp. 13–17.
*** Tom. cit., pp. 33–44.

ferns collected in New Guinea by E. Werner. Among them is the new genus *Hemipteris*, which differs from *Pteris* in having the upper margin of the laciniæ free from sori.

Deciduous British Ferns.*—C. T. Druery writes of the deciduous British ferns. Only one of these (*Polypodium vulgare*) has the property of throwing off the fronds at a basal joint, and this occurs in the spring. The fronds of other species die down on the approach of winter. There are, in fact, three groups :—(1) those that die down entirely in autumn, viz. lady fern, bladder fern, oak and beech ferns, mountain *Lastrea*, marsh fern, and royal fern ; (2) those that retain their greenness if sheltered during winter, viz. soft male fern and broad buckler fern ; (3) the evergreen group, viz. hard male fern, spleenwort, hart's-tongue, shield ferns, and *Blechnum*.

Fossil Pteridophyta.†—T. G. Halle gives an account of some herbaceous Lycopodiaceæ of the palæozoic and mesozoic periods, a subject which was studied by Goldenberg fifty years ago. It is clear that the species of *Lycopodium* and *Selaginella* of the present day must be descended from herbaceous ancestors, and not from the highly organised dendroid *Lepidodendron* and *Sigillaria*. And such herbaceous forms certainly existed in the Devonian. The author gives a résumé of the work of Goldenberg, Schimper, Renault, Kidston, Zeiller, and others. He also adds descriptions of the following specimens : *Lycopodites Zeilleri* sp. n., *L. macrophyllus*, *L. scanicus*, *Selaginellites primævus*, *S. elongatus*.

The same author ‡ makes some remarks on the mesozoic Equisetaceæ of Skåne.

Stigmaria with Centripetal Wood.§—F. E. Weiss describes the structure of a *Stigmaria* with centripetal wood, the first specimen obtained from the English Coal Measures. It came from the Hard Beds of Halifax. The author regards it rather as a *Stigmarian* axis than as a stem of *Lepidodendron mundum* (as Williamson concluded from a more fragmentary specimen) for the following reasons. The periderm is very wide and has a peculiar structure, and exhibits the remains of what must be rootlet-cushions, and there is no hard primary outer cortex. The curious centrical lateral bundles, and the system of delicate reticulate tracheids, show a likeness with *S. Brardii* Renault. The course of the lateral bundles through the secondary wood is as in another *Stigmaria*. The obvious centripetal development of the protoxylem, though more characteristic of Lepidodendroid stems than of *Stigmarian* axes, does yet undoubtedly occur in some examples of *Stigmaria*. The primary wood agrees closely with that of *Lepidodendron mundum* (now identified with *Bothrodendron*), and possibly both may belong to the same plant.

Deceased North American Pteridologists.‖—J. H. Barnhart gives a chronological list of the published papers of the late Professor Lucien

* Fern Bulletin, xv. (1907) pp. 75–6.
† Arkiv Botanik, vii. No. 5 (1908) 17 pp. (3 pls.).
‡ Tom. cit., No. 7 (7 pp.).
§ Ann. of Bot., xxii. (1908) pp. 221–30 (1 pl.).
‖ Bull. Torrey Bot. Club, xxxv. (1908) pp. 17–38.

Marcus Underwood. These are 212 in number; the first was printed in 1878, and the last in 1907, and 78 of them are concerned with the Pteridophyta. It was during the last ten years of his life that Underwood gave his attention more particularly to ferns, collecting material in the United States and West Indies, and paying several visits to Europe in order to study type-specimens of American species.

W. N. Clute * publishes obituary notices of Benjamin Davis Gilbert, Lucien Marcus Underwood, and George Edward Davenport, leading students of ferns, deceased during 1907.

Anatomy and Morphology of Tmesipteris.†—M. G. Sykes describes the external features and the anatomy of *Tmesipteris*, based upon material obtained from New Zealand, and shows that there is an endodermis surrounding the single stele in the rhizome, and that it has characteristic markings on its radial walls. The endodermis loses these markings and becomes less obvious at the transition region; and in the aerial stem it can no longer be distinguished. The pith arises in the centre of the stele in the transition region, and quickly expands to form a large tissue in the stem; the protostele passes into a medullated monostele without the intermediate stage of solenostele. Growth from a single apical cell occurs in both rhizome and stem. In the fertile branch, as in the sterile, the single bundle entering the axis branches into three, the two lateral traces supplying the leaves. The central bundle supplies the synangium, which occurs at the point of divergence of the two leaves. The single trace entering the synangium pedicel branches into three; the two lateral diverge and run round the periphery of the septum. The central trace, described for the first time, is an important argument in favour of the axial theory of the sporophyll in the Psilotales, and is regarded by the author as representing the vascular supply of the apex of the branch. The author searches for evidence of phylogenetic relationship with *Sphenophyllum*.

Origin of Roots in Lycopodium.‡—E. M. Saxelby gives an account of the origin of the roots in *Lycopodium Selago*. They arise near the apex of the stem, but below the first leaves, before the vascular elements have become differentiated; and they arise from a group of cells: the dermatogen of the root from the innermost layer of the stem periblem, and the periblem and plerome of the root from the plerome of the stem. The root-apex is divided into three meristematic regions, the dermatogen giving rise to the root-cap and epidermis, and the periblem producing four layers of cells over the central plerome. The roots run down through the middle cortex of the stem and emerge from the under side of it beneath the soil; they do not dichotomise before emerging. Each root is connected with two protoxylem groups of the stem and the inclosed phloem. Leaf-traces, on the other hand, are never connected with more than one set of protoxylem elements. The roots may be diarch or tetrarch, the metaxylem of the former being in two parallel bands, and that of the latter being in the shape of a horse-shoe. The

* Fern Bulletin, xv. (1907) pp. 65–70.
† Ann. of Bot., xxii. (1908) pp. 63–89 (2 pls. and figs.).
‡ Tom. cit., pp. 21–33 (1 pl.).

protoxylem is formed of spiral and annular vessels; the metaxylem is of wide tracheids, either scalariform or with several rows of pits. The endodermis is of two or three layers, the innermost cells having thickened radial and transverse walls. The lacunæ of the middle cortex do not communicate with those of the middle cortex of the stem. The roots have a firm outer cortex of thick-walled cells.

Types of Embryo-development in Selaginella.* — H. Bruchmann demonstrates that *Selaginella Martensii*, on the one hand, and *S. Poulteri* and *S. Kraussiana* on the other, possess two different types of embryo-development—a difference which is characterised by the original position of the primary rhizophore. In *S. Martensii* the first rhizophore arises between the foot and suspensor. In the other type it arises above the suspensor and foot. Although systematists have arranged the species in different groups according to their external characters, it does not follow that these groups correspond with the differences of structure shown in the embryo. The development of the embryo in each of the two types referred to is described in detail, and at the end of the paper a summarised comparison is appended.

Bryophyta.

(By A. Gepp.)

Harpidium Section of Hypnum.† — J. A. Wheldon discusses the classification of the difficult group of mosses, the *Harpidia adunca* of Sanio. He gives several reasons for not accepting Renauld's view, that *Hypnum aduncum*, *H. Sendtneri*, *H. Wilsoni*, and *H. lycopodioides* should all be regarded as sub-species of *H. aduncum*. Nor does he accept Ingham's view that *H. pseudofluitans* is a state of *H. aduncum* (*typicum*). In the light of his own observations, he holds that the varieties *typicum*, *intermedium*, and *pseudofluitans* are not convertible into one another by wetter or drier conditions. The problem is much more complex. Hardly anything is known of the ecology and phylogeny of the mosses. Why do some mosses have straight leaves, and others falcate? The branching of the moss-stem is not determined merely by such factors as light and shade, vertical or lateral illumination. In attempting to trace the conversion of one species into another in this critical group, the student must avoid being misled by badly developed specimens. The author then gives an account of his own field observations on the following species or groups in the neighbourhood of Liverpool during a period of fourteen years:—*Hypnum aduncum* Ren., *H. Sendtneri* Schimp., *H. Wilsoni* Schimp. The numerous forms of *H. aduncum* are plentifully represented; those of the group *Kneiffii* are found chiefly inland and less in pools near the coast, whereas the groups *pseudofluitans* and *typicum* occur near the coast only. As to *H. Sendtneri*, regarded as an Alpine plant on the Continent, in this country it is confined to the plains, and especially to the vicinity of the sea-coast.

* Flora, xcix. (1908) pp. 12–51 ((figs.).
† Rev. Bryolog., xxxv. (1908) pp. 85–94.

H. Wilsoni he regards as a natural hybrid between *H. Sendtneri* and *H. lycopodioides*, and gives reasons for this view ; for instance, he has never gathered *H. Wilsoni* except in pools where *H. Sendtneri* and *H. lycopodioides* grow together. In conclusion, he appends a list of *Harpidia adunca*, based upon the work of Sanio, Renauld, and Warnstorf, the main features of which (apart from numerous varieties and forms) are as follows :—1. *Hypnum polycarpon* Bland. (*H. Kneiffii* Schimp.) ; (2) *H. simplicissimum* Warnst. ; (3) *H. subaduncum* Warnst. ; (4) *H. pseudofluitans* Klinggr. ; (5) *H. Barbeyi* Ren. ; (6) *H. capillifolium* Warnst. ; (7) *H. Sendtneri* Schimp. ; (7A) *H. Wilsoni* Schimp. ; (8) *H. lycopodioides* Schwaegr. ; (9) *H. latinerve* Arnell.

Introductory Study of the Muscineæ.*—T. H. Russell has published a book on Mosses and Liverworts : an introduction to their study, with hints as to their collection and preservation. He first treats of the mosses, giving some of the more generally interesting facts concerning them, with a sketch of their life-history and various modes of reproducduction. He then treats of the hepatics on the same lines ; and in chapter iv. he goes carefully into the questions of the collection, examination, and preservation of specimens, describing the most appropriate apparatus to use, and how to make it ; and giving explicit instructions for the preparation of Microscope slides, with hints as to how the many pitfalls that beset the beginner may be avoided.

Luminosity of Schistostega.†—W. West expresses the opinion that the luminosity of *Schistostega osmundacea*, which always grows in sparsely lighted caverns, is due to the peculiar shape of the cells of the protonema, which are convex above and conical below. An incident ray of light is first refracted upon entering the cell, then reflected across the cone, again reflected, and finally refracted upon emergence, so that some of the light passes back along the path by which it approached the cell ; and the modification which the light has undergone in the protonemal cells accounts for the strange character of the luminosity.

British Hepaticæ.‡—B. Cockburn publishes a short note on the distribution of *Pallavicinia hibernica* and the rare and inconspicuous *Petalophyllum Ralfsii* in Britain, and the conditions under which they occur, namely, in salt marshes near the sea. The two plants sometimes grow together.

W. Evans § gives an account of the distribution of the species of the genus *Riccia* in the reservoirs around Edinburgh in 1905, in the autumn, when the level of the water was remarkably low. He visited fifteen reservoirs, and found *R. sorocarpa* to be present in all. *R. glauca* occurred in eight, *R. crystallina* in five, *R. Lescuriana* in three, and *R. fluitans* f. *canaliculata* in two. *R. crystallina* was previously unknown

* London : Sampson Low, Marston, and Co. (1908) xiv. and 200 pp. (10 pls.).
† Naturalist, No. 606 (1907) p. 256.
‡ Trans. Proc. Bot. Soc. Edinburgh, xxiii. (1907) pp. 279–80.
§ Tom. cit., pp. 285–7 (1 pl.).

in the Scottish flora. *Fossombronia cristata* was also growing plentifully in most of the reservoirs. Photographs of the living plants are given.

F. Rhodes * records the occurrence of *Ricciella fluitans* in abundance in some dykes at Mablethorpe last summer. This hepatic has apparently been recorded for Lincolnshire only once previously.

Sphagnum bavaricum in Yorkshire.† — W. Bellerby records the occurrence of *Sphagnum bavaricum* in England. It was detected by C. Warnstorf among some interesting species of *Sphagnum* collected in bogs near Ellerbeck by W. Bellerby. Warnstorf had recently published a description of *S. bavaricum* in Hedwigia, xlvii (1907) p. 84. An English translation from the German of this description is supplied by Bellerby. The plant is allied to *S. subsecundum*.

Yorkshire Mosses.—C. A. Cheetham ‡ gives a list of twelve mosses from Cautley, in West Yorkshire, which have not been recorded previously for the district. Among them is *Dicranella secunda* Lindb.

The same author § publishes some field notes upon the more interesting mosses observed during an excursion of the Yorkshire Naturalists' Union. He describes the luxuriance of the species observed on the limestone in Ling Gill; the very restricted flora on the gritstone scars of Pennyghent; the rarities in Douk Gill. A list of eight species new to the district is added.

C. A. Cheetham ‖ gives a list of seven mosses not previously recorded for Inglebro', in West Yorks, and confirms the records of eight which were previously doubtful.

Muscineæ of Flintshire.¶—A. A. Dalman gives an enumeration of ten hepaticæ and seventy mosses of Flintshire, with their respective stations, and a few notes upon peculiarities of structure, etc.

New and Rare Scottish Mosses.**—J. Stirton gives an account of some mosses collected mostly at or near Arisaig, in the west of Scotland. Some of these are interesting because of their rarity. Eleven species and one variety are described as new to science. The descriptions and notes have also been published in the Annals of Scotch Nat. Hist., 1907, pp. 171–80.

Muscineæ of Greece.††—A. Coppey has determined the mosses and hepatics collected in Greece by Maire and Petitmengin, and combined them with a list of all previous records, which are but scanty. The more interesting species are *Barbula papillosissima* (recently described), *Grimmia Hartmanni*, *Funaria Mairena* sp. n., *Bryum provinciale*, *Hypnum commutatum*, *H. falcatum*, *H. irrigatum*. Annotations and figures of these are given.

* Naturalist, No. 607 (1907) p. 327.
† Op. cit., No. 612 (1908) pp. 15–16.
‡ Op. cit., No. 616 (1908) p. 193.
§ Op. cit., No. 617 (1908) pp. 201–2.
‖ Op. cit., No. 606 (1907) pp. 256–7.
¶ Journ. of Bot., xlvi. (1908) pp. 227–30.
** Proc. Roy. Phil. Soc. Glasgow, xxxviii. (1907) pp. 150–8.
†† Bull. Soc. Sci. Nancy (1908) 70 pp. (4 pls.). See also Rev. Bryolog., xxxv. (1908) p. 98.

North American Muscineæ.—C. C. Haynes* gives an obituary notice of Professor L. M. Underwood (b. 1853, d. 1907), with special reference to his work in connection with the North American Hepaticæ, and appends a bibliography of his works. A. W. Evans,† having recognised *Lopholejeunea Muelleriana* among some hepatics collected by S. Rapp, of Sanford, in Florida, points out certain details in which it differs from specimens gathered in Porto Rico and Brazil. Twenty-nine Lejeuneæ are now recorded for the United States, and twenty-four of them for Florida. A. Lorenz ‡ publishes some notes upon *Jubula pennsylvanica*, illustrated for the first time with figures. P. M. Towle § gives data about the fruiting season of a few species of mosses, chiefly *Mnium*, *Rhodobryum*, and *Bartramia*; and shows how the dates differ according to latitude, climate, and the earliness of arrival of spring. E. G. Britton ‖ gives a history of the various opinions that have been published about the presence or absence of the genus *Zygodon* in North America, and the number of species found. She sums up the matter by providing descriptions of three species—*Z. viridissimus*, *Z. rupestris*, *Z. gracilis*—and of *Leptodontium excelsum*, which is usually known as *Zygodon Sulivantii*. A. W. Evans,¶ having had an opportunity of examining the type specimens in the Lindenberg collection of Hepaticæ at Vienna, and having arrived at some conclusions which are at variance with those of recent writers and with his own previous ideas, writes upon the synonymy of three North American species. 1. *Lejeunea lætevirens* Nees and Mont. is the same as *L. lucens* Tayl. and *L. glaucophylla* Gottsche, and belongs to the genus *Microlejeunea*. 2. *L. clausa* Nees and Mont. is the same as *L. opaca* Gottsche, *L. commutata* Gottsche, and *L. lutea* Mont., and should be referred to *Euosmolejeunea*. 3. *Frullania obcordata* Lehm. and Lindenb. is the same as *F. caroliniana* Sulliv. and *F. Martiana* Gottsche. A. Lorenz ** gives figures of *Marsupella Sullivantii* and *M. sphacellata*, with explanatory notes.

New South Indian Moss.†† — H. N. Dixon describes *Brachymenium turgidum*, a new species from the Western Ghâts. It is a very distinct species, characterised by a turgid subpendulous capsule, and by the leaves being narrowly margined and entire, and not spirally twisted when dry.

Tundra-forms of Hypnum.‡‡—W. Mönkemeyer discusses the tundra-forms of *Hypnum exannulatum*, and distinguishes a var. *pinnatum* f. *tundræ*, and a var. *brachydictyon* f. *tundræ*, giving a description of each and adding critical notes on various specimens.

Type Species of Stereohypnum.§§—M. Fleischer publishes the basis of a monograph of the genus *Stereohypnum*, which is also known as *Microthamnium*. This genus is rendered extremely difficult owing to the

* Bryologist, xi. (1908) pp. 41–4 (portrait).
† Tom. cit., p. 45–6.
‡ Tom. cit., p. 46–7.
§ Tom. cit., p. 53–4.
‖ Tom. cit., pp. 61–6 (1 pl. and figs.).
¶ Tom. cit., pp. 67–70.
** Tom. cit., pp. 71–3 (2 pls.).
†† Rev. Bryolog., xxxv. (1908) pp. 94–6.
‡‡ Hedwigia, xlvii. (1908) pp. 300–4 (2 pls.)
§§ Tom. cit., pp. 271–99 (figs.).

uncertainty attaching to several of the older species, the incorrectly determined specimens in the herbaria of the older authors, and the multitude of new, but often doubtful, species described since 1870. The author's purpose here is to give critical descriptions and figures of the oldest species in the order of their original publication, up to about the year 1861, at the same time reducing many of the newer species to the rank of synonyms. He treats some thirteen species in this way, after studying the type-material in each case.

Propagula of the Genus Barbula.*—J. Maheu writes about the propagula and bulbils obtained by experimental culture of some species of *Barbula*. Some species, which do not normally produce them, may be made to do so by submitting them to special biologic conditions, such as confinement in a moist chamber. After a lapse of one to three months, propaguliferous protonemal filaments sprout from stems, leaves, and fragments of sporogonium. The propagula are pluricellular spheres about $\frac{1}{10}$ mm. in diameter, which fall off and develop into moss-plants. The plant cannot maintain its existence indefinitely by means of propagula; but these latter serve to prolong its life until suitable conditions arise for the development of sexual organs and production of a sporogonium. The production of propagula is chiefly due to humidity; light and darkness favour respectively the formation of protonemal and rhizoidal filaments. Rhizoids, protonema, propagula, bulbils, and leafy stems, are fundamentally homologous, being adaptations of one and the same organ to different conditions of life.

Gasterogrimmia in Hungary.†—I. Györffy shows that three species of this section of *Grimmia* which occur in Europe have been found also in Hungary, and claims that a fourth species, *G. poikilostoma*, originally collected in Auvergne by Gasilien, and later in Dauphiné by Sebille, has also been gathered in Transylvania. He gives a table of measurements of the Transylvanian plants.

Bryum zonatum a Philonotis.‡—W. Mönkemeyer discusses the question of what *Bryum zonatum* Schimp. really is. Schimper thought it to be allied to *B. Marratii*. Limpricht at first took it to be a *Bryum*, near *B. Limprichtii*, but later inclined to Hagen's view, that it should be excluded from the genus. Mönkemeyer having obtained a small amount of the original material collected by C. G. Lorentz, finds that it resembles a *Philonotis*, and comes to the conclusion that it is a non-papillate form of *Philonotis seriata*, analogous to the non-papillate var. *mollis* of *P. calcarea*.

European Hepatics.§—V. Schiffner publishes critical remarks upon the specimens issued in the fifth fasciculus of his "Hepaticæ Europææ Exsiccatæ," Nos. 201–50. The genera treated of are *Sphenolobus* (12 specimens), *Acrobolbus*, with figure (1), *Anastrepta* (8), *Plagiochila* (16), *Pedinophyllum* (4), *Leptoscyphus* (9). The species, their varieties and

* Comptes Rendus, cxlvi. (1908) pp. 1161–3.
† Rev. Bryolog., xxxv. (1908) pp. 97–8.
‡ Hedwigia, xlvii. (1908) p. 305.
§ Ber. Naturw. Med. Verein. Innsbruck, xxxi. (1908) Beilage, 70 pp. (1 pl.).

forms, are discussed critically. Three rarities—*Acrobolbus Wilsoni*, *Plagiochila tridenticulata*, *Leptoscyphus cuneifolius*—were supplied to the author from the west of Scotland by S. M. Macvicar.

Calypogeia in Italy.*—C. Massalongo publishes a monograph of the Italian species of *Calypogeia*. He gives new descriptions of the genus and various species and varieties. He maintains four species—*C. Trichomanis*, *C. Neesiana*, *C. suecica*, *C. arguta*—under *C. Trichomanis* are four varieties: *communis*, *fissa*, *Sprengelii*, *gracilis*, and a subspecies, *C. Mülleriana*. Critical notes are added, and attention is called to other species which are likely to be found within the limits of Italy.

Cephalozia in Scandinavia.†—H. W. Arnell and C. Jensen describe and figure some rare Scandinavian species of *Cephalozia*, from the original specimens preserved in the herbarium of Helsingfors University, viz. *C. borealis* Lindb. (1887), *C. subsimplex* Lindb. MS., *C. spinigera* Lindb. (1879), *C. lacinulata* Spruce, and *C.* (*Prionolobus*) *Perssonii* Jensen sp.n.

Notes on Californian Hepatics.‡ — H. B. Humphrey publishes some studies on the physiology and morphology of some Californian hepatics. Certain species are infested with fungi, parasitic in the case of *Fossombronia longiseta*, symbiotic in the case of *Fimbriaria californica*, epiphytic in the case of *Aneura multifida*, *Anthoceros Pearsoni*, and *Porella Bolanderi*. Fertilisation takes place in *Fegatella conica* during early spring; but the spores do not mature until the following January, having passed through the intervening dry season in the tetrad stage. The dry season leads to other adaptations, which are noted. It is fatal to hydrophilous species, but not to xerophilous species, these latter being able to resume growth from thallus or spores even after complete desiccation. The spores of some xerophilous species are capable of germination after two years.

Antarctic Hepatics.§—F. Stephani gives an enumeration of the hepaticæ collected by Skottsberg in Tierra del Fuego, the Falkland Islands, South Georgia, and the neighbouring Antarctic regions. There are seventy-eight species, five of which are new to science.

Illustrated Key to the Genus Lejeunea.‖—Lacouture publishes an analytical and synoptic key of the forty-three subgenera or genera into which the old genus *Lejeunea* is now divided. He gives a typical figure of each in illustration of the text printed opposite to it. The drawings have been made from nature, from sketches made by Spruce, Schiffner, and Stephani respectively.

Morphology and Anatomy of Bucegia romanica.¶— V. Schiffner gives a detailed and illustrated account of the structure and development of the rare hepatic *Bucegia romanica*, based upon an examination

* Malpighia, xxii. (1908) pp. 79–94.
† Bot. Notiser, 1908, pp. 1–16 (figs.).
‡ Proc. Washington Acad. Sci., x. (1908) pp. 1–50 (2 pls.). See also Bot. Gazette, xlv. (1908) p. 420.
§ Schwedisch Südpolar-Exped., iv. 1 (1905) 11 pp. (figs.).
‖ Rev. Bryolog., xxxv. (1908) pp. 101–14 (6 pls.).
¶ Beih. Bot. Centralbl., xxiii. 2te Abt. (1908) p. 273–90 (figs.).

of a good supply of living material in all stages of growth. The genus was first described by Radian in 1903, having been discovered in the Bucegi range of the Roumanian Carpathians. It occurs also at a few stations on the Polish and on the Hungarian sides of the Tatra Mountains, and some specimens have recently been found in the Vienna Hof-museum which were collected thirty years ago.

Notes on Riccardia and other Hepatics.*—V. Schiffner continues his series of bryological notes, and treats of the following subjects:—43. *Riccardia sinuata* var. *stenoclada*, a new variety recalling *R. multifida* var. *major*, but larger, thicker, more branched, etc. 44. The occurrence of *R. incurvata* in Bohemia. 45. *Peltolepis* in the Balkan Peninsula. 46. *Chomiocarpon quadratus*, discovered in China. 47. Some new French hepatics collected by Douin. 48. *Bucegia romanica.*

Riella bialata.†—R. Trabut describes a new *Riella* from Algeria, which is very remarkable for its two parallel wings, dorsally situated and covering right and left the fructifications. It grows either out of water and creeping, or immersed and erect.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Marine Diatomaceæ of France.‡—H. and M. Peragallo have just completed their work on this subject, started eleven years ago. It was issued to subscribers, according to their choice, in fascicles of four plates each with explanations and text, or in sets of ten fascicles, or as a complete work. It was also put on the market in three systematic sections; and finally it was published in the "Micrographe Préparateur," two plates with text in each number of that periodical. In the preface it is stated that the authors had the intention of producing a complete and entirely original flora of the Diatomaceæ of France, divided into three parts:—1. A general treatment, comprising the natural history of diatoms, methods of collection, cultivation, preparation, and their classification—this part being destined to be published last of all. 2. A description of the marine species, which is accomplished in the present work. 3. A description of the fresh-water species, which presumably the authors will now proceed to take in hand. The species and forms are grouped in the text into sections, tribes, families, genera, subgenera, etc., reference to all of which is facilitated by means of synoptical tables. No such tables are employed for the species and forms, since the plates themselves function as the best possible synopsis, exhibiting the forms side by side and enlarged to the same scale. This scale of magnitude is 600 diam., save in the case of *Pleurosigma* and a few other genera. The drawings were all made by camera-lucida, and photographed down to the standard size. Each species or form is described, and references to all important litera-

* Oesterr. Bot. Zeitschr., l. (1908) pp. 8–12.
† Rev. Bryolog., xxxv. (1908) p. 96.
‡ Diatomées Marines de France. Grez-sur-Loing: Tempère, 1897–1908, 492 xii., and 48 pp. (137 pls.).

ture concerning it are cited, but the synonymy is purposely reduced to a minimum. Doubtful species are maintained as species, rather than renamed as varieties; but their position in the text according to their affinity shows how they can be referred as varieties to typical species. Of the three systematic sections into which the present work is divided, the first—Raphidées (Raphideæ)—occupies 233 pages and 50 plates; the second—Pseudo-raphidées (Pseudoraphideæ)—occupies 128 pages and 39 plates; the third—Anaraphidées (Cryptorhaphideæ)—occupies 130 pages and 50 plates. The pelagic or plankton genera of Diatomaceæ—e.g. *Chætoceros*—are separated under the name Pléonémées, a special section of Anaraphidées. At the close of their work the authors, in submitting a synoptical table of the genera and subgenera, systematically arranged, discuss briefly the evolution of the diatoms, and adopt the names Centriques and Pennées for the two main divisions of the group. The former name represents the more ancient type, evidently pelagic in origin; while the Pennées, comprising the Raphidées and Pseudo-raphidées, took their rise from organisms already engaged in vegetal evolution (Chromomonades), whence also sprang the Phæophyceæ.

Yorkshire Diatoms.*—R. H. Philip publishes a note on the distribution of *Diatoma hiemale* in East Yorkshire. He discovered quantities of it in Weedley Springs last summer. He states that it was certainly not present in the springs in 1897; and, indeed, it was not found anywhere in the East Riding before September 1899. Since then he has gathered it in five localities. But during the last year or two it seems to have increased enormously, and to have ousted almost every other species from Weedley Springs. Figures of three forms of the species are given.

The same author † found in a sheep-tank above Conistone, in Wharfedale, some rare and interesting diatoms, among them being *Amphora Normanii*, which was discovered by G. Norman in an orchid-house in 1853, but has not been recorded for Yorkshire since then; but it has been gathered in Brussels Botanic Garden, and at Cambuslang Bridge, near Glasgow. *Cymbella microcephala* and *C. leptoceras* are new records for the East Riding and for Yorkshire respectively. Figures of these are given.

Structure of the Diatom-cell.‡—O. Heinzerling treats of the structure of the diatom-cell, with special reference to the assimilatory organs, and the relation of the structure to systematic classification. First he gives an account of the protoplast—cytoplasm, nucleus, centrosome, chromatophores; then of the assimilatory organs inclosed in the protoplast—double-plates, cell-sap, "volution" (reserve material), oil-drops, pyrenoids; also of the cell-membrane and the gelatinous layers. Next he discusses the movements of diatoms, and the characteristics of the structure of the protoblast, and especially of the chromatophores of such genera as have been investigated. He then gives an account of the

* Naturalist, No. 608 (1907) pp. 312–13 (figs.).
† Op. cit., No. 612 (1908) pp. 21–2.
‡ Bibliotheca Botanica, heft 69. Stuttgart: Schweizerbartsche Verlagsbuchhandlung (1908) 88 pp. (3 pls.).

protoplastic structure of a series of species selected from thirty fresh-water genera, and appends a bibliography.

North American Fresh-water Algæ.*—C. A. Kofoid gives an account of the plankton of the Illinois River (1894–99), including a discussion of the species of Schizophyceæ, Chlorophyceæ, Diatomaceæ, and Conjugatæ found therein, with notes upon their respective seasonal distributions, and the factors that control their production.

Spanish Fresh-water Algæ.†—F. B. Casares gives an enumeration of twenty-one Conjugatæ, mostly Desmids, collected in the provinces of Orense and Pontevedra, in Galicia. Instructions are given as to the best time of year for collecting these algæ, and the best methods of gathering, preparing, and preserving the specimens. The average dimensions of the species are stated.

Fresh-water Algæ of the West Riding.‡—W. and G. S. West give an enumeration of more than 130 species and varieties of fresh-water algæ collected by them from time to time on Austwick Moss, in the West Riding. Some of them are new to Yorkshire, and some to West Yorkshire. The nature of the ground is indicated, and a list of the more important vascular plants associated with the algæ is added.

Genus Hæmatococcus.§—W. Wollenweber publishes some investigations concerning *Hæmatococcus*. He sums up the most important results as follows :—1. *Hæmatococcus* can by appropriate cultivation be made to pass through its complete life-history, yielding zoospores, agametes, gametes, zygotes, aplanospores, and palmelloid states. 2. The cell-membrane does not consist of cellulose. 3. The chromatophore consists of a delicate green tubular scaffold, but in surface-view looks like a net. 4. *Hæmatococcus* possesses numerous (up to sixty) contractile vacuoles, imbedded in the uppermost sheath of the chromatophore, and pulsating independently of one another. 5. These contractile vacuoles afford the most trustworthy distinguishing character between *Hæmotococcus* and *Chlamydomonas*. 6. Size, thickness, and shape of the zoospore-membrane, development of the chromatophore, number and development of the pyrenoid and of the protoplasmic pseudopodia. 7. *Hæmatococcus* is suited to a myxo- and auto-trophic mode of life. In the latter mode of life agamogony preponderates. In *H. pluvialis* only agamogony occurs. 8. *Stephanosphæra* and *Hæmatococcus* are referred by Schmidle to Chlamydomonadeæ as a subfamily (Sphærellaceæ), on account of the similar morphological and physiological conditions. 9. The Red Snow alga finds no place in *Hæmatococcus* as now understood, and is to be regarded as a *Chlamydomonas* (*C. nivalis*), as Wille has shown.

Development of Hydrodictyon.‖—R. A. Harper discusses the organisation of certain cœnobic plants, describing in detail the formation of the

* Bull. Illinois State Lab. Nat. Hist., viii. (1908) pp. 19–61.
† Boletin R. Soc. Española Nat. Hist., viii. (1908) pp. 234–8.
‡ Naturalist, No. 614 (1908) pp. 101–3.
§ Ber. Deutsch. Bot Gesell., xxvi. (1908) pp. 238–98 (5 pls., figs.).
‖ Bot. Soc. of America, publication 36 (1908) 56 pp., 4 pls. See also Bull. Univ. Wisconsin Sci., iii. pp. 279–334.

cell-colonies of *Hydrodictyon*, and summarising the matter as follows:—1. The cylindrical form of the cells and their union at their ends is developed by growth and pressure between the adjacent cells on the principle of functional hypertrophy. 2. The large intercellular spaces of the adult net have their origin in the shrinkage of the mass of the mother-protoplasm during cleavage. 3. The central cavity of the net is due to the scattering of the swarm-spores under the influence of chemical and food stimuli, and their coming to rest upon the mother-cell-wall. 4. The form of the meshes is determined by the chance grouping of the spores in coming to rest, their viscidity tending to maintain chance contacts once established; and the slight readjustments due to gliding of their surfaces upon each other in the crowding incident to their growth as spheres and when first beginning to elongate, the number of sides of the polygonal meshes tending to become larger the greater the amount of intercellular space which is present when the spores come to rest.

Urospora in Norway.*—O. Hagem, when studying the algal flora of Dröbak Sound in the spring of last year, found on some stones in the littoral region several dark green patches containing three species of *Urospora*—*U. mirabilis*, *U. elongata*, *U. Wormskioldii*; the latter two of which had previously been recorded only from the Arctic regions. He describes and figures each of the three species, and discusses their structure, distribution, affinities, etc.

Development of the Genus Ulva.†—J. Schiller has studied the development of *Ulva* in the laboratory. He gives a detailed account of the minute structure of the gametospores and their biology. He finds that the process of conjugation is just as in *Monostroma*, *Entermorpha*, and many Phæophyceæ. He describes the germination and development of the zygotes and of the gametes; he describes the primary and secondary rhizoids, the latter of which have a surprising power of producing a new cell-filament, or rhizoid-shoot. *Ulva* and *Enteromorpha* are indistinguishable in their young stages, and there is a true branching in both of them, arising from a similar division of the apical cell. In both these genera three forms of gametes are found, macrogametes, parthenogametes, and microgametes, and they occur four, eight, or sixteen together respectively.

Cell-wall Structure in Cladophora.‡—F. Brand publishes some notes upon the cell-membrane, transverse walls, and joints of *Cladophora*, to supplement the information given by him seven years ago, in a paper on the structure and growth of the plant. After a general consideration of the structure of the membrane, he treats of the outer lamella, the sheaths of the membrane, its constituent parts, its growth, creases of the membrane, formation of transverse walls, formation of joints.

* Nyt. Mag. f. Naturvid. Christiana, xlv. (1908) pp. 261–9 (1 pl.).
† SB. k. Akad. Wiss. Math.-Nat. Kl. Wien, cxvi. 1 (1907) pp. 1691-1716 (1 pl.).
‡ Ber. Deutsch. Bot. Gesell., xxvi. (1908) pp. 114–43 (1 pl.).

Development of the Sexual Organs of Vaucheria.*—W. Heidinger gives an account of the development of the sexual organs in *Vaucheria*, as studied in species representing the four groups—Corniculatæ sessiles, Corniculatæ racemosæ, Anomalæ, Woroninia. He contrasts the respective statements (1) of Oltmanns, that before the oogonium becomes walled off, all the nuclei but one are withdrawn into the pedicel, and (2) of Davis, that after the oogonium is walled off, all the nuclei but one undergo degeneration and disappear. After describing his own methods of investigation, he gives a detailed account of the development of the sexual organs of *V. pachyderma*, *V. arrhyncha* sp. n., *V. terrestris*, *V. geminata*, and *Woroninia dichotoma*. He then criticises B. M. Davis's work; adds some systematic notes; and sums up his results by stating that they confirm Oltmanns' view, and that in all the groups of *Vaucheria* examined the multinucleate rudiment becomes a uninucleate oogonium by the withdrawal of all the other nuclei into the pedicel just before the oogonium is cut off by the transverse wall. The proper nucleus remains in the apex of the oogonium and puts out processes into the surrounding plasma, but moves back into the centre just before fertilisation, and remains there until germination of the oospore.

Spore-formation in Derbesia.†—B. M. Davis gives an account of the formation of the zoospores of *Derbesia Lamourouxii*. These are large and not biciliate, as in other Siphonales, but provided with a circle of numerous long cilia at the forward end. The lateral globular outgrowth, which develops into a sporangium, becomes separated from the parent filament by the closure of the ingrowing annular thickening in the neck. The sporangium contains at first thousands of nuclei, all alike, slightly larger than the plastids, and each containing a small nucleolus and a large chromatin body. Some of the nuclei enlarge to a diameter 4–6 times that of the plastids, and are rendered conspicuous by the development of numerous protoplasmic strands radiating out from the cytoplasm enveloping the nucleus. These large nuclei are the centres of the future spores. The other nuclei do not fuse (as has been stated), but undergo degeneration. The spore-masses separate and become rounded up. The nuclei of each moves from the centre towards the periphery, and a circlet of granules is deposited, by means of the protoplasm strands, under the plasma-membrane near by. It does not arise from the plasma-membrane. This circlet is the blepharoplast, which splits into two rings; from the lower ring the circle of cilia is produced. The homogeneous chromatin becomes changed into an irregular network of coiled threads. The two rings of the blepharoplast remain for a time at the base of the germinating spore, then gradually grow fainter. The nucleus divides mitotically, the spindle being intranuclear.

West Indian Species of Avrainvillea.‡—F. Börgesen publishes an account of the species of *Avrainvillea* hitherto found on the shores of the Danish West Indies, based upon material collected there by himself

* Ber. Deutsch. Bot. Gesell., xxvi. (1908) pp. 313-63 (1 pl. and figs.).
† Ann. of Bot., xxii. (1908) pp. 1–20 (2 pls.).
‡ Vidensk. Meddel. Natur. Foren. Kjöbenhavn, 1908, pp. 27–44 (1 pl., figs.).

in 1905–6. He describes and figures *A. nigricans*, *A. Muzei*, *A. asarifolia* (a new species distinct from *A. levis* Howe), also a unique plant allied to *A. levis* but not named specifically, and some plants referred to *A. comosa*. He also discusses Howe's genus *Cladocephalus*, and describes a large zonate plant which he considers to be synonymous with *Flabellaria luteofusca* Crouan, and names it *C. luteofusca*.

Anatomy and Histology of Macrocystis and Laminaria.*—M. G. Sykes gives an account of the anatomy and histology of *Macrocystis pyrifera* and *Laminaria saccharina*, based upon material specially preserved, and undertaken in order to determine certain points about which contradictory statements had been published. The conclusions reached by the author are that the "trumpet hyphæ" in both plants are true sieve-tubes, and represent the modified original central cells of the thallus, and may be termed "primary pith filaments." They are homologous with the secondary sieve-tubes of *Macrocystis* and *Laminaria*, which are similarly derived from the modified primary cortex of the young thallus. The histology of the sieve-plates in the primary pith filaments and secondary sieve-tubes is essentially the same. Threads are found traversing the young sieve-plate, and each gives rise in the older plates, apparently by means of ferment action, to a slime string inclosed in a rod of callus. The older sieve-plates are obliterated by the deposition of callus in large masses over their surface. Callus is a hydrated form of cellulose ; it is produced in the young sieve-plates by the action of a ferment on the already formed cell-wall, but afterwards is deposited by the protoplasm on the sieve-plate and on the lateral walls throughout the length of the tube. The histology of these sieve-tubes is shown to agree much with that of the sieve-tubes of Phanerogams. At the advent of the callus the threads acquire an increased capacity for staining ; the development of the sieve-plate is possibly, as in *Pinus*, a function of ferment action. The slime strings are buried under the thick overlying callus, and cannot, as in *Pinus*, be traced through the callus-pad. In young stages of *Laminaria saccharina* the cells of the hyphæ become secondarily attached to those of the primary cortex, probably also in *Macrocystis*. Protoplasmic threads have been demonstrated throughout the tissues of *M. pyrifera* and *Laminaria saccharina*, but in case of secondary attachments their formation is uncertain.

New Zealand Species of Rhodophyllis.†—A. D. Cotton gives an account of the New Zealand species of *Rhodophyllis*, having made a study of the specimens preserved at Kew, in the British Museum, and in the private possession of R. M. Laing at Christchurch, N.Z. As a result he is able to revise the descriptions of the older species and to describe one novelty. Thus the valid species are *Rhodophyllis acanthocarpa*, *R. Laingii* sp. n., *R. membranacea*, *R. Gunnii*, *R. lacerata*. He lays emphasis on the arrangement of the cortical cells, and shows that the size of the tetrasporangium varies considerably. He has cleared away the difficulty that existed of recognising the plants from their descriptions, and of reconciling the statements of different writers. Particularly

* Ann. of Bot., xxii. (1908) pp. 291–325 (3 pls.).
† Kew Bulletin, 1908, pp. 97–102.

is this the case with *R. membranacea*, which, after being united (erroneously) with *Rhodymenia fimbriata*, fell into neglect. *Rhodophyllis membranacea* is abundant on the coast of New Zealand; but *Rhodymenia fimbriata* does not occur there at all.

Criticisms on Calcareous Algæ.*—M. Foslie criticises severely and in detail F. Heydrich's paper on *Sphærantheru lichenoides*.† For instance he strongly disputes Heydrich's assumption that *Millepora calcarea* Ellis and Soland. is a form of *Lithophyllum incrustans*, and questions whether the type figured is a coral at all. Again he repeats his already published opinion that *Sphæranthera* is not a valid genus, but a compound of *Lithothamnion Philippii* and *Goniolithon mamillosum*. And he adds that *Lithothamnion lichenoides* placed by Heydrich in *Sphæranthera* is actually the type of *Lithothamnion* as now understood by algologists. Further he cites two series of synonyms referred by Heydrich respectively to *Lithothamnion Patena* and *Lithophyllum incrustans*, and shows that such a grouping of species is not warranted by facts.

Algæ of Swedish West Coast.‡—H. Kylin gives a list of 47 marine algæ collected on the west coast of Sweden, partly by himself, partly by the late F. R. Kjellman. They are mostly epiphytic on other algæ or on zoophytes, or are endophytic species. Notes on their fruiting season are added.

Algæ of Germany.§—E. Lemmermann, in continuing the monograph of the algæ in the Kryptogamenflora der Mark Brandenburg, treats of Class II., the Flagellatæ. These are divided into seven orders —Pantostomatineæ, Protomastigineæ, Distomatineæ, Chrysomonadineæ, Cryptomonadineæ, Chloromonadineæ, Englenineæ. Each of these is treated in turn, descriptions of the respective orders, families, genera, and species being supplied; and reference is facilitated by the use of keys and by the figures grouped in the plates. The blood-parasite *Trypanosoma*, one tropical species of which causes sleeping-sickness, is classed under Protomastigineæ.

Algal Periodicity.‖—H. B. Brown gives an account of the periodicity of algæ in certain ponds and streams at Bloomington, Indiana, which he kept under close observation in 1906–7. The flora of each was analysed twice monthly. The Conjugatæ, especially *Spirogyra*, were the most abundant algæ. *Zygnema* ranked next. *Mougeotia* was less abundant. Six genera of Desmids were found, *Closterium* being the most plentiful. The Œdogoniales were plentiful, and the Chætophorales fairly abundant. Cladophorales and others were also found. Notes on the behaviour of the different algæ are given; and the following conclusions were reached. (1) Under steady normal conditions an alga continues to grow in a healthy vegetative state throughout the year. (2) A sudden change in external conditions checks the vegetative growth and tends to

* Beih. Bot. Centralbl., 2te Abt., xxiii. (1908) pp. 266–72.
† Op. cit., 2te Abt., xxii. (1907) p. 222.
‡ Arkiv f. Botanik, vii., No. 10 (1908) 10 pp. (fig.).
§ Leipzig: Borntraeger, 1908, iii. heft 3, pp. 305–496 (pls.).
‖ Bull. Torrey Bot Club, xxxv. (1908) pp. 223–48.

cause the alga to enter a resting stage form or to fruit sexually. Tables are given in which the relative abundance and frequency of the commoner algæ are shown; and a complete list of the algæ found is appended.

KAMMERER, P. — **Symbiose zwischen Œdogonium undulatum und Wasserjungferlarven.** (Symbiosis between *Œdogonium undulatum* and the larvæ of a dragon-fly.) *Wiesner-Festschrift.* Wien: K. Konegen, 1908, pp. 239–52.

KARSTEN, G.—**Die Entwicklung der Zygoten von Spirogyra jugalis Ktzg.** (The development of the zygotes of *Spirogyra jugalis.*)
[A detailed and illustrated account of the changes in the spore-cell and nucleus.] *Flora,* xcix. (1908) pp. 1–11 (1 pl.)

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Zygospores of Sporodinia grandis.*—A. Lendner has submitted these to careful examination throughout their development. He finds that one of the protogametes penetrates the other, suggesting a sexual difference. The protogametes possess at first numerous nuclei; later there appear two large nuclei with always two chromosomes; these fuse to form the zygospore; the remaining smaller nuclei divide and line the outer wall; finally they disappear.

Microsiphoneæ.†—Paul Vuillemin explains the meaning of this term, as distinct from Siphomycetes. The name has been given to an uncertain group with fine filaments branched and non-septate, such as *Actinomyces*, etc., but the classification is only provisory. The Siphomycetes represent another somewhat temporary resting place for uncertain forms such as *Cunninghamiella.*

Study of Saprolegniaceæ.‡—C. H. Kauffman collected his material from rivers, ponds, etc., containing aquatic plants, algæ, or merely decaying vegetable matter. He explains his method of cultivating the fungi in the laboratory and of securing pure cultures on beef-gelatin, and then transferring them to capsules of pea-broth and to solutions containing salts and other substances. He noted the effect of the different media on growth and reproduction, the development of the sexual organs, etc. His results corresponded with those of Klebs, that hæmoglobin and leucin were most favourable in inducing the production of sexual organs. He describes in detail all the variations in growth observed by him; these were very extensive and somewhat affect the standards of classification within the genus. His results also seem to provide evidence towards the doctrine that sex in plants is determinable by external conditions.

Norwegian Mucorineæ.§—O. Hagem has isolated from the air a number of *Mucor* species. He exposed Petri dishes with a variety of sterilised substances in and around Christiania, and found that species

* Bull. Herb. Boiss., ser. 2, viii. (1908) pp. 77–8. See also Bot. Centralbl., cvii. (1908) pp. 648.
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1042–3.
‡ Ann. of Bot., xxii. (1908) pp. 361–87 (1 pl.).
§ Vid. Selsk. Skr., i. Math.-Nat. Kl., No. 7, 1907 (1908) 50 pp. (22 figs.).

of *Mucor* were of rare occurrence in comparison with other filamentous fungi: *Penicillium*, *Aspergillus*, and *Cladosporium* being the commonest. The author also tested different soils for species that might be growing there, and he found that *M. hiemalis* was the most abundant: other species grew in special localities, as, for instance, *M. Ramannianus*, which occurred in pine woods. A number of new species were discovered and described in the course of the work.

Sexuality in the Ascomycetes.* — A. Guilliermond continues his review of the work recently done on this subject. He takes up first the yeasts, touching on the question of the nucleus, the existence of which he considers well established. He describes conjugation as it is found in *Zygosaccharomyces* and others, and these conjugations he considers settle the question of the origin of the yeasts, which are autonomous, and not derived from other forms. *Exoascus* is next considered: nuclear fusion has been demonstrated in the ascogenous cells while still under the cuticle of the host.

The most important work has been done on the higher Ascomycetes on *Laboulbenia* by Thaxter, and on *Pyronema* by Harper. Sexual conjugation has been observed by them and subsequent workers. Guilliermond follows each research, and records the points in which the results vary or agree. The original figures in many cases are reproduced, and add to the interest and value of the papers.

Taphrina Alni-incanæ.†—This fungus infests the catkins of *Alnus incana*, and C. von Tubeuf finds that it also attacks the young shoots. He found the deformations on the young branches; the asci were entirely similar to those of the fungus on the catkins, and were without a stalk-cell; the leaves also showed the red coloration which they never do when attacked by *T. epiphylla*. The author further notes that the swellings on the leaves of poplars due to *T. aurea* are occasionally developed on the under surface of the leaves.

Haustoria of Meliola and Asterina.‡—René Maire has attacked the vexed question as to the parasitism of these fungus-genera. The allied *Capnodium* grows on the excreta of aphides, but no trace of animal substratum was to be found in their case. Careful preparation of microscopic sections showed distinct haustoria penetrating the host-plant, and so providing nourishment for the parasite. These sucking-organs are very constant and very simple in *Meliola*, but in *Asterina* they vary from one species to another in their form and in the degree of penetration into the host-plant, in some species only the epidermal cells being reached, in others the hypodermal layer.

Notes on Ascomycetous Fungi.—F. Theissen § discusses Spegazzini's monotypic genus *Diatrypeopsis*, which he has found frequently in Brazil. From his observations he concludes that the fungus is identical with

* Rev. Gen. Bot., xx. (1908) pp. 85–9, 111–20, 178–82, 298–305.
† Nat. Zeit. Land.-Forstw., vi. (1908) pp. 68–73. See also Bot. Centralbl., cvii. (1908) pp. 520–1.
‡ Ann. Mycol., vi. (1908) pp. 124–8 (4 figs.).
§ Tom. cit., pp. 91–4.

Nummularia punctulata, and that the genus *Diatrypeopsis* is redundant. The one feature—the colourless spores—that placed it near to *Diatrype* is not a constant character: they have a greenish tinge, becoming brownish-grey on their escape from the ascus.

J. M. Reade,* working at Cornell University, has followed the development of a number of Sclerotiniæ, and he gives full diagnoses. In all cases where followed out the conidial stage is a form of *Monilia*, which in some cases was the only form known before these researches. The sclerotia were formed in mummified fruits, and in some cases on the twigs and leaves of the host-plant.

Spotting of Bamboos.†—S. Kawamura gives an account of the different kinds of bamboos that are to be found in Japan, some of which are distinguished by dark rings and spots on the stems. This he finds is due to a fungus, *Myostria fusispora* g. et sp. n. The central part of the dark spots is occupied by a cushion-like mycelium in which is imbedded a pyriform perithecium with fusiform colourless spores. Inoculation experiments were unsuccessful, and Kawamura concluded that the fungus could only attack injured areas of the stems.

Yeast as a Fermentative Agent.‡—F. G. Kohl has published an exhaustive treatise on these unicellular fungi that are used to produce fermentation. He discusses their physiological properties, and in the chapter on fermentation he cites the cases in which filamentous fungi, such as *Mucor*, *Penicillium*, etc., have also been employed, these fungi forming yeast torulations in the absence of air. An account is given of alcoholic fermentations and of the by-products formed. A new series of observations includes a description of the methods employed in yeast culture, spore formation, the morphological characters of the plants, and a systematic revision of the various organisms. The book is well illustrated, and is supplied with a good index.

Notes on Glœosporium.§—J. Lind has examined and described a species growing on the leaves of ferns that had been variously classified as *G. filicinum* Rostr. or as *Exobasidium Brevieri* Boud. From his own observations he has placed it in a new genus of Protobasidiomycetes that he has designated *Herpobasidium*. The fungus develops in the interior of the leaf, the mycelium spreading in the intercellular spaces, and also forming coils in the cells of the host. At the stomata it passes into the open and forms a white superficial felt from which arise upright basidia clavate and uniseptate, each cell bearing a sterigma and basidiospore. The fertile hypha branches lower down, and the branches also act as basidia. Lind has also examined *Glœosporium deformans* on willow catkins, and finds that it is a composite form comprehending four distinct species.

Research on Fungi Imperfecti.‖—H. Klebahn continues his studies in this field, and records his new results. *Asteroma Padi* on leaves of

* Ann. Mycol., vi. (1908) pp. 109–15.
† Journ. Coll. Sci. Imp. Univ. Tokyo, xxiii. (1907) pp. 1–11 (5 pls.).
‡ Leipzig: Quelle and Meyer (1908) viii. and 343 pp. pp. (8 pls. and 59 figs.).
§ Arkiv Botanik, vii. (1908) No. 8, 23 pp. (3 pls.).
‖ Zeitschr. Pflanzenkr., xviii. (1908) pp. 129–54 (2 pls.).

Prunus Padus was examined and cultivated, and is fully described. An ascus form was found on the wintering leaves, which was used for experimental cultures and inoculation experiments, reproducing the *Asteroma* on the *Prunus* leaves. The ascus form was found to be a *Gnomonia* with elongate 1-septate spores, and identical with *Sphæria padicola*. The different synonyms of the two related forms are given.

Similar cultures were successfully carried through with *Gnomoniella tubiformis* on alder leaves, of which the "imperfect" form was proved to be *Leptothyrium alneum*. Detailed accounts of cultures are given, and the synonyms, which are many, are added. He has found in *Gnomonia*, so far, that for four different species the imperfect forms are to be sought in four different genera of Sphæropsideæ.

Hyphomycetes.*—Lindau concludes the study of the brown-spored forms with the Phæostaurosporæ, a family containing a few genera with conidia of peculiar form. He begins the third family, that of the Stilbaceæ, which includes those with compound fructification, the conidiophores being massed together to form a definite fruiting body. Under the first section of the family, Hyalosporæ, he describes the genera *Cilicipodium*, *Stilbella*, and *Dendrostilbella*.

Uredineæ.†—E. Fischer passes in review the development of the Uredine through its different life-stages. He notes the disappearance of different stages (uredo or æcidium) in certain forms, and attempts to explain the factors that have caused the shortening of the life-history. He finds that these fall into two classes: (1) indirect, through selection —in Alpine localities those that formed teleutospores early in the autumn had a better chance of survival, and in time there persisted those forms with teleutospores only; (2) direct influence of climate, which caused the uredo stage to be omitted when sudden lowering of temperature took place.

Merulius lacrymans.‡—C. Mez has issued a treatise on the dry-rot of houses. He has examined the different species of fungi that are wood-destroyers, and gives descriptions of them. Special attention is devoted to *Merulius*, which is really a forest fungus which has been transported into human dwellings, and he considers that *M. silvester* is only a wild form of *M. domesticus*. Instructions are given as to the best method of destroying or preventing the "rot."

Möller § has also published a communication on this important subject. He describes specimens that he found growing in the open, but concludes that they belonged to the species *M. silvester*, which he considers autonomous. He made a series of experiments on the germination of the spores, and found that spores of the "dry-rot" of houses germinated quite normally after seventeen months.

* Rabenhorst's Kryptogamen Flora, i. 9te Abt., Lief. 109 (Leipzig, 1908) pp. 241–304.

† Mitth. Nat. Ges. Bern (1907) 21 pp. See also Centralbl. Bakt., xx. (1908) pp. 532–4.

‡ Dresden: R. Lincke (1908) 260 pp. (1 pl. and 90 figs.). See also Hedwigia, xlvii. (1908) Beibl. pp. 176–7.

§ Hausschwammforschungen, 1907, heft 1. See also Centralbl. Bakt., xx. (1908) p. 537.

Notes on Lycoperdon sculptum.* — W. A. Setchell describes this large puff-ball from the Sierra Nevada Mountains of California. He accounts for the different times it has been collected high up among the mountains, usually on alluvial soil beside streams, but also in drier localities among pines. It is characterised by well-marked sculpturings on the outer wall; the spores are minute, the capillitium threads short and unbranched. From the mode of dehiscence—the breaking up of the peridium into plates—it has been referred by some authors to *Calvatia*.

Revision of Ceylon Fungi.†—This task has been undertaken by T. Petch, who points out the inevitableness of mistakes when diagnoses or determinations are made on dried specimens alone. A study of fresh material on the spot results in the reduction of a number of species already described, though new forms must be added as so many have been overlooked by passing collectors. Redescriptions of species add to the value of the work.

Effect of Formic Acid on Fungi.‡—This study was taken up by Henri Coupin to discover if possible why the fungi of ants' nests never produced the fruiting forms. He found that *Rhizopus nigricans*, grown in atmospheres impregnated with formic acid of varying densities, was influenced by the acid chiefly in the reproductive organs, which may disappear altogether while the mycelium continues to grow.

Biology of Wood-destroying Fungi.§—C. Rumbold has cultivated on artificial media a large number of the higher fungi that grow normally on wood. Her aim was to find out how far Hartig's statement was correct that only in dry-rot do the clamp-cells (Schnallenzellen) grow out, and also to test the comparative influence of acid on alkaline media, on the growth of mycelium, and on germination of spores. Rumbold proved that clamp-cells grow out whenever present; that no wood-fungus grew on alkaline media, but if the alkali was so weak as to be neutralised by the action of the fungus itself, a slow development of the mycelium was possible. Dry-rot was the most susceptible to alkalis.

Phosphorescent Fungi.‖—Hans Mollisch, writing on this subject, insists upon two points: 1. It is impossible to decide whether a fungus is phosphorescent unless pure cultures of the mycelium have been made, culture methods being given. 2. No conclusion can be drawn from finding the fructification of a fungus on phosphorescent wood as to its identity with the cause of the phosphorescence. He finds that a number of forms have been erroneously considered as phosphorescent, such as *Xylaria Hypoxylon*, *X. Cookei*, *Trametes Pini*, *Polyporus sulfureus*, *Collybia cirrhata*, etc.

* Bull. Torrey Bot. Club, xxxv. (1908) pp. 291–5 (1 pl.).
† Ann. Roy. Bot. Gard. Peradenya, Ceylon, iv. (1907) pp. 21–68.
‡ Comptes Rendus, cxlviii. (1908) pp. 80–1.
§ Nat. Zeit. Land.-Forstw., vi. (1908) pp. 81–141 (1 pl. and 14 figs.). See also Bot. Centralbl., cvii. (1908) pp. 518–19.
‖ Wiesner Festschrift. Wien: Carl Konegen, 1908, pp. 19–23. See also Hedwigia, xlvii. (1908) Beibl. p. 170.

Colour-variation in Fungi.*—F. J. Seaver is preparing a monograph of North American Hypocreales, and records some of his observations on the colour of different members of the group. He finds that the well-known *Nectria cinnabarina* from cinnabar-red colour becomes, with age, dark-brown, and finally almost black. In each colour-stage specimens have been described as new species: *N. Russellii*, *N. offuscata*, *N. nigrescens*, *N. Meliæ*. The writer finds similar confusion existing in species of *Hypocrea*; fuller details are promised with the issue of the complete monograph.

Local Records of Fungi.†—C. Crossland gives a list of forty-seven species that were collected on a natural history expedition to Robin Hood's Bay, in the autumn of last year. Among the interesting species noted was a little black mould *Clasterosporium fungorum*, that grows on species of *Corticium*.

A similar account ‡ is given of the fungi of Littondale, in Yorkshire. Most of the forms collected belonged to the microfungi, many of them coprophilous.

T. Gibbs § reports on the fungi of Ribblesdale; some eighty species were collected, but the weather conditions were found unfavourable, a period of dry weather having followed on a cold wet summer, and checked the growth of the mycelium.

The same author ‖ describes a new *Coprinus* (*C. cordisporus*), which he found on dung of horse, sheep, rabbit, etc., in various parts of Yorkshire and Derbyshire. The spores are described as obtusely heart-shaped, and compressed, front view cordate.

W. Fowler ¶ records the appearance of *Hydnum auriscalpium* at Welbeck Abbey, where it was first collected in Britain by the Duchess of Portland, and not since recorded for Yorkshire. John Lightfoot identified it for the Duchess 140 years ago.

C. Crossland ** describes a new species, *Humaria globose-pulvinata*, found near Hebden Bridge, on sediment in disused dye-tank; and, along with this species, gives a list of plants new to Yorkshire, and discovered by him and others since the publication of the "Fungus-Flora" in 1905.

Chemistry of the Higher Fungi.††—J. Zellner has summed up all that is known of the chemical constituents of the higher fungi, as also some of the microscopic forms. He takes the different substances, and states where they occur, and their properties, so far as these have been ascertained. Carbonates, fats, minerals, acids, colouring agents, enzymes, toxins, etc., are all included in his survey.

Parasitic Fungi.‡‡—Ducomet has studied the development of a number of subcuticular fungi. In some of these, *Cycloconium*, *Cuticularia Stigmatea*, and *Fusicladium Pruni*, the vegetative mycelium is

* Bull. Torrey Bot. Club, xxxv. (1908) pp. 307–14.
† Naturalist, 1907, pp. 288–9.
‡ Tom. cit., pp. 350–3.
§ Tom. cit., pp. 395–6.
‖ Op. cit., 1908, p. 100.
¶ Tom. cit., p. 157.
** Tom. cit., pp. 214–18.
†† Chemie der höheren Pilze. Leipzig: W. Engelmann (1907), 257 pp.
‡‡ Thèse Sc. Paris: Rennes (1907) 208 pp. (34 pls.). See also Bot. Centralbl. cvii. (1908) pp. 368–9.

constantly found just beneath the cuticle; in other forms it goes deeper into the tissue, as in *Guignardia*, *Fusarium*, *Venturia*, and *Marsonia*. In *Mycetoderma* the tissues are only invaded when the leaves are dead; *Fusicladium pyrinum* and *F. dendriticum* are subcuticular in the leaf, but penetrate more deeply in fruit or branch. Many other points of interest are entered on in the memoir: action of the fungus on the host, form of the thallus, etc. Some new species have been discovered, and are described.

Blue Disease of Pine-wood.* — The blue colour is stated by E. Münch to be due to a light-effect on finely divided mycelium, and not to any colour produced. The disease is caused by a species of a Pyrenomycete, *Ceratostomella*, a composite species which includes several, distinguished from each other more particularly by their conidial form—in some being a species of *Cladosporium*, in others a *Graphium* or *Chalara Ungeri*. The author also describes a species of *Cladosporium* on pine-wood which induced a blue coloration, but he did not find any higher fruiting form connected with it.

In a further paper † the author discusses the biological conditions that affect the growth of the parasite. It does not grow except in the presence of a certain amount of air, and increases rapidly when the air is also increased by disappearance of the sap, etc.

Diseases of Plants.—E. S. Salmon ‡ describes the nature and extent of the disease of apple-leaves and fruit caused by a fungus, *Fusicladium dendriticum*, and known as "apple scab" or "black spot," which first becomes noticeable by the damage it causes to the young fruit. On the leaves, the fungus is usually to be found on the upper surface, where it forms black patches. It also occurs on the young wood of the tree, producing a blistered appearance. The disease can be checked and controlled by systematic spraying with Bordeaux mixture, the first application of which should be on the young unfolding leaves, just before the blossoms open. If the wood has been attacked, it should be cut out as much as possible, and the tree sprayed during the winter.

Several cases of fungus disease are reported in the same § journal: Anemones from Penryn were attacked by rust, peaches from Ilminster were injured by leaf-curl, *Exoascus deformans*, and the roots of young peas from Chertsey were attacked by *Thielavia basicola*, a fungus which spreads very quickly under favourable weather conditions. Remedies are suggested for these diseases.

Kirchner ‖ has conducted a series of experiments by artificial inoculation of wheat with *Tilletia Tritici*—drawing a parallel between the germinating force and the liability to infection. In summer wheat, the greater the force the less danger there is of the disease; but this does not hold good for the common winter wheat, as the results there prove exactly the opposite.

* Nat. Zeitschr. Land.-Forstw., v. (1907) pp. 531–73. See also Bot. Centralbl., cvii. (1908) pp. 275–6.

† Op. cit., vi. (1908) pp. 32–47. See also Bot. Centralbl., cvii. (1908) p. 515.

‡ Journ. Board Agric., xv. (1908) pp. 182–95 (9 figs.).

§ Tom. cit. p. 203.

‖ Fühling's Landw. Zeit., 1908, p. 161. See also Ann. Mycol., vi. (1908) pp. 168–9.

Kock and Kornauth * give their experiences in combating the mildew of Cucurbitaceæ. Different genera within the order show considerable variation in their liability to disease, probably due to the type of leaves. Bordeaux mixture was found to be the best fungicide. Heavy rains and high variation of temperature favoured the appearance and dissemination of the disease.

W. M. Scott and J. B. Rorer † describe the apple-leaf spot caused by *Sphæropsis malorum*. A number of other microfungi grow on the diseased leaves, notably *Coniothyrium pirinum*. Spraying with Bordeaux mixture has been found of service.

L. C. Shear ‡ has given the results of a series of investigations on Cranberry diseases caused by different fungi, and resulting in scald on the berry, blast which attacks the flower, rot caused by *Acanthorhyncus Vaccinii*, and anthracnose due to *Glomerella rufomaculans-vaccinii*. In addition, cases of hypertrophy caused by *Exobasidium* are discussed.

J. L. Spaulding § describes the effect of *Phyllosticta solitaria* on apple, causing fruit-blotch disease, and occurring on branches, leaves, and fruit. A blight disease of young conifers was found by the same author to be due to a species of *Pestalozzia*, and a heart-rot of Sassafras to *Fomes Ribis*. He describes the manner in which the fungus attacks the tree and develops in the tissues.

F. L. Stevens ‖ describes two apple fungi: *Hypochnus ochraleuca*, which occurs extensively on apples and quinces in North Carolina, and a form of *Phoma*, or *Phyllosticta*, which causes a canker of the apple, and has proved very destructive to the trees.

G. F. Atkinson and C. W. Edgerton ¶ publish a preliminary note on a new disease of the cultivated vetch, causing spots on the pods. They propose a new generic and specific name, *Protocoronospora nigricans*.

E. H. Smith ** finds that a *Fusarium*, probably *F. Solani*, causes the blossom end-rot of tomatoes. A detailed description of the fungus is given; the paper is well illustrated.

A disease of chestnut trees was discovered in 1905 in Bronx Park, New York, and described by W. A. Murrill †† as due to *Diaporthe parasitica*. The parasite has attacked other species of *Castanea*, and the disease has spread largely in the neighbourhood.

P. Cruchet ‡‡ describes new parasites on *Polygonum alpinum*,

* Zeitschr. Landw. Versuch. Oesterr., 1908, p. 128. See also Ann. Mycol., vi. (1908) p. 169.

† U.S. Dept. Agric. Bull., No 121, part 5 (1908) pp. 47–54 (2 pls.). See also Ann. Mycol., vi. (1908) pp. 169–70.

‡ Bull. Bur. Pl. Ind., No. 110 (1907). See also Bot. Centralbl., cvii. (1908) pp. 147–8.

§ Science, xxvi. (1908) pp. 183, 220, 479. See also Bot. Centralbl., cvii. (1908) pp. 148–9.

‖ Op. cit., xxvi. (1907) p. 724. See also Bot. Centralbl., cvii. (1908) p. 313.

¶ Tom. cit., p. 386. See also Bot. Centralbl., cvii. (1908) p. 357.

** Mass. Agric. Exp. Stat. Techn., Bull. No. 3 (1907) 6 drawings and photos. See also Bot. Centralbl., cvii. (1908) p. 357.

†† Journ. New York Bot. Gard., ix. (1908) pp. 23–30. See also Bot. Centralbl., cvii. (1908) p. 594.

‡‡ Bull. Herb. Boiss., ser. 2, viii. (1908) pp. 245–7. See also Bot. Centralbl., cviii. (1908) p. 94.

Puccinia Polygoni-alpini, and *Sphacelotheca alpina*. The latter destroys the flower ; a second species was detected on the leaves of the same host.

Study of Anthracnoses.*—C. W. Edgerton limits this term to the fungi that at one stage form a *Glœosporium*. In many cases the perfect fruit form is known, but not in all. The author includes *Colletotrichum* as a synonym of *Glœosporium* : the difference between the two he does not consider of generic importance. He describes the development of *Glœosporium* and then its different forms as it appears when associated with different ascogenous fungi. He takes first the *Gnomonia* type, and gives an account of *G. veneta* with the pycnidial stage *Glœosporium nervisequum*, which is parasitic on sycamore and oak. The *Pseudopeziza* type was first worked out by Klebahn, and his work is referred to. Most of the work was done by Edgerton on the *Glomerella* type : the perfect stage, one of the Pyrenomycetes, was found to be extremely variable both from the same and from different hosts. It is doubtful if they represent different species or only forms—thus two forms were found on the apple : one from the north, the other from the south, that from the south alone producing perithecia. In artificial cultures very considerable variety was also produced, but the author deprecates the use of these characters in the determination of species as being generally too variable. A full bibliography of the subject is given.

BAMBEKE, CH. VAN—**Le recueil de figures coloriées de champignons delaissé par Fr. Van Sterbeck.**
[An account of the 32 coloured plates of fungi left by Sterbeck.]
Bull. Soc. Roy. Bot. Belgique, xliv. (1907) pp. 297–338 (3 pls.).

BUBAK, FR., & J. E. KABAT—**Mykologische Beiträge. V.** (Mycological contributions.)
[Descriptions of a number of new species of microfungi from Bohemia.]
Hedwigia, xlvii. (1908) pp. 354–64 (8 figs.).

CRUCHET, DENIS—**Contribution à la Flore mycologique suisse.** (Contribution to the Swiss mycological flora.)
[A list of Phycomycetes and Ustilagineæ parasitic on various phanerogams.]
Bull. Soc. Vaud. Sci. Nat., xliv. (1908) pp. 27–33.

DIETEL, P—**Einige neue Uredineen aus Sudamerika. II.** (Some new Uredines from South America.)
[Species from various collectors in Brazil and Chili.]
Ann. Mycol., vi. (1908) pp. 94–8.

FERDINANDSEN, C., & O. WINGE—**Mycological Notes.**
[Notes on various misunderstood forms, with diagnoses of several new species.]
Bot. Tidssk., xxviii. (1907) pp. 249–56.
See also *Bot. Centralbl.*, cvii. (1908) pp. 245–6.

,, ,, ,, **Svampe vegetationen paa Borris Hede.** (The vegetation of fungi on the heath at Borris.)
[An examination of the habitat of the different fungi.]
Bot. Tidssk., xxviii. (1907) pp. 257–64.
See also *Bot. Centralbl.*, cviii. (1908) p. 95.

* Bot. Gazette, xlv. (1908) pp. 367–408 (1 pl. and 17 figs.).

HENNINGS, P.—**Fungi philippinenses. I.**
[Many new species are described.]
Hedwigia, xlvii. (1908) pp. 250–65.

„ „ **Fungi bahienses.**
[Most of the species are new. The collection was made by E. Ule.
Tom. cit., pp. 266–70.

LENDNER, A.—**Cinq espèces nouvelles du genre Mucor.** (Five new species of the genus *Mucor*.)
[Several of these were developed in artificial cultures. One was growing on a rust from Brazil, the others from Switzerland.]
Bull. Herb. Boiss., ser. 2, viii. (1908) pp. 78–9.
See also *Bot. Centralbl.*, cvii. (1908) p. 648.

LIND, J.—**Bemerkungen über einige parasitische Pilze aus Ruzland.** (Remarks on some parasitic fungi from Russia.)
[List of an unpublished set of 50 microfungi by U. C. Sredinsky, and of some other parasites also found in St. Petersburg herbarium.]
Ann. Mycol., vi. (1908) pp. 99–104.

MAIRE, RENÉ—**Champignons de Sao Paulo.** (Fungi of San Paulo, Brazil.)
[Diagnoses of a number of new species and of rare forms.]
Tom. cit., pp. 145–53 (1 pl., 7 figs.).

MATTIROLO, O.—**Relazione intorno alla Memoria. . . Richerche intorno ad alcune specie del genere Elaphomyces.**
[Report on a paper on the systematic position of *Elaphomyces*, presented by Elfisia Fontana.]
Atti Accad. Sci. Torino, xliii. (1908) pp. 97–8).

REHM—**Ascomycetes Exs. Fasc. 41.**
[Notes and diagnoses of species, several of them new, Nos. 1751–75; with a series of notes on species already published.]
Ann. Mycol., vi. (1908) pp. 116–24.

RICK—**Fungi Austro-Americani, Fasc. ix. and x.**
[Notes on a number of species, some of them new to science.]
Tom. cit., pp. 105–8.

SARTORY, A., & A. JOURDE—**Le Sterigmatocystis fusca.**
[An account of some morphological and biological characters of this fungus and of its pathogenic properties.]
C.R. Soc. Biol. Paris, lxiv. (1908) pp. 926–8.

„ „ „ **Note sur le pouvoir pathogène des Sterigmatocystis nigra et S. carbonaria.** (Note on the pathogenic power of *Sterigmatocystis nigra* and *S. carbonaria*.)
Tom. cit., pp. 1135–6.

SYDOW, H. & P.—**Ueber eine Anzahl aus der Gattung Uromyces Auszuschlieszender, resp. unrichtig beschriebener Arten.** (Some species of *Uromyces* that should be omitted, or that are imperfectly described.)
Ann. Mycol., vi. (1908) pp. 135–43.

TRILLAT & SAUTON—**Etude sur le rôle des levures dans l'aldéhydification de l'alcool.** (On the part played by yeasts in converting alcohol into aldehyde.)
Comptes Rendus, cxlvii. (1908) pp. 77–80.

VOGLINO, PIETRO—**De quibusdam fungis novis pedemontanis.** (Some new fungi from Piedmont.)
[Diagnoses of new species of microfungi.)
Atti Accad. Sci. Torino, xliii. (1908) pp. 246–51.

Lichens.

(By A. Lorrain Smith, F.L.S.)

French Lichens.* — J. Harmand has issued the third part of his systematic and descriptive catalogue of French lichens, which includes the Cladoniæ and filamentous genera, such as *Usnea*, *Alectoria*, *Ramalina*, *Roccella*, *Anaptychia*, etc. Harmand does not follow the new classification, which places *Cladonia* near to *Lecidea*, and *Roccella* among the Graphideæ ; he follows the older method of classification, according to the form of the thallus. Distribution of the species in French territory is given, and keys are supplied for each genus.

Lichens from the Island of Samoa.†—The collection was made by K. Rechinger, and the species determined by A. Zahlbruckner. It has been found that the lichen flora resembles that of New Caledonia. There are many forms with *Chroolepus* gonidia, especially on twigs and branches in mangrove swamps. Crustaceous forms were generally plentiful, but there were few representatives of *Pertusaria*, *Parmelia*, and *Usnea*. There were only two species of *Cladonia*, and none of *Stereocaulon*. A few new species are described, and one new genus, *Pseudolecanactis*.

Lichen Notes. V.‡—These notes by G. K. Merrill deal with the genus *Ramalina*. He compares Tuckerman's with Nylander's arrangement, and proceeds to give a short review of the different species. He finds a leading mark of differentiation in the spores, which in *R. fastigiata* and *R. fraxinea* are curved, while in *R. calicaris* and *R. farinacea* they are straight. The forms of *R. calicaris* are so many and so varied that a constant character such as the form of the spores is of great importance.

Lichens Chemically Considered.§ — W. Zopf has devoted much attention to the chemical constituents of lichens, and he here sums up the results of his researches. He reckons some 143 different substances, most of them of an acid character, and all of them crystallisable. He describes his methods of obtaining the acids from the plants ; none of them have been found in any other plant or animal. He gives a list of the reagents that may be employed in determining the presence of the acids, which are also useful from a systematic point of view, though the surroundings, humidity, etc., may influence the quantity and quality of the acid. He does not consider them in the light of protective substances for the lichens, as in many cases they are eaten by animals even when they contain very bitter substances. Zopf also discusses the economic properties and uses of the acids, and finally divides them into their chemical groups.

* Lichens de France. Paris: Paul Klincksieck, part ii. (1907) pp. 211–478 (3 pls.).

† Math.-Nat. Kl. k. Akad. Wiss. Wien, lxxxi. (1907) 66 pp. (1 pl.). See also Hedwigia, xlvii. (1908) Beibl., pp. 172–3.

‡ Bryologist, xi. (1908) pp. 48–53.

§ Jena: G. Fischer (1907) xi. and 49 pp. (71 figs.). See also Bot. Centralbl., cvii. (1908) pp. 196–201.

Chemical Constituents of Lichens.—P. Rave * re-examines the work on *Evernia furfuracea* by Zopf, who had decided that this lichen was the representative of a new genus, *Pseudevernia*, and who had split it into six species. Elenkin questioned the correctness of Zopf's theories. Rave has taken up the question, and upholds Zopf's views; he finds morphological as well as chemical differences between the different species.

Emmanuel Senft † writes on the occurrence of physcion and parietin in lichens. They are insoluble in water, but can be easily extracted with alcohol, chloroform, etc., and they crystallise in characteristic forms. Coloured tables are given showing the forms of the crystals.

BRITZELMAYR, MAX.—**Die Cladonien des Harzgebietes und Nordthüringens nach dem "Herbarium Oszwald."** (The *Cladoniæ* of the Harz and North Thuringia according to Oszwald's Herbarium.)
[A collection of about 300 specimens of *Cladoniæ*.]
Beih. Bot. Centralbl., xxiii. (1908) pp 318–23 (7 pls.).

ELENKIN, A.—**Lichenes floræ Russicæ Mediæ, Fasc. ii., Nos. 51-100.**
[A varied selection of lichens from Central Russia.]
St. Petersbourg, 1907. See also *Bot. Centralbl.*, cvii. (1908) p. 492.

HASSE, H. E.—**Lichens collected in the Tehachepi Mountains, California, June 1907.**
[A considerable list of plants is given, with instructive notes on some of the species.] *Bryologist*, xi. (1908) pp. 55–7.

HOWE, HEBER REGINALD—**Lichens of the Mount Monadnock Region, N.H., No. 2.**
[Several forms of *Thelochistes* are discussed and compared.]
Tom. cit., p. 74.

TOBLER, F.—**Kritische Bemerkungen über Rhaphiospora, Arthroraphis Mycobacidia.**
[Critical notes on various lichens.]
Hedwigia, xlvii. (1908) pp. 140–4 (2 figs.)

ZAHLBRUCHNER, A.—**Neue Flechten.** (New lichens.)
[Diagnoses of species from Patagonia, California, Chili, Herzegovina, and Steiermark.]
Ann. Mycol., vi. (1908) pp. 129–34.

,, ,, **New North American Lichens.**
[New species described from Arizona; all of them collected from basaltic rocks.]
Bull. Torrey Bot. Club, xxxv. (1908) pp. 297–300.

Mycetozoa.

(By A. LORRAIN SMITH, F.L.S.)

Notes on Swiss Mycetozoa.‡—A. and G. Lister report on a series of forms collected on high ground, most frequently in the neighbourhood of melting snow. They note certain variations, due apparently to their Alpine surroundings: great variation in the size and shape of sporangia, etc., which other observers have also remarked. They publish a new variety of *Physarum virescens* with larger sporangia, more rigid

* Inaug.-Diss. von Munster, i. W. Borna. Leipzig: R. Noske (1908) 51 pp. (2 pls.). See also Hedwigia, Beibl., xlvii. (1908) p. 171.
† Wiesner Festschrift. Wien: Carl Konegen, 1908, pp. 176–92 (1 pl.). See also Hedwigia, Beibl., xlvii. (1908) p. 171.
‡ Journ. Bot., xlvi. (1908) pp. 216–19.

capillitium, and darker, rather larger, spores. *Chondrioderma niveum* was found in a position which indicated that the plasmodium stage must often be passed under the snow.

Myxomycete Studies.*—E. Jahn devotes the seventh of these papers to *Ceratiomyxa*. He describes the work done by Famintzin and Woronin on this genus, which differs from other Myxomycetes in possessing a four-nucleate spore: the amœba which issues from the spore separates into four smaller amœbæ, these dividing once again, so that eight swarmers arise from each. In the development of the fruit of *Ceratiomyxa* he distinguishes (1) the cushion stage; (2) elongation stage, when horn-like processes are formed; (3) a mesh condition, the plasma covering the "horns" with threads; (4) a "plaster" stage (round amœbæ); (5) a spore stage. From careful preparations Jahn found that in the mesh stage there is one mitotic division before spore formation which, as in other Myxomycetes, is a reduction division—previous to that there had been a fusion of nuclei in the plasmodium, the resulting nucleus containing 16 chromosomes; associated therewith were many unpaired degenerate nuclei.

JAAP, O.—**Myxomycetes exsiccati, Ser. 1, Nos. 1–20.**
[A new issue of Myxomycetes. E. Jahn has assisted in determining the specimens.] Hamburg 25, Burggarten 1a 1907.
See also *Bot. Centralbl.*, cviii. (1908) p. 274.

Schizophyta.

Schizomycetes.

Bacillus intermediate to Bacillus typhosus (Eberth) and to Bacillus paratyphosus A (Brion and Kayser).†—G. Faroy has isolated from the blood of a fatal case of continuous fever resembling typhoid, a flagellate micro-organism morphologically very like *B. typhosus*. Broth, agar, and potato cultures resembled those of *B. typhosus* or *B. paratyphosus A*; growth occurred on gelatin without causing liquefaction; there was no production of indol; growth was less vigorous under anaerobic than under aerobic conditions; milk was not coagulated, but litmus-milk showed a persistent acidification; like *B. typhosus*, but less actively than *B. paratyphosus A*, this bacillus fermented glucose, maltose, lævulose, galactose, and mannite; like *B. typhosus*, it had no action on lactose, saccharose, raffinose, arabinose, or dulcite; it fermented glycerin slightly, like *B. paratyphosus A*, which, however, acts on dulcite. On gelatin with nitroprussiate of soda a green coloration was slowly formed, an effect which appears more rapidly and to a more marked degree with *B. paratyphosus A*, and not at all with *B. typhosus*. In neutral-red broth a slight orange-red fluorescence appeared after 48 hours, an effect which appears more intense with *B. paratyphosus A*, and not at all with *B. typhosus*.

In its agglutination reaction this organism appeared to be intermediate between *B. typhosus* and *B. paratyphosus A*. The serum of

* Ber. Deutsch. Bot. Gesell., xxvi. (1908) pp. 342–52 (2 figs.).
† C.R. Soc. Biol. Paris, lxiv. (1908) p. 1093.

rabbits immunised against *B. paratyphosus A* Brion and *B. Gaertner* did not agglutinate the bacillus under consideration.

Jelly-forming Bacteria.*—M. Gonnermann describes several jelly-forming bacteria. (1) *Myxobacterium Betæ*, met with in jelly-like masses during the manufacture of sugar. It forms slender non-motile rods 2–5μ long, 0·3μ thick, two or more being often joined together; it stains by the ordinary anilin dyes, showing a granular appearance, but no distinct capsule; growth is slow at room temperature, and best at 34–37° C.: it ferments sugar only slightly, and without acid formation; at room temperature, or at 37° C. after 24 hours, it forms oval spores with cross sections wider than the bacilli, but this is preceded by the formation of threads which break up into short rods, each of which forms a spore.

(2) *Plennobacterium Gon.* appears as a transparent expansion of a fine thready slimy consistence on agar-plates exposed to the air of the room of the sugar press. Morphologically the organism resembles the hay bacillus. Individual rods are 2·5–5μ long and 0·4–0·6μ wide, and have either blunt or, more often, finely pointed ends; the threads are often much tangled; growth is slower at room temperature than the *Myxobacterium*; spores are formed at 37° C. after 24 hours.

Dicyandiamid-bacteria.†—R. Perotti finds that in nutrient liquids containing a suitable amount of glucose, and for nitrogenous material only about 1–2 p.c. of dicyanamide, there occurs a vigorous and characteristic development of micro-organisms. These belong to different bacterial forms and classes, many not yet described, some being ordinary soil organisms, but only certain of these microbes find in this medium the best conditions for development. The dicyanamide is incapable of undergoing a fermentative action.

Lactic Fermentation in Milk.‡—M. W. Beijerinck finds that from a temperature point of view there are three classes of organisms in milk, viz. cryo- (5–20), meso- (20–35), and thermo-flora (35–45). The most characteristic of the aerobic cryoflora are the different varieties of *Bacillus aromaticus*. It is possible to distinguish three forms of lactic fermentation determined by the temperature; a muciliaginous fermentation at very low temperatures; the ordinary fermentation by the *Lactococcus* at medium temperatures; and at a relatively high temperature the fermentation by the *lacto bacillus*. Cultures of the mucilaginous lactic fermentation thrive in cultivations of baker's yeast, anaerobically, at 15–18° C. in malt-extract, and in boiled milk or skimmed milk (petit lait) at 25–30° C. The acidity of the fermentation is low. Cultures of *Lactococcus lactis* are obtained by allowing milk to become sour in a closed flask at 20–25° C., and sub-culturing in boiled milk at the same temperature. The acidity is about 8 c.mm. of normal acid to 100 c.mm. of milk. Cultures of *lacto bacillus* are best obtained in butter-milk kept anaerobically at 37–40° C., and sub-cultured into boiled milk at over 30° C. The degree of acidity may reach 18–23 c.mm. of normal acid to 100 c.mm. of milk.

* Centralbl. Bakt., 2te Abt., xxi. (1908) p. 258. † Tom. cit., p. 200.
‡ Arch. Neerland. Sci. Exact. et Naturel., xiii. (1908) p. 357.

Differentiation of Streptococci by Media containing Carbohydrates.*—E. Salomon considers three groups of streptococci. (1) *S. pyogenes* produces acid from starch, but not from glycerin, mannite, or raffinose, though strains grown from blood do produce acid from glycerin and mannite; (2) *S. mucosus* produces acid from glycerin, arabinose, and mannite, but not from raffinose or starch; (3) *Pneumococcus* produces no acid on carbohydrate litmus ascitic agar.

Coli-bacillosis.†—K. Neumann finds that strains of coli bacillus causing calf dysentery, when cultivated on artificial media, do not appreciably diminish in virulence during a period of two years, nor does continuous subculture from gelatin to gelatin, or from milk to milk, heighten the virulence. Passage of the organism through guinea-pigs increases its virulence for guinea-pigs, but not for mice; passage through mice does not increase the virulence for mice, but does so for guinea-pigs.

Researches in Bacillary Dysentery.‡—A. Di Donna finds that the virulence of the Shiga-Kruse and Flexner bacilli is diminished rather than increased by passage through guinea-pigs. A nucleo-proteid can be obtained from Shiga-Kruse dysentery bacillus, which has immunising properties for rabbits. By the autolysis of bacilli by means of physiological salt solution, a nuclear substance can be obtained which is precipitated by absolute alcohol, and after drying may be kept unchanged for a long period; its immunising action is closely allied to that of the nucleo proteid. The serum of rabbits treated with the filtrate of broth cultures has protective properties against the living bacilli. The Shiga-Kruse immune serum exerts no influence on the Flexner bacillus or on *B. coli*.

Protective and Curative Artificial Immunity.§—A. P. Ohlmacher reviews the work of Wright and others on the theory of opsonins and on the treatment by vaccines, for which he proposes the name "opsonogens." The author mentions a number of diseases to which the treatment has been applied, and gives an account of his own clinical experiences in the treatment of acne, furunculosis, staphylococci, psoriasis, eczema, septic surgical affections, and gonorrhea, with very remarkable success.

Developmental Cycle of Bacteria.‖—F. Fuhrmann believes that the ordinary involution forms of bacteria are by no means always accompanied by serious injury to the bacterial protoplasm, but that the altered cells have preserved their vital energy, and under suitable conditions can reproduce individuals of the original form. The author has found that *Pseudomonas cerevisiæ*, in a mineral medium containing 1–2 p.c. of ammonium chloride and $\frac{1}{2}$ p.c. of saccharose, passes through a complete developmental series. The actively motile bacteria grow out into threads, become non-motile, and form at various points knot-like joints, in which are seen strongly refractile granules which are not of the nature of spores; in fresh medium they again give rise to short motile rods.

* Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) p. 1.
† Op. cit., xlvi. (1908) p. 674.
‡ Op. cit., p. 603.
§ Michigan Acad. Sci., Rep. ix. (1907) p. 148.
‖ Centralbl. Bakt., 2te Abt., xxi. (1908) p. 257.

Bacillus fœdans and Miscured Ham.*—E. Klein isolated from softened and putrid hams an essential anaerobe, *B. fœdans*, which is Gram-positive and non-motile. The bacterium presents itself as short or long rods (1·5–3·5 μ) and as filaments of considerable length (14 μ). It is 0·4 μ thick, may be straight or curved, the ends being mostly rounded. The microbe was cultivated under anaerobic conditions in glucose-gelatin, glucose-broth, and glucose-pork-broth, best at 20° C. After about 8 weeks the gelatin was liquefied. There was gas production with evolution of an offensive putrid smell.

Micrococcus of Osteomalacia and Rickets.†—B. Morpurgo claims to have isolated a diplococcus from the bones of white rats. It is 1·2 μ in diameter, tends to form chains, and is Gram-positive. Gelatin is slowly liquefied; milk slowly coagulated; it forms acid in broth, but does not produce indol or nitrite. On agar it grows as a grey delicate film or as small round colonies. When injected into adult animals it induces osteomalacia; into young rats, rickets.

Diphtheroid bacillus found in Cardiac Vegetations.‡—V. Babes and D. Manolesco describe a new diphtheroid organism isolated from a case of acute rheumatism. While it resembles morphologically and culturally *B. diphtheriæ* Klebs-Loeffler, it is less sensitive to the composition of cultivation media and to temperature. It is pathogenic to animals.

Bacillus subtilis in the Blood and Tissues.§—G. Ferrarini describes a case of enlargement of the spleen and lymphatic glands associated with the presence of *B. subtilis* in the glands and blood. Microscopical examination of the glands revealed fibro-epithelioid hypertrophy; in places the structure resembled a perithelioma, in others there were giant-cells, in some of which the Gram-positive bacillus could be found.

* Lancet (1908) i. pp. 1832–4 (3 figs.).
† Archiv Sci. Med. Turin, xxxi. (1907) p. 1.
‡ C.R. Soc. Biol. Paris, lxv. (1908) pp. 93–5.
§ Brit. Med. Journ. (1908) ii. epit 36. See also Siena: G. Bernardino, 1908, 146 pp., 32 figs.

MICROSCOPY.

A. Instruments, Accessories, &c.*

(1) Stands.

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

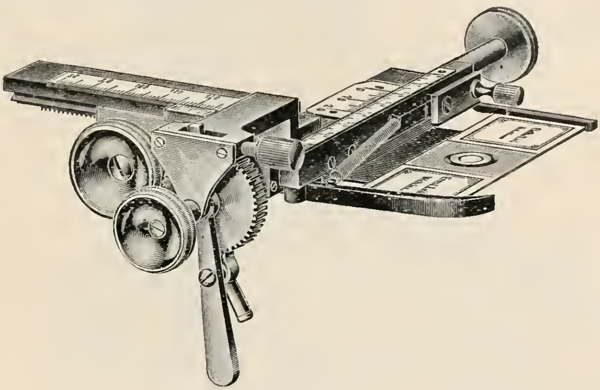


Fig. 139.

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

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

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

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

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

screen lights up under the action of the ultra-violet rays, and focusing is then possible. Focusing high-power monochromatic objectives is, however, tedious and difficult; but the authors consider that they have devised a great improvement in this respect. Instead of employing a single pair of electrode holders, they recommend a double pair (four in all) arranged so that the cadmium electrodes can be instantly swung out and replaced by a pair of magnesium electrodes by means of

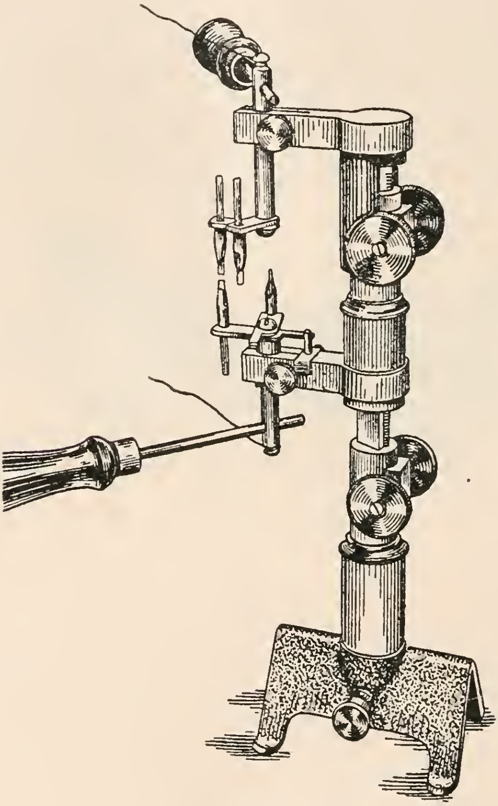


Fig. 140.

the handles shown in fig. 140. The cadmium eleotrode holders are longer than those for the magnesium, for a purpose explained later. There is an automatic stop on the lower pair of holders to insure the spark gap falling in the axis of the collimator lens. The swing-out electrode changer was suggested by the discovery that the monochromatic lenses, though giving only badly blurred and coloured images with ordinary light, did give very good images that could be focused sharply even to the finest detail providing strictly monochromatic visible light were used. The object is, therefore, first found and centred with a low-power visual lens, using the magnesium blue light. Then the high-power monochromat is used and the spot found which it is desired to photograph. The camera is then moved into place, and the objective must be adjusted for the change from magnesium to cadmium light; this adjustment must be determined by trial and noted for future use. By making the arms of the magnesium electrode holders 5·5 mm. shorter than those for the cadmium, it was found possible to bring the blue light and the ultra-violet rays to a focus at the same distance beyond the prisms and the collector lens though not in the same spot, as the ultra-violet rays are refracted much more than the blue rays in passing through the prisms. It is found very advantageous to be able to do all the exploratory and focusing work with blue light and then to apply the ultra-violet light merely for the few seconds necessary for photography. Moreover, owing to the greater precision in focusing, it will be no longer necessary for the biologist to equip himself with a whole series of expensive monochromats.

Reichert's Movable Mechanical Object-stages.*—One type of these auxiliaries is shown in fig. 141. The two adjacent rack screw-heads

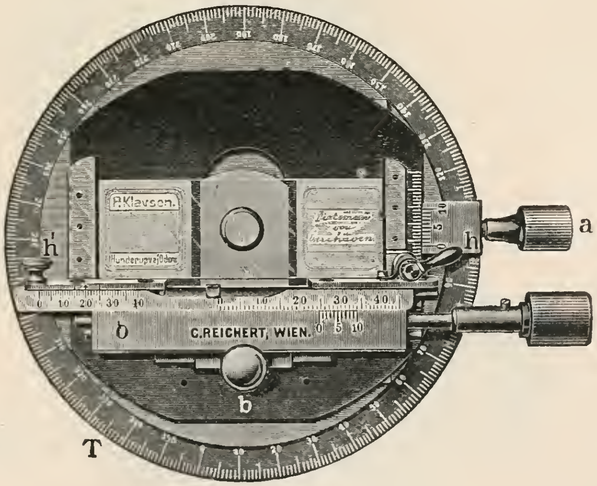


Fig. 141.

a a' act in such a way that the object can be easily and safely moved in two mutually perpendicular directions. Both co-ordinate edges are graduated and provided with verniers for convenience of orientation and for recovery of known positions. The circular periphery is radially divided. By lifting up the screw *b* the centre object-holder can be removed, so as to admit of the insertion of culture dishes. This stage is only applicable to stands A I and A Ic.

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) pp. 42–3, figs, 30, 32, 33

Another type is shown in fig. 142, and is only applicable to stands with rectangular stages. The movable stage is secured by two screws to the ordinary stage.

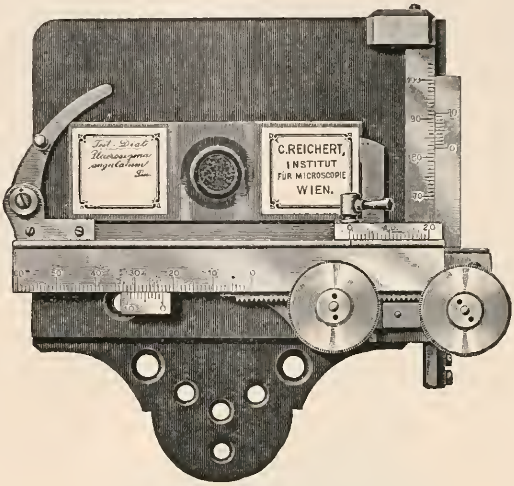


Fig. 142.

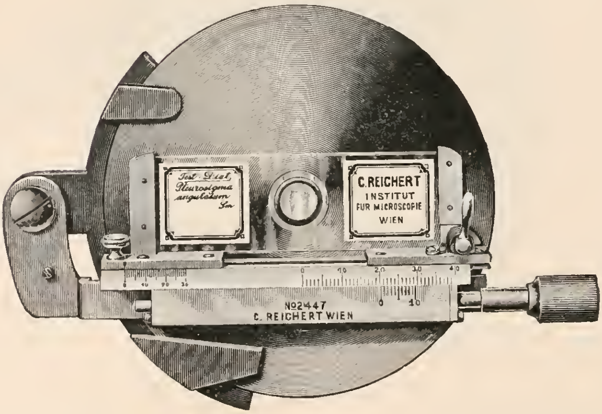


Fig. 143.

A third type is shown in fig. 143, and is only intended for stands fitted with strong circular brass stages. It will be noted that the transverse movement is mechanical, and that the vertical is by action of the jointed arm.

Reichert's New Large Stand B.*—This (fig. 144) is a little smaller than stand A ii by the same firm. It has a new horizontally-placed,

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 20, fig. 8.

and on its upper side protected, micrometer movement, with lateral action. The object-stage (110 mm. diameter) is circular and rotatory, and has centring screws. The instrument is fitted with Abbe's illuminating

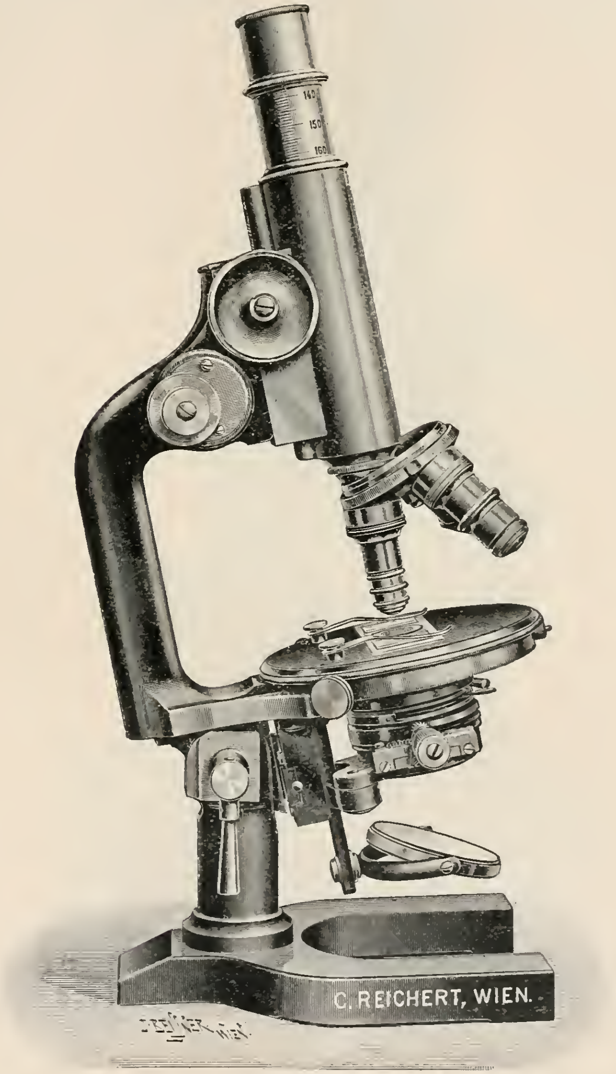


Fig. 144.

apparatus, with iris-diaphragm, and rack-and-pinion for raising and lowering the illuminating apparatus. The tilting is regulated and clamped by a lever.

Reichert's New Medium Mineralogical Stand A iii c.* — This stand (fig. 145) corresponds in general design to stand C (*vide supra*), with rotatory object-stage, divided into 360 degrees, and vernier readings to

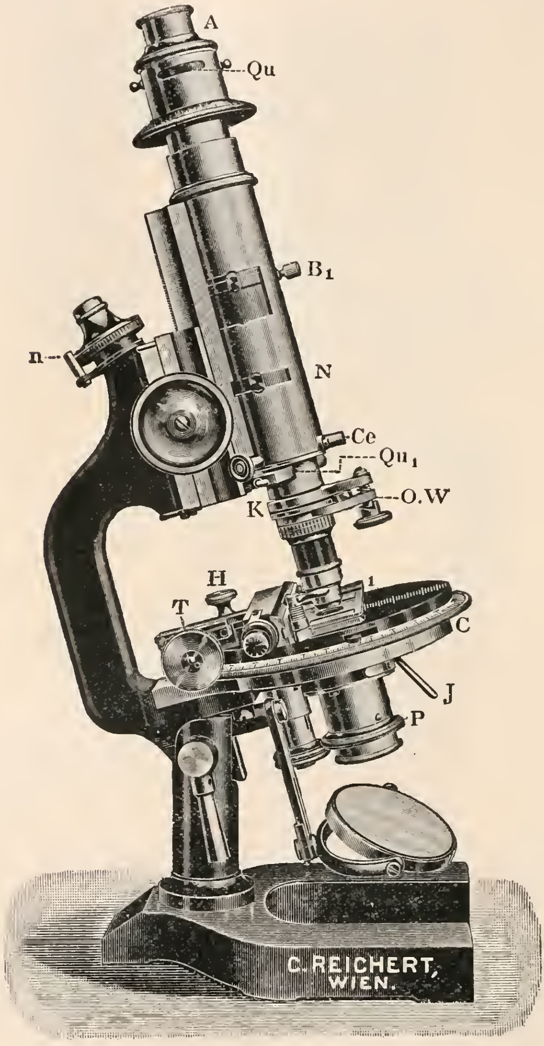


Fig. 145.

0·1°. It has cross-graduations for orientation of known preparations. The polariser is easily rotatory, and can be adjusted up and down by a screw; the four quadrants of rotation are marked by the engaging of a

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 39, fig. 26.

spring-tooth. There is an iris-diaphragm, and a removable illumination system. The analyser can be put in and taken out without interference with the adjustment of the instrument. There is a second analyser over the ocular, with a circumference divided into 360 degrees. The instrument has a quartz plate and an opening for inserting a quartz wedge. It is also equipped with Bertrand lens, Glans prisms, and an object-centring arrangement.

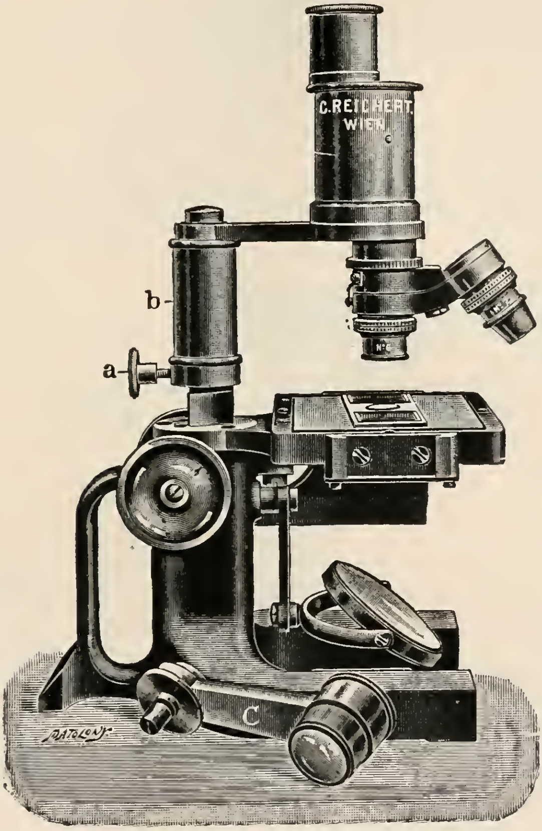


Fig. 146.

Reichert's Large Stand, A 1.*—This stand, which was figured and described in this Journal for 1905 (p. 241) is now made with a graduation on the limb, to assist in the focusing of high-power objectives and to prevent injury to slides.†

Reichert's New Preparation Microscope.‡—This Microscope, listed as No. 131, has a prism tube (fig. 146), with erecting Porro-prisms

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 16, fig. 6.

† It is interesting to note that limb-graduation was first introduced by John Marshall in 1704.—Ed.

‡ C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 47, fig. 40.

and Ramsden ocular. The tube can be applied to several patterns of preparation stands supplied by the firm.

Photomicroscope for Ultra-violet Rays and its Significance for Histological Investigations, especially of Hard Structures.* — W. Dreck fully describes his methods, which seem to have been very successful. He gives several photographic plates of diatoms and of sections of teeth and bones.

Marx, H.—**Ein handliches Obduktionsmikroskop.**
Zeit. f. Medizinalbeamte Jahrg., xx. (1907) No. 21, pp. 744–5.

(2) Eye-pieces and Objectives.

Reichert's Spectral-ocular.†—This ocular (fig. 147) is due to Abbe, and has the prisms arranged rectilinearly. By means of a spiral movement the ocular lens can be focused accurately upon the slit which can

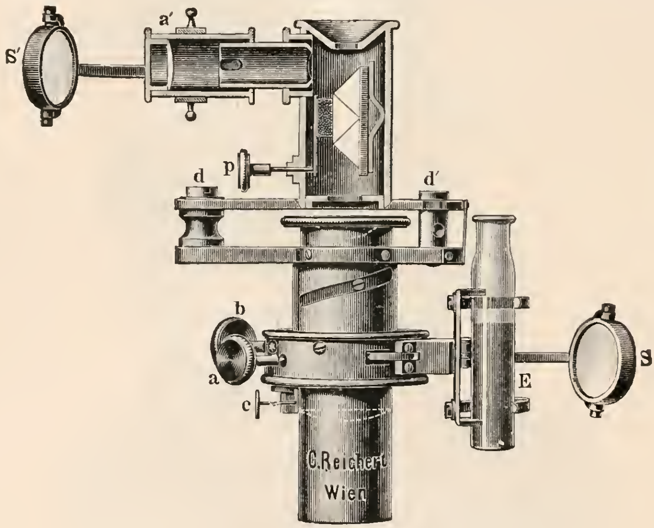


Fig. 147.

be regulated both in breadth and height. There is a comparison prism, a lateral stage, and illuminating mirror, as well as a measuring apparatus for Fraunhofer's lines.

Reichert's Index-ocular.‡ — This auxiliary, constructed after Bourguet's design, is shown in fig. 148. Its peculiarity consists in the externally adjustable index by means of which any point in the field of

* S.B. Gesell. Naturf. Freunde, 1906, No. 4 (April) pp. 108–25 (18 figs.).
† C. Reichert, Vienna, Catalogue, Mikroscope, p. 58, fig. 56.
‡ Tom. cit., p. 60, fig. 60.

view can be designated. It is especially adaptable for class-work, where the teacher wishes to demonstrate to his pupils.*

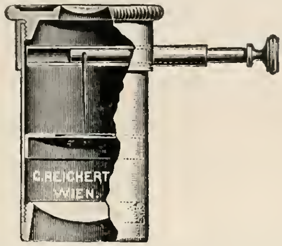


Fig. 148.

Reichert's Goniometer-ocular.†—This (No. 94 in maker's catalogue) is represented in fig. 149, and is intended for the measurement of angles of crystals.

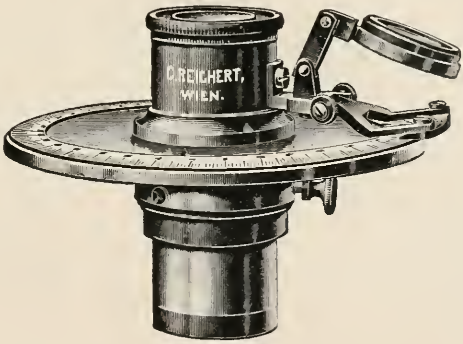


Fig. 149.

Reichert's Objective.‡—The 8 mm. objective of the Hart apochromat series has been increased in N.A. from 0·5 to 0·6. There is also a general reduction of prices. Among the achromats there is a new $\frac{1}{6}$ in. water immersion of N.A. 1·10–1·15; and among the semi-achromats a new $\frac{1}{10}$ in. homogeneous immersion of N.A. 1·3.

(3) Illuminating and other Apparatus.

New Easily Legible Micrometer Divisions.§ — Gebhardt has, with the help of the Zeiss firm, designed a micrometer with a novel style of graduation to lessen the difficulties felt in the application of the ordinary pattern to uncoloured objects, and to minimise the fatigue frequently experienced in continuous observations. The new ideas are

* It is noteworthy that this device is due to Quekett. See Quekett on the Microscope, first edition (1848) p. 130, fig. 91.—Ed.
† C. Reichert, Vienna, Catalogue, Mikroscope, p. 42.
‡ Tom. cit., pp. 11–12.
§ Zeitschr. wiss. Mikrosk., xxiv. (1908) pp. 366–9 (2 figs.).

shown in figs. 150 and 151, which represent respectively fine and coarse graduations. It will be observed that the ordinary strokes are replaced by small squares placed cornerwise. The squares may be black or red. Dr. Gebhardt speaks very favourably of his trials with these micrometers, and describes which of Zeiss' oculars he found most suitable for them.

Fig. 150.

Fig. 151.

Apparatus for Measuring Micrometer Levels.*—M. Gouy, in his investigations on the surface tensions of large drops, has found the cathetometer unsuitable for small measurements, and has contrived a micrometric method of measurement. His Microscope, provided with a thread micrometer, rests by its three feet on a polished, plain, and horizontal disk of glass. The Microscope is perfectly horizontal, and can be raised and lowered. A closely divided vertical glass scale is so arranged as to be also in the field of view. A point, A, on the micrometer can be thus identified on the scale, and the relation between A and the scale zero be obtained. This operation repeated on other points gives the differences of level desired. The author gives full practical explanations, and states that the probable error of observation is only about $0\cdot043\mu$.

Greenman, M. T.—**A New Laboratory Projection Apparatus.**
Anat. Record, No. 7, 1907.

Seibert, W. & H.—**Dunkelfeldkondensor und Dunkelfeldblende.**
Zeit. f. angew. Mikr., xiv. (1908) p. 4.

(4) Photomicrography.

Interference Fringes produced by Photographs in Colours.†—M. E. Rothé describes some observations on the above, sometimes called Talbot's False Fringes. It is well known that an interferential photograph illuminated by white light, and seen by reflection from the glass side, exhibits fringes extending over the whole spectrum, from the red to the violet. When the sensitive emulsion has been spread on a perfectly horizontal glass the fringes are arranged almost parallel to the spectral rays; but if the gelatin layer varies in thickness, the fringes are more or less inclined to the rays. These fringes can be more easily studied in proofs obtained without mercurial mirror, for the colours are

* Comptes Rendus, cxlvi. (1908) pp. 1191–3.
† Op. cit., cxlvii. (1908) pp. 43-5.

then less dazzling than those of mercurial photochromes. The author has systematically studied fringes due to deposits of silver by stationary waves. He shows that if the gelatin surface were absolutely parallel to the glass, the appearance, seen from the glass side, would be only a uniform tint due to the aggregation of strata of wave-length λ. But, practically, perfect parallelism is never obtained, and hence numerous gelatin surface planes must cut the glass plane. This fact, he shows, is sufficient to account for the effect produced.

Photography of Very Translucent Diatoms at High Magnifications.*—The President of the Quekett Club, after describing the difficulties encountered in the above research, recommends the following method. A first negative being taken on a rapid plate, say at some thousand or more diameters, is developed, preferably with hydrokinone, to obtain as much contrast as possible. If it is a good one, showing the dots or secondary markings sharply focused, it is left to dry. When examined it will be seen to show the veil which causes so much difficulty; perhaps such will be well seen around the dots, and will give them the appearance of being immersed in a bath of fog. Perhaps the print may show this defect more definitely than the negative itself. A fast plate is then placed in contact (such a one as the "Flashlight" of the Imperial Company), and the printing frame is waved once before a 16 c.p. electric lamp, or some other powerful illuminant, placed about 2 ft. away. This is developed as if it were a negative, i.e. by time. The result is a very well exposed and developed positive, and not a very thin and transparent one. The dots appear very plainly and sharply focused, but there is a decided fog over the whole picture. This is specially noticeable between the dots, and serves to muddle them up in a very disappointing way. When dry, a copy of this is made upon a slow plate, such as a process or a lantern-plate, and again developed by time. This becomes the second negative. Even a cursory glance shows at once how much brighter it is than the first taken direct from the object; but when the print or lantern-slide is taken from this the improvement becomes very apparent.

(5) Microscopical Optics and Manipulation.

Whittaker, E. T.—**The Theory of Optical Instruments.**
Cambridge: University Press, 1907, viii., 72 pp.

(6) Miscellaneous.

Influence of the Medium on Brownian Movements.†—V. Henri studied these movements by means of photomicrographs obtained kinematographically with magnifications of 600 diameters. The medium used was diluted latex, to which were added increasing quantities of hydrochloric or acetic acid, of soda, urea, and alcohol. The results obtained were that the Brownian movements are slowed by the addition of a coagulating agent before the phenomena of coagulation are apparent,

* Journ. Quekett Micr. Club, 1908, pp. 243–6.
† Comptes Rendus, May 18 and July 6, 1908.

In the presence of an alkali these movements are twice as slow, and in the presence of acid are nine times feebler than in distilled water.

Felgenträger, W.—**Eine einfaches Methode zur Bestimmung der periodischen Fehler von Mikrometerschrauten.**
Verhandl. d. Deutsch. Physik. Gesell., ix. (1907) p. 251.

Hager, H.—**Das Mikroskop und seine Anwendung.** (Zehnte, stark vermehrte Aufl. 463 figs.) Berlin: Jul. Springer (1908) 444 pp.

Jagie, N. v.—**Atlas und Grundriss der Klinischen Mikroskopie mit Berücksichtigung der Technik.** Wien: M. Perles, 1908.

Kaiser, W.—**Die Technik des modernen Mikroskopes.** (Zweite, gänzlich umgearb. Aufl., mit vielen Abbild.) Wien: M. Perles, 1908.

Kitt, Th.—**Bakterienkunde und pathologische Mikroskopie für Tierärzte und Studierende der Tiermedizin.** (Fünfte, wiederholt verbess. u. umgearb. Aufl.) Wien: M. Perles, 1908.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Colour Reaction for the Recognition of Bacillus typhosus.†—E. A. Kindbörg employs the following medium: neutral fleischwasser-agar 3 p.c. and lactose 5 p.c., heated in a water bath till completely dissolved; then add fuchsin, 5 c.cm. to 100 c.cm. of agar, and malachite-green, 4 c.cm. of a normal solution of 1 : 120, and plate out; the medium solidifies after 24 hours. A suspension of fæcal matter in salt solution or in broth is spread over the medium by means of a stout platinum loop. After 12–24 hours incubation the colonies begin to appear, and after 48 hours the decolorising reaction is well marked. The suspicious colonies are then submitted to further diagnostic tests.

Cultivating Bacillus typhosus and Bacillus coli.‡—H. Dunschmann has compared *B. coli* and *B. typhosus* with regard to the nutritive value of taurocholate and glycocholate of soda in combination with nutrose and malachite-green. The author finds that glycocholate does not increase the amount of growth of *B. typhosus*, but that taurocholate increases it considerably; on *B. coli* the influence of these two salts is intermediate to that on *B. typhosus*. Nutrose is a favourable nutriment for *B. typhosus*, but not for *B. coli*. Malachite-green exerts an antiseptic action on these two organisms.

Detection of Bacillus coli in Drinking-water.§—G. E. Gage, from a comparative study of media for detecting *B. coli*, draws the following conclusions. 1. Lactose neutral-red broth offers a good means of making

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

† Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 554.

‡ Comptes Rendus, cxlvi. (1908) p. 1175.

§ Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) pp. 280–7.

presumptive tests for *B. coli*. 2. The bile-salt broth of MacConkey and Hill also is a good medium for making rapid tests when the organism is present in appreciable numbers. 3. The Smith solution is not so successful as the foregoing for rapid diagnosis. 4. Endo's medium is of inestimable value in determining the active presence of *B. coli*. 5. Lactose litmus-agar does not react readily to the small traces of acid produced by different strains of the colon bacillus.

Pipette-holder for Opsonic Work.*—E. C. L. Miller has devised a special holder for opsonic or other small-calibred pipettes (fig. 152).

Fig. 152.

The long handle gives a firm grip on the pipette, while the screw enables one to control the column of liquid very accurately. The glass pipette can be introduced into the soft rubber stopper as readily and quickly as

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) pp. 730–1 (2 figs.). See also Parke Davis and Co., Research Lab. Reports.

into a rubber nipple. In fig. 153 is shown a section of the pipette. 1 is the rubber stopper by means of which air-tight connections are made between the glass pipette 4 and the body of the holder 5*a*; 2 is the union by which the two parts of the pipette 5*a* and 5*b* are held together with the rubber diaphragm 6 firmly clamped between them. The screw-control 3 acts as follows: by turning the screw to the right, the disk 7 is lowered and the rubber diaphragm 6 made taut. Then a slight turn of the screw 3 to the left will draw liquids into the pipette, and a corre-

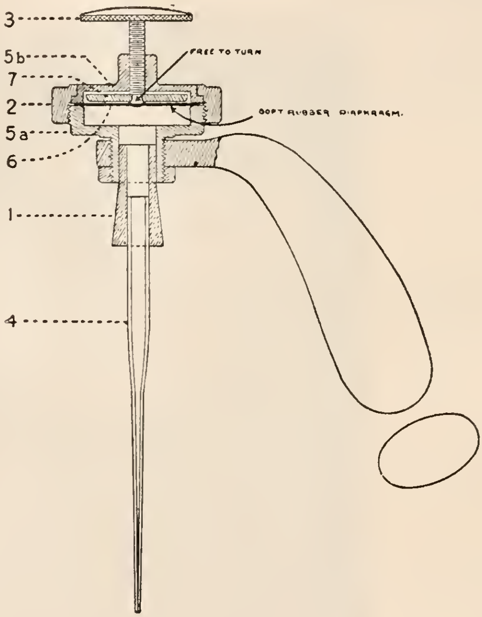


Fig. 153.

sponding turn to the right will expel them. The aluminium handle enables the fingers to obtain a firm grasp, leaving the thumb free to move the screw.

Plates for Growing Germs in Quantity.* — E. C. L. Miller uses enamelled pans 10 in. diam. and 1 in. deep. The cover consists of a round piece of wire screen of $\frac{1}{8}$-in. mesh, bound round the edge with tin. Over this wire mesh is placed a layer of cotton-wool, and over this a disk of thick paper. Under the wire screen a braid of coil cotton extends round the periphery. All these constituents are securely sewed together. These plates are sterilised by dry heat in the usual way, and afterwards melted agar poured on to form a suitable layer. Condensation-

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) pp. 731–2 (2 figs.).

water is absorbed by the cotton-wool. Inoculations are made in the usual way. By stacking these plates one on the other, considerable agar surface is secured. The covers with care may be used several times.

REIDEMEISTER, W.—**Ueber den Einfluss von Säure, usw. Zusatz auf die Festigkeit des Agars.** (Experiments showing the action of acids and other ingredients on nutrient agar.) *Zeitschr. wiss. Mikrosk.*, xxv. (1908) pp. 42–52.

RÖTHIG, P. — **Eine Verrichtung zum lebenswarmen Fixieren und lichten Transportieren der Eileitereier der Vögel.**
[Describes a box fitted with wide-mouthed stoppered bottles for supra-vital fixation and easy transport of birds' eggs.] *Tom cit.*, pp. 68–9 (2 figs.).

(2) Preparing Objects.

Studying the Eggs of Acanthodoris pilosa.*—B. Schaposchnikoff, when studying the eggs of *Acanthodoris pilosa* for the purpose of investigating the polycentric mitoses of maturation, fixed the animals during copulation. For this purpose he used sublimate-acetic acid and Gilson's fluid (sublimate-acetic acid, nitric acid, and alcohol). The fixed material was imbedded in paraffin and then sectioned. The sections were stained with iron-hæmatoxylin, either alone or after a previous staining with Bordeaux-red. Borax-carmin and Lyons-blue was also a good combination.

Demonstrating the Syncytial Appendages of Placental villi.†—W. L. H. Duckworth has found that the human placenta from the sixth or seventh month provides material for easily demonstrating the appearance of syncytial masses of protoplasm. Formalin-fixed material was treated with strong nitric acid (25 p.c.) for 3 days, and then after washing stained with Delafield's hæmatoxylin. After dehydrating and cleaning, the fragments were teased out on slides and mounted in balsam. Instead of Delafield's solution, borax-carmin (10 days) or a 10 p.c. solution of Grübler's hæmalum may be used. It was found later that the preliminary treatment with acid was unnecessary.

Examining the Nervous Elements of Osseous Fishes.‡—Anton Nemiloff used the following fixatives: chromo-acetic acid, Lenhossek's, Flemming's, Zenker's, and Hermann's fluids, trichlor-lactic acid, Carnoy-Gilson's mixture, and the silver method of Ramon-y-Cajal. The preparations were imbedded in paraffin, with bergamot-oil as clarifier, in celloidin, or more frequently in celloidin-paraffin. The stains most frequently used were safranin followed by light-green, iron-hæmatoxylin, toluidin-blue-erythrosin, Weigert's elastin staining, and some others. The observations on the fixed material were controlled by *intra-vitam* stainings with methylen-blue, the ganglia and nerves being stained *in toto* or by means of sections of fresh tissue in elder-pith.

Examining the Eggs of Ornithorhyncus.§—J. T. Wilson and J. P. Hill remark that, while it is relatively easy to manipulate the

* Anat. Anzeig., xxxii. (1908) pp. 369–85 (18 figs.).
† Proc. Camb. Phil. Soc., xiv. (1908) pp. 425–7 (7 figs.).
‡ Arch. Mikr. Anat. u. Entwickl., lxxii. (1908) pp. 1–46 (2 pls.).
§ Phil. Trans., Series B, cxcix. (1908) pp. 31–168 (17 pls.).

earliest and latest stages of the uterine egg, the treatment of the intermediate condition, represented by the cellular wall of a blastodermic vesicle with fluid contents, is difficult. In the earlier years of their research the material was fixed with picro-sulphuric or picro-nitric fluids; latterly, the authors have generally used picro-corrosive-acetic solution. They regard double imbedding in cedar-oil celloidin and paraffin as indispensable for embryological work of a critical character. The sections, after having been stuck on the slides with Mayer's albumen and thoroughly dried, were coated with a thin solution (0·5–0·75 p.c.) of celloidin to insure perfect adhesion. When the celloidin has set, the slides are placed in a mixture of 90 p.c. alcohol, to which 10 p.c. of chloroform has been added, and this chloroform-alcohol must be used whenever alcohol is required. The sections were stained as a rule with hæmatoxylin or hæmatein, and counterstained with eosin. In surface observation great advantage was derived from the use of the binocular stereoscopic Microscope. The paper is illustrated by numerous photomicrographs and some drawings.

Studying the Structure of Œdogonium.* — C. van Wisselingh fixed and hardened the material in Flemming's fluid, and afterwards macerated it in 20 p.c. chromic acid. After the chromic acid had been thoroughly washed out, the preparations were stained with brilliant blue extra.

Demonstrating the Spermatogenesis of Hornets.†—F. Meves and J. Duesberg fixed the material in Hermann's and Flemming's mixtures (1 p.c. platinum chloride or 1 p.c. chromic acid 15 c.cm., 2 p.c. osmic acid 2 c.cm., glacial acetic acid (1 c.cm.), which were diluted with an equal quantity of distilled water.

The sections were stained with iron-hæmatoxylin.

For demonstrating mitochondria some of the testicles were fixed in the following modification of Flemming's fluid (1 p.c. chromic acid 15 c.cm., 2 p.c. osmic acid 4 c.cm., glacial acetic acid 3 drops); and further treated by Benda's method thus:—1. After an hour's washing the material was placed for 24 hours in a mixture of equal parts acet. pyrolig. rectif. and 1 p.c. chromic acid. 2. For 24 hours 2 p.c. pot. bichrom. 3. After washing for 24 hours in up-graded alcohols to paraffin, material treated in this way was stained with iron-alizarin and crystal-violet, and differentiated with acid as follows:—1. The sections were placed for 24 hours in a 4 p.c. solution of iron-alum. 2. After washing with distilled water they were transferred to a solution of sulphalizarinate of soda, made by diluting 1 c.cm. of a saturated aqueous solution with 80–100 c.cm. of distilled water. 3. After washing in distilled water the slide or coverslip is placed in a crystal-violet solution; this is warmed until it vaporises, and then allowed to act for 3 to 5 minutes longer. The crystal-violet solution is a 3 p.c. alcoholic solution, which is diluted with an equal quantity of anilin water. 4. After differentiating in 30 p.c. acetic acid for 1 to 2 minutes the preparations are washed in running water for 5 to 10 minutes, in order to remove all

* Beih. Bot. Centralbl., xxiii. (1908) pp. 157–90 (4 pls.).
† Arch. Mikr. Anat. u. Entwickl., lxxi. (1908) pp. 571–87 (2 pls.).

traces of acid. 5. The sections are then mopped up with blotting-paper, and after a momentary immersion in absolute alcohol are cleared up in bergamot oil, then xylol and balsam.

Micrographic Study of Leather.*—H. Boulanger gives the following methods for demonstrating the microscopic appearances of raw and tanned hide. In the former case pieces of skin are soaked for 12 hours in a solution composed of distilled water 5, glycerin 5, aceton 90. They are then allowed to dry, imbedded in hard paraffin, stained and mounted in the usual way. In the process for preparing sections of cowhide tanned with oak-bark and carried with dégras, a small strip of leather about 10 mm. wide is taken, and the flesh side shaved away until the piece has a thickness of about 2 mm. The shaved strip is placed in melted tallow, not too hot, for about a quarter of an hour. After cooling the strip is imbedded in hard paraffin, and cut in a Ranvier microtome. The sections are degreased with xylol, then washed two or three times in alcohol and stained with Weigert's fuchsin. The staining takes about 3 hours. The Weigert solution is poured off, and a few drops of absolute alcohol remove excess of dye and differentiate the various parts. Usually the section is dehydrated with alcohol, cleared up with xylol, and mounted in balsam.

(3) Cutting, including Imbedding and Microtomes.

Arrangements for Utilising the Entire Cutting-edge of Microtome Razors.†—C. Funck refers to the troubles frequently met with in pathological sections, arising from the notching or bluntness of the microtome knife, and points out the great advantage which would arise if the whole of the cutting-edge could be used: the precious time now required for re-sharpening could then be saved. The author describes two methods of attaining his purpose, the first of which depends on *supplementary jaws*, and does not involve any alteration in the microtome itself. Suppose that in fixing the razor the handle is turned towards the operator, and that it is the further end which one wants to be able to bring into use. But if the operator draws the blade towards himself the remote end becomes free. To overcome this difficulty the author suggests that, between the extremity of the razor and the fixed jaw, an additional jaw (fig. 154, *a*) could be inserted. This additional jaw would be fixed firmly by the prolongation P, whose sectional form would be analogous to that of the razor. If the razor should be turned in the way opposite to that described, the form of jaw would be analogous and symmetrical to that shown in fig. 154, *a*. If the microtome should not be provided with this upper transversal stem T, it would be convenient and less costly to make in one piece the two jaws connected to each other by their bases, as shown in fig. 154, *b*.

Although the method gives the use of an increased amount of edge, it does not effect anything for the handle end. For this purpose the author has designed his second method, which consists in modifying the

* Bull. Soc. Encouragement, Feb. 1908. See also Nature, lxxviii. (1908) pp. 18–19 (2 figs.).

† Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 53–60 (4 figs.).

slider-support. Instead of a backward and forward motion of the knife, the author proposes a lateral movement (*vide* arrow x in figs. 155 and 156), in order to present to the object the parts of the razor

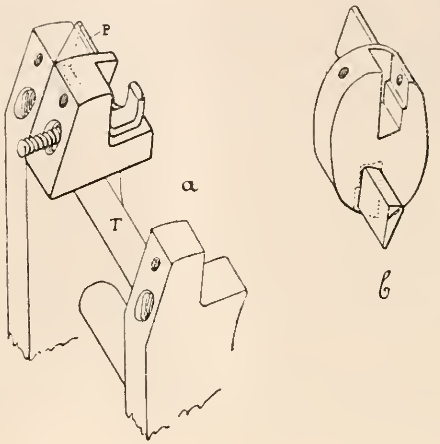


Fig. 154.

previously unused. The indispensable pieces of construction are shown in fig. 155. The rectangular plate A, with two fillets, R and R′, along its greatest sides, is pierced by a rectangular hole, whose longest axis

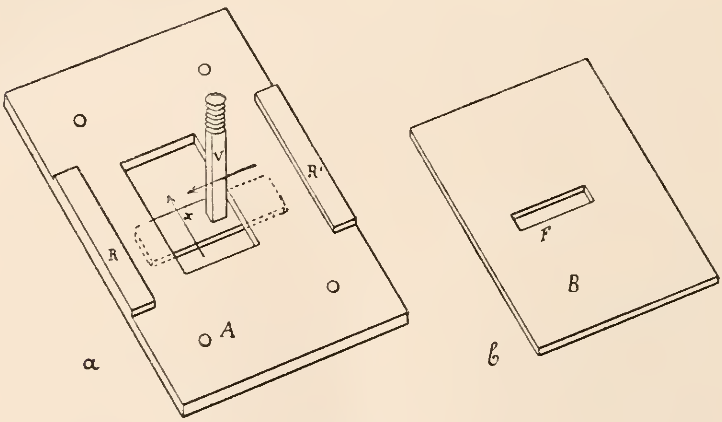


Fig. 155.

indicates the direction of the new lateral displacement, as shown by the arrow x. Through this hole passes the stem V of the raising and lowering gear, its head (as dotted) having a firm rest behind the plate

A. This screw will serve to give solid fixing to the razor support as the old type of raising gear. The support itself will be guided in its movements by the piece B (figs. 155 and 156), on which it rests, and the two little fillets *r*, *r'* will amply fix it. The plate B will be itself guided by the said lateral movement by the two fillets R R' of the plate A, between which it will be placed. An inspection of fig. 156 will show the method of operation.

The lateral displacement in regard to the object will be effected by gliding this support in the direction of the arrow towards the desired spot. The two fillets *r*, *r'* of the support will engage the plate B, which, itself engaged by the fillets R, R' of the plate A, will thus have

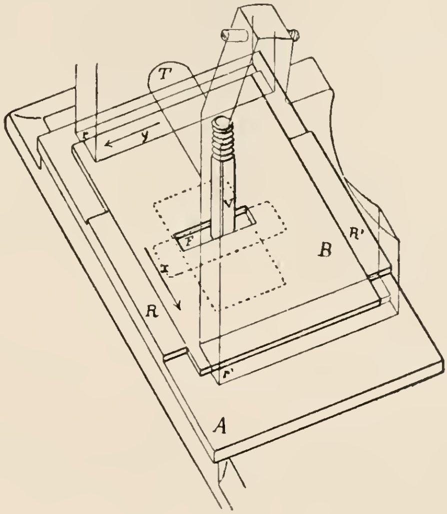


FIG. 156.

a direction strictly parallel to the axis of A. The screw of the raising gear V, retained and engaged by the transverse bar T of the support as well as by the hole F of the plate B, will perform all the movements communicated to it by the two pieces. The rectangular hole in A is of such dimensions that it does not interfere with the stem of the screw in this displacement. The older form of movement is not, however, obviated, for when B has arrived at the end of its course the usual antero-posterior displacement of the support will ensue, and can be used if desired. The author has had the Minot microtome more particularly in view, but with some modifications his design could be adapted to other types of instruments.

Celloidin Imbedding.*—L. Neumayer has obtained excellent results by carrying out the various stages of the impregnation in exsiccators

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 38–41.

which must be air-tight and contain some substance like copper sulphate or calcium carbide, for absorbing any moisture. After the imbedding is over, the pieces are covered with very thick celloidin, left exposed to air under a bell-jar for 15–20 minutes, then for 30 minutes to the vapour of 70–80 p.c. alcohol, and finally hardened in 70–80 p.c. alcohol. The author claims that by this method quite large pieces may be prepared.

Preparing Celloidin Sections.*—W. Dantschakoff discusses Rubaschkin's method of preparing celloidin serial sections,† and points out certain defects of the method. One is that instead of the 90 and 70 p.c. alcohol used for dissolving out the oily clarifying mixture, 96 p.c. and absolute alcohols should be employed. When the anilin-oil-of-clove mixture is dropped on there is a great tendency for the section to wrinkle and pucker, and this inconvenience may be lessened by using a mixture of 2 parts of oil-of-clove, and 1 part anilin-oil, instead of equal parts. Rubaschkin smoothed down the section with the brush, but the author finds that it is more efficacious and expeditious to do this with blotting-paper. The albumen-glycerin mixture should be wiped on with a clean rag instead of being smeared on with the finger. On removing the cleared-up sections from the absolute alcohol, they may be placed in ether-alcohol until the celloidin is dissolved, after which down-graded alcohols from absolute to water. They are then stained in the usual way.

(4) Staining and Injecting.

New Method of Staining Spores and Metachromatic Granules: a Substitute for Gram's Method.‡—L. Trincas stains spores as follows:—maceration for some minutes in 5 p.c. chromic acid; heat in carbol-fuchsin, wash, decolorise with 10 p.c. hypochlorite of lime, wash freely, pass through 40 p.c. formalin (a few seconds), wash freely, stain with 1–30 chrysoidin solution. The spores are red-brown, bacilli yellow, and the vacuoles lemon-yellow. For demonstrating the metachromatic granules, the author stains for 1 minute in the following solution:—toluidin blue 0·25, alcohol 5, acetic acid (2 p.c.) 100. The preparations are transferred without washing to 1 p.c. vesuvin solution for 1 minute. The granules are blue-black, the other parts of the cells pale green.

New Cold Injection Method.§—H. J. Hamburger has improved on Grosser's injection fluid ‖ by substituting horse or ox blood-serum for egg-albumen, and using a fluid preparation of indian ink, commercially known as Perltusche. Three volumes of serum are mixed with two of the ink. The material is fixed in sublimate-formalin, and after staining with alum-cochineal, paraffin-sections made. The results are stated to be excellent.

* Zeitschr. wiss. Mikrosk., xxv. (1901) pp. 32-7.
† See this Journal (1907) p. 633.
‡ Soc. Sci. Med. e Natur. di Cagliari, 1907. See also Centralbl. Bakt., 1te Abt Ref., xli. (1908) p. 316.
§ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 1–3.
‖ See this Journal (1900) p. 732.

Bielschowsky's Method for Demonstrating Connective-tissue Fibres.*—A. Zimmermann fixed the material in formalin and afterwards in alcohol. Paraffin sections were made and then the imbedding matrix removed with xylol. The sections were then placed for 48 hours in 2 p.c. silver-nitrate, and then, after a wash in water, in the ammonia-silver solution, prepared by adding 40 p.c. caustic soda solution to 10 p.c. solution of silver-nitrate until no more precipitate falls. The precipitate is then dissolved in as little ammonia as possible, filtered and diluted four times with distilled water. In this solution, which must always be freshly prepared, the sections remain for ½-hour. On removal they are washed rapidly in water and placed in the reducing fluid, 5 p.c. formalin, for ½-hour. On removal the sections are washed and then immersed in a 1 per 1000 gold-chloride solution to fix the silver. After another wash in water the sections are placed in 5 p.c. sodium-hyposulphite in order to remove any unreduced silver. After this they are washed in running water for 6–12 hours, then dehydration in upgraded alcohols, xylol, balsam. The foregoing procedure, which is very successful for locating connective-tissue elements, differs only in detail from Bielschowsky's original method.†

Demonstrating the Presence of Tannin.‡—L. E. Cavazza recommends chloride of vanadium for demonstrating the presence of tannin in vegetable sections. It imparts a dark indigo hue, due to the formation of tannate of vanadium. Vanadium chloride is preferable to iron-chloride in that the reaction occurs more readily and with greater intensity. The greater part of the author's paper is purely chemical.

(6) Miscellaneous.

Examining Seminal Stains.§—F. N. Windsor soaks a small piece of cloth with the suspected stain in Müller's fluid for 24 hours, preferably at 37° C. On removal the piece is well washed in water and then picked up by forceps, is drained on blotting paper, after which it is laid flat on a slide. Next both surfaces are scraped with a scalpel or another slide. The piece is then picked up and squeezed between thumb and finger, the exuded fluid being allowed to fall on the slide already used. The film is then dried and fixed with heat or saturated sublimate, after which it is stained in 1 p.c. aqueous solution of eosin for 3 minutes. After washing in water, the film is dried and mounted. This method is specially suitable for old dried stains or those subjected to a tropical climate.

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 8–13.
† See this Journal, 1906, p. 735; and 1907, p. 498.
‡ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 13–20.
§ Brit. Med. Journ. (1908) ii. p. 501.

Metallography, etc.

Formulæ of Metallic Compounds.*—Much of the formerly accepted information regarding the composition of compounds of metals with each other has been derived from the chemical analysis of insoluble residues. W. Guertler points out that the application of the methods of physical chemistry has proved this information to be to a large extent erroneous. While, however, the method of thermal analysis has so largely superseded the older methods, abnormal behaviour of some elements renders conclusions uncertain in some cases; in these instances chemical methods may be profitably employed. The author discusses the discrepancies between the formulæ of silicides of copper as given by Philips and by Rudolfi—the method of residue analysis being used by the former, while the latter employed thermal methods. E. Rudolfi † continues the discussion.

Selective Colouring.‡—R. Böhler remarks on the advance in metallographic methods resulting from the introduction of Lumière colour-photomicrography. A section of an 83-p.c. ferro-wolfram, when etched with 2 p.c. hydrochloric acid in alcohol for 30 minutes, showed two constituents. Further etching with a dilute solution of potassium ferrocyanide in water brought out the duplex character of one of these substances, colouring one of the two constituents of which it was made up a deep blue.

Cobalt-sulphur Alloys.§—K. Friedrich has studied the equilibrium diagram from 0–35 p.c. sulphur. A eutectic line occurs at 879° C. The constitution of the compounds is uncertain: Co_3S_2, Co_4S_3, Co_6S_5, CoS, are suggested. Iodine in potassium iodide solution and concentrated nitric acid were used for etching.

Antimonides of Iron and Cadmium.‖—N. S. Kurnakow and N. S. Konstantinow give the equilibrium diagrams of the systems antimony-iron and antimony-cadmium. In the former system the compounds $FeSb_2$ and Fe_3Sb_2 occur, and two eutectics. The limit of solid solubility of antimony in iron is about 5 p.c.; this is confirmed by microscopic examination. In the range 0–70 p.c. cadmium of the antimony-cadmium system, stable equilibrium is obtained by inoculating the melt with crystals of CdSb. If the molten alloys are allowed to cool undisturbed, without inoculation, a labile state is established. The diagram corresponding to labile equilibrium differs from the stable diagram in that both the eutectic and "dystectic" (maximum) temperatures are lower. The compounds are CdSb and Cd_3Sb_2. Some heating curves were taken. The crystal angles of the compounds of both systems were measured. Characteristic photomicrographs are given.

Copper-tin Alloys.¶—O. Sackur and H. Pick have investigated the action of solutions of lead chloride and other metallic salts upon

* Metallurgie, v. (1908) pp. 184–6.
† Tom. cit., pp. 257–9.
‡ Tom. cit., pp. 201–2 (2 figs.).
§ Tom. cit., pp. 212–15 (14 figs.).
‖ Zeitschr. Anorg. Chem., lviii. (1908) pp. 1–22 (18 figs.).
¶ Tom. cit., pp. 46–58.

powdered copper-tin alloys, with the object of measuring the chemical affinities existing between the two metals. The alloys containing 0–56 p.c. copper precipitate lead from lead chloride solution in the same way as pure tin does: they therefore contain free tin. By similar reasoning from their other experimental results, the authors deduce the existence of two compounds, Cu_3Sn and Cu_5Sn_2, or Cu_2Sn.

Tellurides of Arsenic and Bismuth.* — In the tellurium-arsenic system H. Pélabon finds minima at 329° C. and 355° C., maxima at 362° C. (As_2Te_3) and 358° C. In the tellurium-bismuth system there are two eutectic points, 410° C. (15 p.c. bismuth) and 263° C. (1 p.c. tellurium). A maximum at 583° C. indicates the compound Bi_2Te_3. The author calculates the cryoscopic constant of tellurium from the lowering of its melting point by solution in it of As_2Te_3, Bi_2Te_3, and other tellurides, arriving at the mean value 520.

Occluded Gases in Special Nickel Steel.†—G. Belloc has determined the composition of the gases evolved from a steel containing 45 p.c. nickel, 0·15 p.c. carbon, at different temperatures.‡ The occluded gases were CO_2 (all given off below 520° C.), CO (increasing to 75 p.c.), N (all evolved above 520° C., and only found in small amount), and H. When the steel was in the form of wire, the total volume of gases was 10 times that of the steel, while with drillings from the ingot the volume was 3½ times the volume of the steel. The greater part of the gas was evolved while the iron was in the γ state and the nickel in the β state.

Factors of Safety in Marine Engineering.§—J. O. Arnold points out that, although in structural steel the ratio of maximum stress to elastic limit is approximately 2 to 1 in the majority of cases, yet in an important number of instances the ratio differs very widely from this. Over-annealed steel has a very low elastic limit, and the factor of safety calculated from the maximum stress of such steel would be dangerously low. Over-annealing (excessively slow cooling from a high temperature) causes the formation of pearlite in which the lamellar structure is highly developed, and the partial separation of pearlite into massive cementite and ferrite. The author explains the formation of decarbonised "ghosts," on the theory that dissolved phosphide of iron expels carbon from a segregated spot. The author's alternating stress test is described, and though its theoretical defects are admitted, it is recommended in preference to Wöhler or similar tests in which the elastic limit is not exceeded, for the detection of brittle material. The possible danger in using steels of high elastic limit is indicated.

Planimetric Analysis of Alloys.‖—A. K. Huntington and C. H. Desch describe the method of determining the proportions of the component metals by microscopic examination of alloys. A constituent

* Comptes Rendus, cxlvi. (1908) pp. 1397–1400.
† Op. cit., cxlvii. (1908) pp. 244–5.
‡ See this Journal, 1908, p. 124
§ Engineering, lxxxv. (1908) pp. 565–6, 598–601 (16 figs.).
‖ Tom. cit., p. 589.

may be of fixed composition (a pure metal, a definite compound, or a eutectic mixture), or its composition may vary within a certain range (a homogeneous solid solution). If the alloy is in a known condition of equilibrium, reached by slow cooling or by quenching from a given temperature, and the composition of the constituents is known, the proportions of the metals present may be determined by measurement of the areas of the constituents. It is often necessary to enlarge photomicrographs or to project them on to drawing or tracing paper. A planimeter is used to measure the area of any particular constituent, or if the pattern is complicated the drawing may be divided into squares of 1 cm., and the proportion of one constituent, which may be shaded in the drawing to distinguish it, estimated in each square. By the planimetric method the composition of Muntz metal might be determined with remarkable accuracy in half an hour; this includes all operations, from grinding to planimetric measurement. The method failed to yield satisfactory values for copper-phosphorus alloys, the explanation being the segregation of copper from the eutectic. The correction to be applied was calculated, and the method then gave reliable results.

New Fatigue Test for Iron and Steel.* — T. E. Stanton has devised a test which gives a combination of rolling abrasion and alternate bending. A hollow ring of rectangular section, cut from the steel to be tested, is placed between three hardened steel rollers. The upper roller is loaded with a weight and rotated, thus imparting rotation to the test-piece and the two lower rollers. The outer surface of the test-ring is thus subject to rolling abrasion, and every radial section of the ring is subject to alternate bending stresses which go through a complete cycle three times in one revolution. A number of steel rails were tested in this manner, at 800 reversals per minute. In the course of the test the outer surface of the ring is worn down and spread over the edges. In time small cracks appear parallel to the axis, and failure takes place through the development of one of these cracks. The number of reversals endured varied from 25,000 to 370,000.

Metallurgical and Chemical Laboratories in the National Physical Laboratory.†—W. Rosenhain, in the course of this paper, describes the metallographical outfit. The following details may be noted. A Zeiss stereoscopic binocular Microscope is used for examination of fractures. Two small rooms are provided for preparation of metal sections, one is devoted to grinding (for which two carborundum wheels are used), and emery rubbing, while the other is reserved for the last stages of polishing and etching. A horizontal disk 9 in. diameter, covered with cloth, is used for polishing. For etching steel sections picric acid in alcohol and nitric acid in amyl-alcohol are employed. The author describes his method of heating and quenching metal specimens without contact with air: the metal is heated in an evacuated tube of fused silica, through which a heavy stream of water may be directed when the specimen is at the desired temperature.

* Journ. Iron and Steel Inst., lxxvi. (1908) pp. 54–70 (9 figs.)
† Tom. cit., pp. 87–108 (9 figs.).

Application of Colour-photography to Metallography.* — E. F. Law draws attention to the unsatisfactory character of ordinary photographs of metal sections in which the constituents have been distinguished by differential colouring. Coloured sections are obtained by heat-tinting, by allowing the polished surface to tarnish by exposure to the atmosphere, or by heating the specimen in air containing iodine, bromine, or sulphuretted hydrogen. Photomicrographs of such sections in their natural colours are given by the Lumière process. A colour-photograph can be taken, developed, dried, and bound as a lantern-slide in less than one hour.

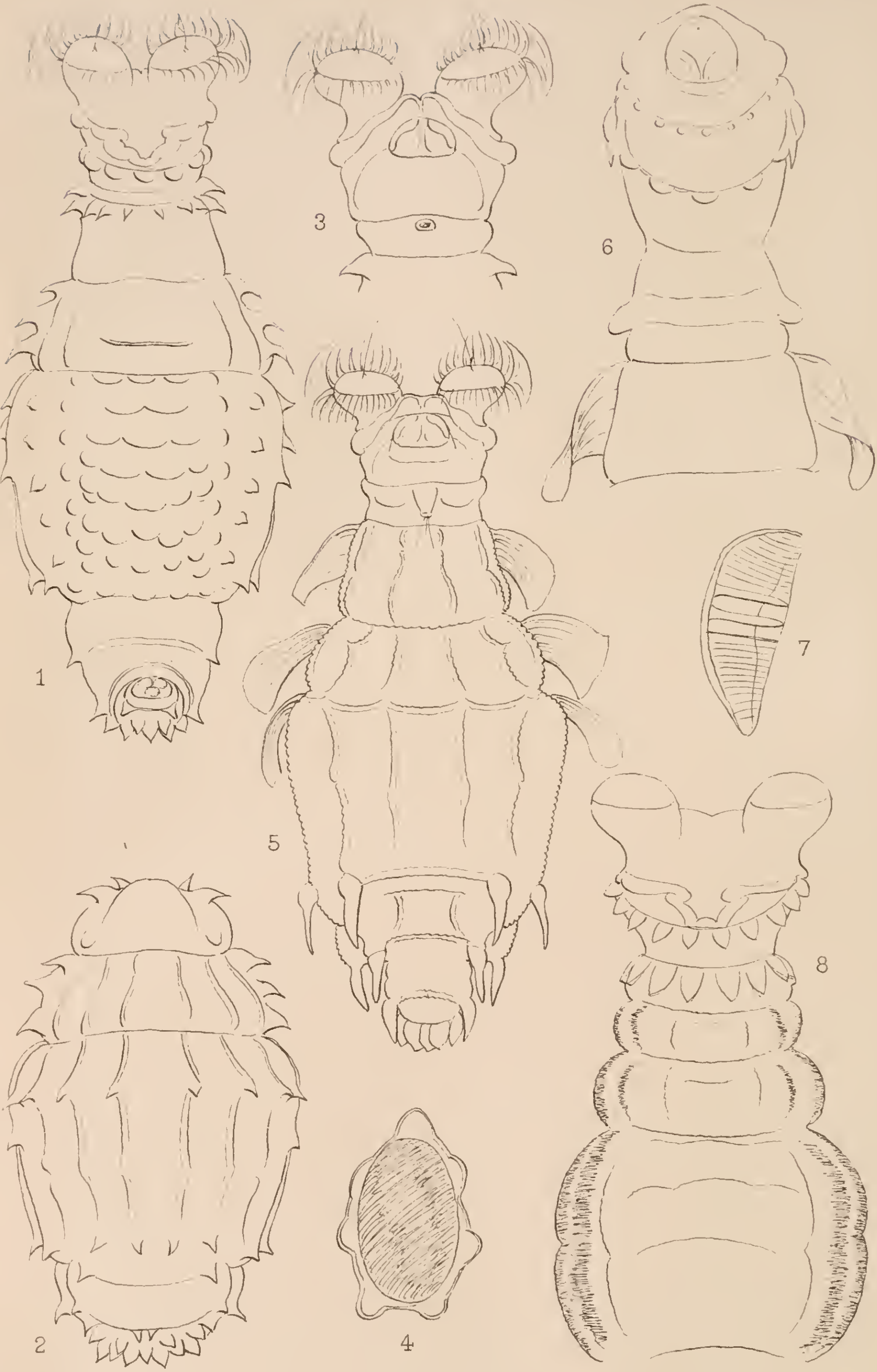
Microscopic Features of Hardened Supersaturated Steels.†—E. Hess heated three bars of crucible steel containing 1·01, 1·41, and 1·77 p.c. carbon respectively, in such a way that one end was white-hot while the other end was below the critical temperature. The bars were then quenched, and sections cut from each at points 1 in. apart. The difference of structure between edge and centre leads the author to doubt whether the real condition at high temperatures is preserved by sudden cooling. Howe's theory that supersaturated steels at temperatures above the critical range consist of austenite is held to be confirmed. The austenite undergoes partial decomposition when the steel is quenched.

Iron, Carbon, and Sulphur.‡—D. M. Levy has made a very complete investigation of the effect of sulphur on iron-carbon alloys. A number of alloys were prepared by melting pure cast iron with sulphide of iron, cooling curves were taken, and physical and chemical properties and microstructure were studied. In cast-iron free from silicon and manganese the saturation limit is about 0·8 p.c. sulphur ; it exists as FeS (melting point above 1180° C.). A certain excess of FeS may be mechanically retained. Sulphur lowers the melting-point of cast iron. At about 1130° C. the sulphide separates from a solidifying alloy, as a constituent of a triple austenite-cementite-sulphide eutectic. In sulphur-free cast iron the cementite segregates into large masses which decompose at high temperatures, giving rise to graphite : grey iron is thus produced. When iron sulphide is present it forms layers and films in the eutectic. These appear to prevent the coalescence of the cementite, which is a necessary preliminary to its decomposition. Thus the iron is retained in the white form. No evidence of any chemical union of the sulphide with the carbon or carbide was obtained. The influence of sulphur in retaining the carbon in the combined state appears to be purely physical or mechanical.

Constitution of Iron and Phosphorus Compounds.§—B. Saklatwalla has made a thermal and microscopical investigation of the iron-phosphorus system. Pure electrolytic iron was used. Much difficulty was experienced in preparing a high phosphorus alloy free from im-

* Journ. Iron and Steel Inst., lxxvi. (1908) pp. 151–4.
† Op. cit., lxxvii. (1908) pp. 1–4 (30 figs.).
‡ Tom. cit., pp. 33–91 (31 figs.).
§ Tom. cit., pp. 92–103 (10 figs.).

purities: it was finally made by melting pure iron with phosphorus in an atmosphere of nitrogen, in a carbon resistance furnace. A tantalum-wire resistance furnace was also used. Up to 1·7 p.c., phosphorus forms a solid solution with iron. This solid solution forms a eutectic with Fe_3P, melting-point a little over 1000° C., and about 10·2 p.c. phosphorus. Fe_3P forms a eutectic with Fe_2P, 16·2 p.c. phosphorus, melting-point 960° C. Another eutectic appears to exist, and melts about 1218° C. The micro-sections were heat-tinted.



J. Murray del. ad nat.

West, Newman photo-lith.

African Rotifers

JOURNAL

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ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1908.

TRANSACTIONS OF THE SOCIETY.

XVII.—*Some African Rotifers.*

BY JAMES MURRAY.

(*Read December* 18, 1907.)

PLATE XV.

THROUGH the kindness of friends I have recently had the opportunity of studying the Bdelloid Rotifers of various parts of Africa.

Mr. W. Milne, of Uitenhage, Cape Colony, sent me moss from several localities in Cape Colony. This moss was primarily examined for Tardigrada, but it was noted that the fauna of Bdelloida was abundant and peculiar, including many undescribed species. As Mr. Milne was already far advanced in a study of the Bdelloids of Cape Colony, my notes and sketches were put at his disposal.

About the same time, Mr. N. D. F. Pearce, of Cambridge—to whom I am already deeply indebted for opportunities to study the microfauna of many lands—sent moss, or moss-like plants, from Old Calabar, Uganda, and Madagascar.

EXPLANATION OF PLATE XV.

Fig. 1.—*Callidina multispinosa* var. *brevispinosa* var. n. Ventral view, feeding.
,, 2.— Ditto. Dorsal view, contracted.
,, 3.—Ditto. Dorsal view of head.
,, 4.—Ditto. Egg, seen in body of parent.
,, 5.—*C. pinniger* sp. n. Dorsal view, feeding.
,, 6.—Ditto. Head, showing two necklets.
,, 7.—Ditto. Jaw.
,, 8.—*Rotifer longirostris* var. *bitorquata* var. n.

The present communication deals with the Bdelloids obtained in those three localities.

The moss reached me in the dry condition, and was moistened in fresh, cold water. The study of the Rotifers was made within a few hours after moistening the moss, as very few of them will survive for any length of time. Most of the examples found had made the journey in the contracted state, though some may have hatched out from eggs. A Bdelloid which has been dried for a long time may generally be recognised by the condition of the intestine, the contents of which form a compact ball of dark colour, which does not soften and expand for some time after the animal has resumed full activity.

Old Calabar.

The material received from this district looked very unpromising. There seemed to be little true moss in it, but a sort of whitish dust containing many vegetable fragments, which might be leaves. When moistened it made a sort of porridge.

It was very poor, but yielded four species of Bdelloids, and only one example of each, except *Callidina longiceps*, which was abundant.

C. angusticollis Murray (*3*).*—The typical case measured 166 μ in length. The contained animal did not extend itself.

C. perforata Murray (*5*).—Only the empty case was seen. It was like the Indian type, but there was an obscure panelling of the surface, as in the var. *americana* Murray (*6*).

C. longiceps Murray (*4*).—Till it reappeared in Old Calabar, this species was only known from a very few examples found in Loch Morar, in Scotland.

There was some doubt as to whether the very peculiar case which it inhabits was a normal structure appertaining to the species, or had merely been adopted for shelter. The case is of an irregular flask-shape, jagged at the mouth, of a yellow colour, the surface traversed by numerous curved lines.

The great abundance of the cases in Calabar, each case containing a Bdelloid with the correct dental formula, renders it certain that the case is proper to the species, though it was never seen in process of formation. None were seen actually feeding, but several were seen partly extended.

C. multispinosa Thompson (*7*) var. *brevispinosa* var. n., plate XV. figs. 1 to 4.

Distinctive Characters.—Spines all short, few on anterior trunk-segments. Central surface of trunk transversely plicate and crenate with papillæ.

* The figures in brackets refer to the bibliography at end of paper.

There is a ventral necklet of hemispherical processes close under the mouth, and close below this is a second necklet of sharp spines. On the dorsal surface of the trunk there are two transverse rows of spicules, as in the type, and there are many small spines on the rump and foot. Dental formula, 2/2 or 2+1/1+2. Length, creeping, 250 μ.

The egg measures about 100 μ in length, and bears a number of low rounded prominences, one of which coincides with the anterior pole of the egg, as seen within the body of the parent (plate XV. fig. 4).

The variety is widely distributed, being known to occur in India, British Guiana, Uganda, Madagascar, and Cape Colony.

The species *C. multispinosa* is extremely variable. Even in Britain there is much variety in the number, size, and arrangement of the spines. In tropical and subtropical countries there is a profusion of forms which can be grouped round *C. multispinosa*, but some of which differ very markedly from the type.

The most distinct of these are almost certainly of specific value, but as there are many intermediate forms it seems well, pending further study, to retain most of them as simple varieties.

The variety *brevispinosa* appears to be pretty constant. The reduction of the spines is not its sole distinction from the type. The dorsal and anterior-lateral processes are fewer in number, and the small spines and papillæ on the ventral surface more numerous.

Uganda.

The moss from Uganda was more productive than either of the others. Seven species were noted, and several varieties—one species and two varieties being previously undescribed.

Philodina brycei Weber (*8*).—The form found differed somewhat from the type. There were ten spines in the chief dorsal transverse row, one lateral spine at each side of the trunk, a little in front of the end spines of the chief row, and on the same skinfolds as those spines. The central anterior processes of the trunk (between which the antenna is held, as in a fork, when the animal is feeding) were very small warts. The pair of processes on the fourth central segment were reduced to small knobs.

Callidina perforator Murray (*5*).—Only the case was seen. The examples were typical.

C. eremita Bryce (*1*).—Several examples.

C. longiceps Murray (*4*).—Many cases with living animals, one case with two examples. Dental formula, 5/5, 5/6, 6/6, and 7/6.

C. habita Bryce (*1*).—Many living examples, quite typical.

C. multispinosa Thompson (*7*) var. *brevispinosa* var. n.—(See paragraph on Old Calabar for description.) Several.

Callidina pinniger sp. n., plate XV. figs. 5 to 7.

Specific Characters.—Size moderate. Trunk with many processes, those on anterior trunk-segments broadly expanded, fin-like; posterior trunk processes, stout flattened spines, with bulbose bases. Some smaller dorsal processes on foot, variable, scale-like, or spoon-shaped. Dental formula, $2 + 1/1 + 2$.

The general form is like *C. multispinosa.* The spurs are small. There are two ventral necklets of papillæ on the head. The dorso-lateral processes (on each side of the antenna) of the first cervical segment are low and two-lobed.

There are three of the expanded lateral processes on each side, on distinct segments. They are usually expanded upwards, wedge-shaped, and look like fins or flippers.

The transverse rows of dorsal spicules, characteristic of *C. multispinosa,* are usually absent, but an example has been seen which had one spicule of the anterior row, close to the third flipper, and another had four spicules of the posterior row.

The stout posterior trunk-spines are usually five on each side. They are strongly compressed, acute, and the greatly swollen bases appear to articulate with the skin. Those of the first row are largest—one is quite lateral and the other is on the next dorsal skinfold; the second row is similar, but smaller; the last spines are single and sublateral.

The foot is kept so contracted that the true position of the small processes, whether on anal segment or foot, cannot be seen. They are variable, and are either, as in plate XV. fig. 5, scale-like and overlapping, or narrower, spoon-shaped, and standing apart. They are from six to eight in number.

There may be other small foot-spines hidden by the contraction of the foot.

Though a large number of skins were seen, there were very few living examples, and it was only once seen to feed. The head in the feeding attitude did not differ perceptibly from that of *C. multispinosa.*

Length, when feeding, about 200 μ, to 250 μ when creeping.

The flipper-like processes are in no degree functional as fins or swimming organs, so far as my observations of the few living examples show. Like the spines of *C. multispinosa,* they seem to change position merely with the varying tension of the skin, and to be purely defensive weapons.

Rotifer longirostris Janson (*2*).—Type, frequent, form with thick plates on the trunk, like those of *Philodina tuberculata* Gosse.

Var. *fimbriata* Murray (*5*).—Several examples.

Var. *bitorquata* var. n. (plate XV. fig. 8).—Besides the festoon of conical processes close below the mouth, as found in the type, there is a similar row of larger leaf-like processes on a lower neck-segment (third cervical, or possibly first trunk-segment, as there is some doubt as to homologies). These processes are not free at the points, but they stand further from the skin at the apices than at the bases.

Otherwise as the type. The skin is viscous and has adherent matter, usually of a warm brown colour. The spurs are of the normal size, and are stippled. Abundant.

Madagascar.

Five species of Bdelloida were obtained in moss from Madagascar, which reached me early in April 1907. There were four species of *Callidina* and one of *Rotifer*—the ubiquitous *R. longirostris* Janson. Very few examples were seen, but the time I was able to give to the examination of this moss was very limited, or much better results would probably have been obtained.

Callidina angusticollis Murray (*3*).—Several cases, but no living example.

C. perforata Murray (*5*).—Two empty cases.

C. multispinosa Thompson (*7*) var. *brevispinosa* var. n.—One example. (For description, see paragraph on Old Calabar.)

C. crenata Murray (*3*) var. *nodosa* Murray (*5*).—One contracted example. Previously known only from India.

Rotifer longirostris Janson (*2*).—Several contracted examples. As they were not seen extended, it was impossible to tell whether they were of the type, or of one of the tropical varieties.

Remarks.

This short list, of only a dozen forms, collected in widely separated regions—all, however, situated within the tropics—has several features of interest.

The poverty of the list is no doubt due to the small quantity of moss available, and to the limited time which could be given to its study.

The lists show little local peculiarity. Only one species and two varieties are considered to be distinct from all previously described forms. Though only two forms are common to all three regions, and five to two of the regions, all but two of them are known in other lands.

Four of the species (*Philodina brycei*, *Callidina habita*, *C. angusticollis*, and *Rotifer longirostris*) are among the most widely distributed Rotifers. Two species (*Callidina eremita* and *C. longiceps*), though discovered in Britain, are rare there, and probably have their headquarters in warmer climes. Six forms (*C. perforata*, *C. pinniger*, *C. multispinosa* var. *brevispinosa*, *Rotifer longirostris* vars. *fimbriata* and *bitorquata*, and *Callidina crenata* var. *nodosa*) are only known to exist in tropical and subtropical countries.

C. pinniger and *Rotifer longirostris* var. *bitorquata* are the only forms in our list at present only known in Central Africa. Varieties approaching *Callidina pinniger* are known in India, South Africa, etc.

In the isolated island of Madagascar only known species were observed.

An examination of various tropical and subtropical regions (India, Africa, South America) indicates a considerable Bdelloid fauna restricted to hot climates. The polar regions have not exhibited any such peculiarity, such species as have been found there being common natives of the temperate zone.

There is no bar to the distribution of Bdelloids over the whole globe, except such as is imposed by climate. Where similar conditions prevail, the same species may be expected.

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XVIII.—*On the Resolution of Periodic Structures.*

By Edward M. Nelson.

(*Read October* 21, 1908.)

It has been often noted that when periodic, or lined, structures are resolved upon a bright field, they may become invisible with dark-ground illumination. One may search microscopical text-books in vain for an explanation of this phenomenon. The Abbe "Spectrum Theory" may be wrung up to its breaking point, but not a drop of enlightenment can be squeezed out of it; Mr. Gordon's "Antipoint Theory," however, at once supplies an answer.

If one of Mr. Grayson's beautiful rulings be placed on the stage, and a band, say of 45,000 lines to the inch—the lines diagrammatically represented by the shaded portions in A, fig. 157—be examined with a $\frac{4}{10}$-in. object-glass, under a full cone of transmitted light, B may be taken to represent the image as seen in the Microscope.

Now Mr. Gordon tells us that the bright field is made up of a mosaic of antipoints, the diameter of the antipoint being inversely as the W.A., that is, the larger the W.A., the smaller the antipoint. In this supposed case the W.A. is equal to the N.A. of the object-glass. A glance at C shows how it comes to pass that the broad lines at A are imaged in the Microscope by the narrow lines at B: for we see the half-antipoints (diagrammatically but not accurately illustrated by semicircles) eating into each side of the broad lines, leaving a narrow central part. If the antipoints were so large that the semicircles met in the middle of the broad lines, there would obviously be no resolution: the lines would remain invisible.

Now let us see what happens when the lines are illuminated upon a dark ground. The lines will be bright, the interspaces dark, and the antipoints will eat, not into the lines, but into the spaces, and so broaden the lines. D, drawn to the same scale, shows that as the half-antipoints now meet in the dark spaces, there can be no resolution, and the 45,000-band will appear a blank, as at E, the limit of resolution being lowered to the 30,000-band.

Next let us examine the case under different conditions. In fig. 157 the assumption has been made that the breadth of the lines is wider than that of the interspaces, which is probably the case with the higher bands. Now a very little consideration will show that when the spaces are wider than the lines, the above recorded phenomena will be reversed, and resolution upon a dark ground ought to be carried to a further point than when on a bright ground; also, it appears that when the width of the line is equal to that of the interspace, it ought to be a matter of indifference whether the examination be made upon a bright or a dark field.

Experiments show that this is just what takes place. The case chosen for illustration in the first instance was selected because it

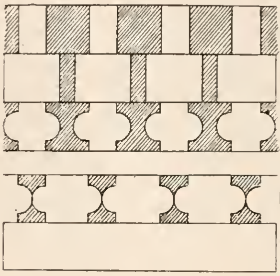

Fig. 157.

is the one most often observed, for resolutions are seldom if ever carried on with low powers. It seems, however, that with object-glasses of N.A. 0·25 to 0·35, resolutions upon a dark ground are about as strong as those upon a bright ground, but with object-glasses of N.A. 0·20, and lower, resolutions are better carried out upon a dark ground.

The following corollary is of interest. *Upon a bright ground no object of less size than an antipoint can be imaged at all. Upon a dark ground the most minute object must have an image the size of an antipoint.*

In conclusion, there are three practical lessons to be learnt from the preceding investigations:—

1. When periodic structures are examined with object-glasses having a N.A. of 0·35 and upwards, they should be placed upon a bright ground.

2. When periodic structures are examined with object-glasses having a N.A. of 0·20 and less, they should be placed upon a dark ground.

3. Minute dots, specks, flagella, etc., should be examined, when possible, upon a dark ground.

XIX.—*An Auxiliary Illuminating Lens.*

By Edward M. Nelson.

(*Read October* 21, 1908.)

An objection, repeatedly raised against my method of critical illumination, ever since its introduction more than thirty years ago, is that the image of the edge of the flame does not fill the field. This is a great drawback to biologists in general, who use a Microscope merely as a glorified magnifying glass, and prefer to search over specimens beautifully clothed in the woolly garments of diffraction fringes on a fully illuminated field, to any careful examination of an object when seen in the image of the edge of the flame. Some years ago I tried to remedy this defect of an incompletely illuminated field by placing in the path of the illuminating rays a small plano-convex lens at a distance of about its own focal length from the edge of the flame.

When this lens is properly adjusted it appears as a luminous disk, and this disk, projected upon the plane of the object by the substage condenser, yields a full and evenly-lighted field. This method was, however, abandoned because any object partaking of the nature of a minute lens, when examined upon this fully illuminated field, appears with a diminutive image of the edge of the flame in it: whereas, when the same object is viewed in the image of the edge of the flame, it appears as a small disk. This small disk is, in reality, an image of the back lens of the substage condenser. These phenomena may be studied upon an *Actinocyclus Ralfsii*, or other suitable diatom.

Another, and more serious objection, is that unless care be exercised, the W.A. may be considerably reduced. The state of the case is this:—(1) If the auxiliary lens is focused upon the edge of the flame, the rays which fall upon the substage condenser are parallel. The substage condenser will, therefore, require to be focused up a little nearer to the object. The W.A. will be of full size, the field will not be illuminated by an even disk of light but by a magnified image of the edge of the flame. (2) If the auxiliary lens is arranged so that it will give an even disk of light upon the field, it must be placed closer to the lamp flame. A divergent beam will fall upon the substage condenser, which must be focused down until the image of the auxiliary lens appears quite sharp in the field. The W.A. will be reduced and the field evenly illuminated. When the auxiliary lens has been placed in position, it is advisable to remove the eye-piece and examine the W.A. at the back lens of the objective. The auxiliary lens is supplied with a single diaphragm, having a $\frac{1}{4}$-in. hole. It is obvious that the use of this diaphragm in no way influences the size of the W.A.

If the auxiliary lens had increased the resolution by a single jot, it would not have been laid aside, so no one need expect the Thames to be set on fire by its re-introduction. For certain objects, such as bacteria and their flagella, it may prove serviceable owing to increase of contrast through the brightening of the field. Mr. Baker has made me a lens from my formula to take the place of the crude plano-convex of former years, and has mounted it in a short tube to hold the single diaphragm. This lens has been tested both by Mr. Merlin and myself, and has been found quite satisfactory.

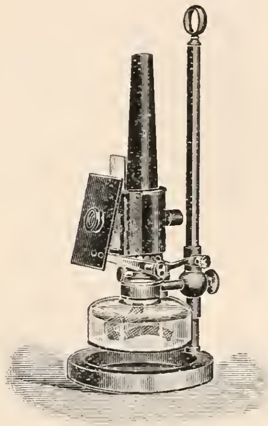

FIG. 158.

Mr. Baker has sent me one of his lamps fitted with my auxiliary lens. Fig. 158 shows the auxiliary lens mounted in a metal screen, and in the position it would occupy when illuminating an inclined Microscope "direct" without a mirror. The arm which holds the screen consists of two parts, held together by a pinching-screw working in a slot; this allows the lens not only to be focused, but also to be placed at right angles to the path of an upward, horizontal, or downward beam. This arm is not attached to the pillar itself, but to the sleeve of the arm which holds the lamp-cistern: it can therefore be raised or lowered with the lamp. When its pinching-screw is released, the arm can be moved to one side. It will be noticed that the lens has the diaphragm in position.

Some of the Microscope lamps sold by opticians differ in essential particulars from the one I designed thirty years ago, and are quite inefficient. I had nothing whatever to do with the design of several lamps which are named after me.

XX.—*Note on a Remarkable Alcyonarian, Studeria* mirabilis g. et sp. n.*

By Professor J. Arthur Thomson, M.A.

(*Read November* 18, 1908.)

Plate XVI.

A collection of Alcyonarians made by the 'Investigator' in the Indian Ocean included a specimen from the Andamans which is certainly one of the most remarkable of the many interesting representatives of this sub-class that have been discovered within recent years. It is a cup-like colony, with a large retractile polyparium. The cup is 45 mm. in height by 55 mm. in maximum diameter, and it is continued into a basal wisp (19 mm. in length), which, however, shows no attaching disk. The specimen gave indication of having been imbedded in the mud up to about the maximum diameter of the cup.

General Structure. — The most striking peculiarity of this Alcyonarian is that the whole of the polyp-bearing portion is retracted within the exceedingly substantial, densely spinose cup, the circular mouth of which is about 30 mm. in diameter, and shows the tips of numerous finger-like polyp-bearing lobes or branches. It seems quite likely that the mouth of the cup was capable of more complete closure, and, on the other hand, that the retracted polyparium was capable of considerable protrusion.

A longitudinal median section of the single specimen shows a dome-shaped fleshy centre, or thalamus, from the margins and summit of which most of the numerous finger-like polyp-bearing lobes arise. Some of them, however, are attached to the inner wall of the cup at different levels. The central dome, it should be noted, rises quite freely in the middle of the cup; its diameter is greater than half the maximum diameter of the cup. The arrangement of the polyp-bearing lobes may be compared to the distribution of carpels and stamens in the flower of some of the Rosaceæ, in which the former are disposed on a dome-shaped central thalamus, and the latter on several whorls on the inner wall of the "calyx-tube." Or, again, the central region of our specimen may be com-

* I have named this type in honour of Professor Th. Studer, of Bern, who has contributed so largely to our knowledge of Alcyonaria.

pared to the disk of a Composite's capitulum and the peripheral parts to the ray-florets (plate XVI. fig. 1).

There are large longitudinal canals in the central dome, separated by tough hyaline mesoglœa. Very strong muscle-bands pass down their walls, and there are others in the wall of the cup reaching almost to the margin. These longitudinal bands pass for a short distance into the wisp-like stalk and gradually disappear. Numerous well-defined transverse muscles extend between the several longitudinal bands.

The Cup.—The cortical part of the wall of the cup, which is very definite and has a thickness of about 2 mm., is extremely hard, consisting mainly of long spindles, readily visible to the naked eye (some over 5 mm. in length), arranged for the most part in longitudinal interlacing rows. On the surface many of the spindles lie exposed throughout their whole length. Towards the base of the cup the spicules increase in size, and they attain their maximum dimensions—almost 1 cm. in length—in the basal wisp. These are probably the largest Alcyonarian spicules as yet known.

The internal part of the wall of the cup, as distinguished from the hard cortex just described, is soft and muscular. It is about 9 mm. in thickness where it joins the base of the dome, and narrows gradually to the margin of the cup.

The System of Canals.—Each of the finger-like polyp-bearing lobes has a large canal, with which the cavities of the polyps communicate. These branch canals pass into the dome or the wall of the cup, as the case may be, and uniting with others form the main longitudinal canals. These are relatively large, especially at the base of the cup and below the central dome, where they are about 2·5 mm. in diameter. From this region of maximum size, they gradually taper into the wisp-like stalk. The walls of the canals bear the strong longitudinal muscle-bands, and there are very few spicules.

Polyp-bearing Lobes or Branches.—Looking down into the mouth of the cup, one sees the heads of between sixty and seventy polyp-bearing lobes or branches, but the number visible will of course depend on the degree to which the dome is contracted. Besides the branches on its summit, the central dome bears four whorls, and there are also four tiers on the wall of the cup. It should be noted, however, that the lobes do not all arise singly from the central dome, but may cohere for a distance of 2–6 mm. at their bases. Some are united in pairs; in one case seven were found to be cohering.

Polyps.—Each of the finger-like branches resembles a spike-inflorescence, and bears 150–200 close-set sessile polyps. These almost cover the surface, but without discernible arrangement. At

FIG. 1.—Longitudinal section of *Studeria mirabilis* g. et sp. n. Natural size.

FIG. 2. — The upper part of one of the digitiform polyp-bearing lobes or branches of *Studeria mirabilis* g. et sp n. It shows the terminal polyp much larger than the others. × 12.

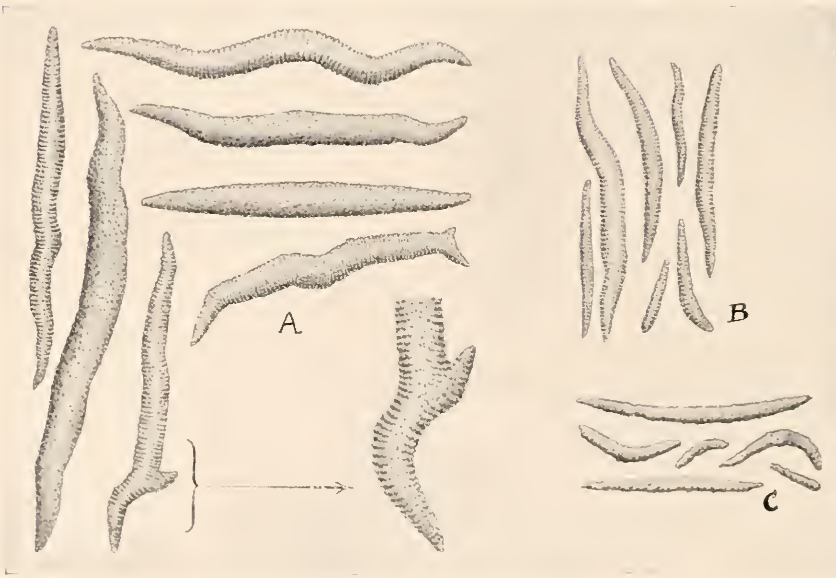

FIG. 3.—Spicules of *Studeria mirabilis*.
A. From the stalk. B. From the internal wall of the cup. C. From a polyp-bearing lobe.

the summit there is a terminal polyp which is larger than the others. In many cases a branch has a length of 15 mm. and a maximum diameter of 3 mm., but in regard to these and other measurements of soft parts it must be remembered that the whole colony has been much contracted by preservation in strong spirit (plate XVI. fig. 2.).

The polyps have almost globular calyces or verrucæ, with a diameter of about 1 mm. The tentacles are in most cases completely retracted, and the summit of the calyx shows a sharply defined circular aperture. The polyps with their calyces and precise circular aperture recall those of some of the Pennatulids, such as Virgularids. On the wall of the calyx there are eight triangular points, each consisting of two to three pairs of spicules arranged *en chevron*, surmounting a collaret of several horizontal rows. In most cases, however, the projecting spindles of the cortical cœnenchyma hide the base of the calyx and may even intrude upon it. The anthocodia is very minute and is completely retractile within the globular calyx. The tentacles are short and thick, apparently without spicules, and with about half a dozen pairs of pinnules.

Spicules.—Apart from a few irregular minute forms found on the canal walls (and possibly extraneous) all the spicules are spindles. Many are huge, most are densely warted. The warts are often in close-set transverse rows, so that the spindle has a striated appearance. Many of the spindles are curved in a sinuous fashion; not a few are irregularly forked (plate XVI. fig. 3).

The following measurements were taken of the spicules, length and breadth in millimetres:—

From the stalk:	$9 \cdot 5 \times \cdot 534$;	$7 \times \cdot 51$;	$5 \cdot 75 \times \cdot 476$.
From the cortex:	$5 \cdot 5 \times \cdot 476$;	$3 \cdot 5 \times \cdot 28$;	$1 \cdot 75 \times \cdot 153$.
From the inner wall of the cup:	$5 \times \cdot 4$;	$3 \times \cdot 2$;	$2 \times \cdot 15$.
From the canal walls:	$6 \times \cdot 51$;	$4 \cdot 25 \times \cdot 4$;	$2 \cdot 75 \times \cdot 32$.
From the polyps:	$1 \cdot 6 \times \cdot 112$;	$1 \cdot 02 \times \cdot 05$;	$\cdot 45 \times \cdot 034$;
		$\cdot 17 \times \cdot 018$;	$\cdot 13 \times \cdot 017$.

Position of Studeria.—If this type is to be referred to any of the recognised families of the Alcyonacea it must be to the Alcyoniidæ. In the retractility of the whole polyparium, as well as in the mode of branching, the disposition of the polyps and their armature, it is removed from the Nephthyids and Siphonogorgids.

In certain respects, e.g. the distinct calyces into which the delicate upper parts of the polyps are retracted and the large longitudinal canals continued in part to the base of the colony, *Studeria* resembles *Nidalia*, but the *Nidalia* colony is unbranched, and there are many other differences apart from *Studeria's* retractile polyparium. In certain respects, e.g. in its huge spindles and in the finger-like lobes densely covered with polyps, *Studeria* resembles a form like *Sclerophytum polydactylum*, but the polyps are quite different in the two, and there is not in *Studeria* any hint of dimorphism. The non-retractile calyces, the mode of branching, the nature of the spiculation, and other features separate *Studeria* from *Alcyonium* and several nearly related genera. So we might review all the genera of Alcyoniidæ, but to little profit, for there is only one which can be thought of as having close affinities with our new type. That one is the genus *Paralcyonium*, established by Milne-Edwards. Milne-Edwards gave the following diagnosis of *Paralcyonium*: "Polyparium of a coriaceous tissue towards the base and there forming a cylindrical tube with spiculose walls, into the interior of which all the upper and soft part of the polyparium, including the polyps themselves, can be completely retracted."*

In his original description of *Paralcyonium*, when he called it Alcyonide,† Milne-Edwards gave a number of interesting details. He distinguished a brown firm "foot" fixed by its base, and a white, delicate, branched trunk with twigs ending in small polyps. The cavities of the polyps unite in forming longitudinal canals which are continued to the base, those which lie to the outside having their walls strengthened by numerous brown spindles. Ova are developed on lamellæ in the lower part of the canals of the trunk and fall into the cavity, accumulating further down. On the polyps there are, according to Milne-Edwards, rows of "spicules cartilagineuses brunâtres."

Wright and Studer gave the following definition of *Paralcyonium* in the 'Challenger' Report on Alcyonarians (1889):—"The colony presents two distinct portions: one, the basal portion, is dense, with firm walls; the other, the head, alone bears the polyps, and can be in part withdrawn into the basal part. The polyp-bearing portion is but feebly lobed." In his "Versuch eines Systemes der Alcyonaria" ‡ Studer had suggested affinity with *Nidalia*.

Our new type *Studeria* agrees with *Paralcyonium* (1) in having the polyp-bearing portion retractile into the basal portion, (2) in the disposition of the longitudinal canals, and (3) in having very large fusiform spicules. But there the resemblance stops, and there can be no question as to the distinctiveness of the two very remarkable genera.

* Histoire Naturelle des Coralliaires, 1857, p. 129.

† Ann. Sci. Nat., ser. 2, iv. (1835) pp. 323–33 (9 figs.).

‡ Arch. Natur., liii. (1887).

The most obvious differences between *Studeria* and *Paralcyonium* may be summed up in the following contrast :—

Studeria mirabilis.	*Paralcyonium.*
The polyps are crowded on numerous finger-like branches, which cover a central dome, and also grow out from the inner walls of the cup.	The polyps are distant from one another, and are borne on the ends of the twigs of a loosely-branched polyparium.
The polyps have a dense armature of spicules, forming a well-defined calyx.	The polyps have minute spicules at the base of the tentacles, but there is no calyx.
The walls of the cup are very massive and hard.	The walls of the cylindrical lower portion are not thick, and the whole is readily compressible.
The retractile polyparium is very substantial, including strong muscle-bands.	The retractile polyparium is very delicate and translucent.
The larger spindles are very characteristic, being covered with warts in thick-set rows.	The spindles are much smaller, and much less warty.

It should be noted that *Studeria mirabilis* is much larger than *Paralcyonium elegans*, much more massive, with much larger and coarser spicules, and so on ; but we have reason to believe that the massiveness of architecture is a specific, not a generic character. We saw in September in the Zoological Museum in Hamburg a number of un-named specimens of a form which we believe to be closely related to *Studeria*. By the courtesy of the director, Professor Kraepelin, and of Dr. Michaelsen, who has charge of the section of the museum containing Alcyonaria and the like, we were able to examine this form, and to compare it with the 'Investigator' type. The Hamburg specimens, which were collected off Formosa (Takao), agree with the 'Investigator' specimen in having a retractile polyparium, similar polyps, and the same type of huge warty spindle, but they have not the strong massive cup, nor, so far as we have seen, the same development of central dome, or of digitiform lobes. We do not wish to pursue the comparison in the meantime, since Professor Kükenthal has, we believe, undertaken to describe the un-named Alcyonarians in the Hamburg Museum. We would, however, express our conclusion that the Hamburg specimens belong, or are closely related, to the genus *Studeria*, which we have established for the 'Investigator' type. [It must be added that we exhibited, described, and named the 'Investigator' specimen in August 1907, at the Meeting of the International Congress of Zoologists at Boston. As we have heard nothing regarding the manuscript which we deposited, we have thought it necessary to record the facts afresh.]

M. Camille Viguier * has described and given beautiful figures of a type which he calls *Fascicularia*, and has proposed to include *Paralcyonium* along with it in a special family or sub-family, Fasciculariniæ. But it is not evident that *Fascicularia* is really related to *Paralcyonium*: it consists of groups united by stolons; the cavities of the polyps are continued, quite distinct from one another, down the "basilar column;" there is no common region except the base; the large polyps expand from the top of the basilar column, but there is no branched or lobed polyparium; in fact, as the author says, there is no polyparium properly so-called. He makes the same remark, it is true, in regard to *Paralcyonium*, which, however, he had not seen. What at once marks *Paralcyonium* as distant from *Fascicularia*, is the presence of a branched polyparium rising from the top of a firmer cylindrical stalk, into which it can be retracted. Viguier speaks of the "incontestable resemblance" between his *Fascicularia* and the *Paralcyonium* of Milne-Edwards, but we are unable to share this view. The description of *Fascicularia* suggests to us relationship with *Sympodium* rather than with *Paralcyonium*.

A recent careful study† of abundant material of *Fascicularia* and *Paralcyonium* by Sophie Motz-Kossowska and Louis Fage corroborates Viguier's view. In their interesting paper the authors point out that the two types agree (1) in having a stolon connecting the colonies (but this is often almost suppressed in *Paralcyonium*); (2) in having a rigid basal portion into which the polyps can be retracted (but in *Fascicularia* this is composed of the unfused gastric cavities of the polyps, whereas in *Paralcyonium* there has been much coalescence, and therefore far fewer longitudinal canals than polyps; moreover, *Paralcyonium* has a branching polyparium with secondary polyps arising from primary polyps); (3) in having similar spicules—small, flat, opaque elliptical forms in a sub-tentacular collar and larger spindles in the basal portion (but the spindles are very much larger in *Paralcyonium*). The authors point out that *Paralcyonium* passes through a *Fascicularia* stage, and in spite of the great difference in the basilar portion and in the relations of the polyps to one another, they unite them in the family Fascicularidæ, defined as follows: "Colonies very poor in cœnenchyma, composed of several groups of polyps united by a stolon; polyps united at the base in a rigid column within which they can be completely retracted." It is suggested that the family is connected by *Fascicularia* with the Clavularidæ, that there are some affinities with *Nidalia* and

* Études sur les animaux inférieurs de la Baie d'Alger. III. Un nouveau type d'Anthozoaire (*Fascicularia edwardsi*). Arch. Zool. Expér. ser. 2, vi. (1888) pp. 351–73 (2 pls.). See also H. de Lacaze-Duthiers; Coralliaires du Golfe du Lion. Alcyonaires. Arch. Zool. Expér. ser. 3, viii. (1900) pp. 353–462 (4 pls.).

† Contribution à l'étude de la famille des Fascicularidés. Arch. Zool. Expér., . (1907) pp. 423–43 (10 figs.).

Nidaliopsis, and that the nearest related form is *Organidus*. The armature of the polyps in *Nidalia*, its unbranched habit, and many other features separate it far from *Paralcyonium*, and *Gersemia*, to which, as Kükenthal has shown, *Organidus* must be referred, is equally remote.

We have not as yet been able to procure a specimen of *Fascicularia* for examination, and we would not therefore dogmatically exclude the possibility that *Fascicularia*, *Paralcyonium*, and *Studeria* form a series showing the progressive differentiation of a rigid basilar portion into which the rest of the colony can be retracted. The descriptions given by Motz-Kossowska and Fage are very precise, and their discussion of the possible relationships is admirable; what surprises us is that in spite of the differences which they indicate between *Fascicularia* and *Paralcyonium*, they should propose to include the two in one family. From their descriptions, as from Viguier's, it appears to us that *Fascicularia* is more nearly related to *Sympodium* than to *Paralcyonium*; that it differs from *Paralcyonium* too markedly (in the structure of the basilar portion and in the relations of the polyps to this and to one another) to allow of their being included in one family; and that neither is nearly related to *Studeria*.

Diagnosis of Studeria.—A colony consisting of a strong densely spiculose cup, within which very numerous finger-like polyp-bearing lobes or branches are retracted; these arise at different levels from a strong muscular central thalamus, and from the upper parts of the inner wall of the cup; each finger-like lobe is thickly covered with polyps and ends in a polyp larger than the rest; the cavities of the polyps communicate with a central canal in the digitiform lobe, and these central canals unite in a few large longitudinal canals with few spicules in their walls; the polyps have a distinct non-retractile calyx or verruca, covered with spindles arranged in double rows; the spicules are all spindles, except a few minute irregular forms found (along with sparse spindles) in the canal walls; many of the cortical spindles attain huge dimensions (over 9 mm.); many are sinuous and forked; almost all are very warty, and there is a characteristic arrangement of the warts in transverse rows.

Our general conclusion, which is based on a single specimen, of which we had to be careful, is that we have to do with a very distinct genus, related to *Paralcyonium*, but not very closely; perhaps connected through forms like *Nidalia* with other Alcyoniidæ; but more probably deserving, as Professor Verrill suggested to us, the establishment of a new family.

XXI.—*The Present Status of Micrometry.*

By Marshall D. Ewell, M.D. Chicago.

(*Read November* 18, 1908.)

By the establishment of the International Bureau of Weights and Measures, and more recently of our own National Bureau of Standards, the subject of Metrology has been placed on a sound and satisfactory basis, more so than ever before in its history. Under the able direction of Professor S. W. Stratton, to whom is rightfully due the credit of having created and organised our National Bureau of Standards, this Bureau has become an institution of which all Americans may justly be proud. It has, through its publications and its work, become a great educational force, and by placing the verification of all sorts of scientific standards within easy reach of scientists and artisans of this country, without the delay and expense of sending abroad, it has conferred a benefit upon science and art that can never be measured by any merely pecuniary standard.

It appears not to be generally understood, though why we are unable to understand, that all American standards of length, area, and cubic measure are derived from the international metre, the legal equivalent being 1 m. equals 39·37 in.* In 1893, the United States Office of Standard Weights and Measures was authorised to derive the yard from the metre, using for the purpose the relation legalised in 1866, viz. 1 yd. equals $\frac{3600}{3937}$ m.

The customary weights are likewise referred to the kilogram.† This action fixes the values, inasmuch as the reference standards are as perfect and unalterable as it is possible for human skill to make them.‡

The metric system is, therefore, the basis of the entire system of weights and measures in the United States, and in our judgment the Act of Congress, 1866, and the executive orders in pursuance thereof, showed great wisdom in thus finally settling the relation between the yard and metre, and deriving the yard and other units from the metre. Hitherto this relation had been unsettled and ambulatory. At present the British legal (Board of Trade) equivalents sustain the following relation: 1 m. equals 39 370113 in., which is very nearly the same value as that found by the late Professor William A. Rogers, of this country. The last relation adopted by Professor Rogers was, as the writer remembers, 1 m.

* See United States Statute of July 28, 1866; Revised Statutes of the United States, 3570. † Executive order approved April 5, 1893.

‡ See Tables of Equivalents, Department of Commerce and Labour, Bureau of Standards, S. W. Stratton, Director, 3rd edition, p. 5.

equals 39·37012 in. For some time previously he had adopted the relation 39·37015. The United States yard, established by the relation, 1 yd. equals $\frac{3600}{3937}$ m., is therefore about 2·6 μ longer than the present accepted value of the British yard, a difference, if it really exists, of no consequence whatever, except in measurements of the greatest precision. It is, however, uncertain whether any such difference actually exists, for the reason that successive comparisons between the British yard and its authentic copies usually vary more than the amount above stated.

Since the death of Professor Rogers, to whom the science and art of metrology and micrometry are very greatly indebted, very little attention, outside of the National Bureau of Standards, appears to have been paid, at least in this country, to either metrology or micrometry, and the making of micrometers has become almost wholly a commercial matter, with what results in point of accuracy it is the principal object of this paper to disclose. By Professor Rogers metrology and micrometry were most ardently and arduously pursued from mere love of the subject, and at great pecuniary loss to himself; and to-day the micrometers ruled by him are far superior to any others manufactured and on sale in the United States.

In pursuance of the object above stated, the writer has, for the last year, been collecting micrometers from all available sources, and subjecting them to measurements, the results of which are recorded in the following tables. The scales for sale at the present time, both here and abroad, are almost universally on glass. Nearly all of them are engine ruled, but some are photographic copies of ruled scales; and for use with low powers are very good indeed. The lines of these, however, are altogether too coarse and rough for use with medium or high powers. A few scales appear to have been etched on glass, and these also have lines so coarse as to be of no use with others than low powers. The lines of those ruled with a diamond on glass in many instances have greatly deteriorated, a very common experience, so far as the writer's observation goes. A few were ruled on speculum metal, silver or platin-iridium, and the lines on these are in a state of perfect preservation, as good in fact as when first ruled. In the writer's experience with micrometers, extending over a period of about twenty-three years, the only scales that can always be relied upon are ruled upon metal surfaces. These, whether the surface be silver, nickel, speculum metal, platin-iridium, or steel, are, with reasonable care, entirely free from deterioration by lapse of time, and are so far superior to glass that no one accustomed to their use would be satisfied with anything else. The only difficulty lies in the illumination, and that difficulty is trifling. A good line on metal would stand any degree of amplification. The writer has often measured spaces ruled on speculum metal and platin-iridium with a power of from 1000 to 1500 diameters, the lines under even the greater amplification being as clear and sharp as with a power of 300 diameters. For such use, the prismatic illuminating objectives, manufactured by the Bausch and Lomb Optical Company, are unequalled by anything the writer has ever used. In making the measurements below recorded, low and medium powers only were used, but always with a filar micrometer, the mean of from five to ten readings of each end of every space being adopted. It is the experience of the writer that when a series of measurements is made, there is no advantage in using a very high power, the results being sensibly the same with high, medium, and low powers, having regard, of course, to the unit measured.

It is not pretended that the measurements here recorded can be depended upon to the last place of decimals in every instance. No one knows better than the writer the difficulty inherent in such work. The results recorded are, however, believed to be in the main correct, and to reflect accurately the differences between the various scales measured, all having been measured under substantially the same or similar conditions, except as otherwise indicated. The tables give in every instance a short description of the scales measured, the instruments used, the spaces measured in terms of divisions of the filar micrometer, and the relative corrections of each space in divisions of the micrometer and in microns. The relative errors are determined by subtracting the value of each space from the mean value of all the spaces measured. A plus sign indicates that the space measured is shorter than this mean, and a minus sign indicates that it is longer. The correction for total length has been given in only a few instances, as the object of this paper is not to standardise the individual scales, but to determine their relative accuracy of graduation.

The original observations, the results of which are here given. are recorded in books K, L, and M. The references to "Record Book" are to "Book Z," in which these results are tabulated.

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections.		Remarks.
			In Div. of Micrometer.	In Mikrons.	
	$\frac{1}{10}$ mm.	div.	div.	μ	
No. 1. Bausch and Lomb Optical Co., stage micrometer on glass, ruled to tenths and hundredths of a millimetre. Instruments: Bulloch Stand No. 2, Zentmayer filar micrometer and AA Zeiss objective. 1 div. = 0·2508 μ 398·8 div. = $\frac{1}{10}$ Mikron.	1st	402·4	− 4·2	−1·0	Record Book, page 1. Correction for total length not determined.
	2nd	405·4	− 7·2	−1·8	
	3rd	394·1	+ 4·1	+1·0	
	4th	394·4	+ 3·8	+1·0	
	5th	394·6	+ 3·6	+0·8	
	Mean	398·2			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{10}$ mm.	div.	div.	μ	
No. 2. Zeiss stage micrometer on glass; divided like No. 1. Same instruments. 1 div. = 0·2508 μ	1st	391·6	+ 5·6	+1·4	Record Book, page 3. Correction for total length not determined.
	2nd	400·4	− 3·2	−0·8	
	3rd	401·7	− 4·5	−1·1	
	4th	392·1	+ 5·1	+1·3	
	5th	400·1	− 2·9	−0·7	
	Mean	397·2			
No. 3. Möller (1) photographic scale on glass, divided like No. 1. Same instruments. 1 div. = 0·2508 μ	1st	395·7	0·0	0·0	Record Book, page 3. Correction for total length not determined, lines too coarse for high powers.
	2nd	396·0	− 0·3	−0·1	
	3rd	395·7	0·0	0·0	
	4th	395·0	+ 0·7	+0·2	
	5th	396·2	− 0·5	−0·1	
	Mean	395·7			
No. 3 (*a*). Möller (2) similar to No. 3. Spencer stand, Zeiss filar, Leitz No. 3 objective. 1 div. = 0·169 μ	1st	581·2	− 0·9	−0·1	Record Book, page 11. Same as No. 3. *Supra.*
	2nd	578·6	+ 1·7	+0·3	
	3rd	580·3	0·0	0·0	
	4th	580·4	− 0·1	0·0	
	5th	581·1	− 0·8	0·1	
	Mean	580·3			
No. 4. Zeiss stage micrometer on glass. One centimetre divided into millimetres, first millimetre divided into tenths. Spencer stand, Zeiss filar, Leitz No. 3 objective. 1 div. = 0·169 μ	1st	593·1	− 0·9	−0·1	Record Book, page 7. Lines too coarse for high powers. Total length not determined.
	2nd	591·2	+ 1·0	+0·2	
	3rd	588·0	+ 4·2	+0·7	
	4th	593·8	− 1·6	−0·3	
	5th	594·8	− 2·6	−0·4	
	Mean	592·2			
No. 5. Micrometer on glass ruled on Cornell University Engine; similar sub-divisions. Same instruments as in No. 1. 1 div. = 0·25 μ	1st	396·0	+ 0·7	+0·2	Record Book, page 4. Total length not determined.
	2nd	395·6	+ 1·1	+0·3	
	3rd	396·8	− 0·1	−0·0	
	4th	396·8	− 0·1	−0·0	
	5th	398·3	− 1·6	−0·4	
	Mean	396·7			
No. 6. Zentmayer stage micrometer on glass; similar sub-divisions. Spencer stand, Zeiss filar, Leitz No. 3 objective. 1 div. = No. 0·169 μ	1st	588·0	− 2·2	−0·4	Record Book, page 5. Total length not determined.
	2nd	588·4	− 2·6	−0·4	
	3rd	586·0	− 0·2	−0·0	
	4th	582·6	+ 3·2	+0·5	
	5th	583·2	+ 2·6	+0·4	
	6th	586·6	− 0·8	−0·1	
	Mean	585·8			
No. 7. Leitz stage micrometer on glass. Similar sub-divisions; same instruments. 1 div. = 0·169 μ	1st	590·3	+ 0·8	+0·1	Record Book, page 7. Lines too coarse for high powers. Total length not determined.
	2nd	590·5	+ 0·6	+0·1	
	3rd	590·7	+ 0·4	+0·1	
	4th	591·6	− 0·5	−0·1	
	5th	592·2	− 1·1	−0·2	
	Mean	591·1			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{10}$ mm.	div.	div.	μ	
No. 8. Powell and Leland stage micrometer on glass, similar sub-divisions; same instruments. 1 div. = 0·169 μ	1st	578·1	+ 4·1	+0·7	Record Book, page 10. Total length not determined.
	2nd	588·0	− 5·8	−1·0	
	3rd	576·7	+ 5·5	+0·9	
	4th	585·3	− 3·1	−0·5	
	5th	582·9	− 0·7	−0·1	
	Mean	582·2			
No. 9. Glass micrometer by the late Charles Fasoldt. Same instruments as above (1 div. = 0·169 μ) used in first series. Bulloch stand No. 2, Bausch and Lomb filar, and A A Zeiss objective (1 div. = 0·369 μ) used in second series.	1st	..	..	−0·1	Record Book, pages 5, 17. These corrections represent the mean of two series of measurements; twenty micrometer readings on each space in each series.
	2nd	..	..	+0·1	
	3rd	..	..	+0·0	
	4th	..	..	+0·4	
	5th	..	..	+0·1	
	6th	..	..	+0·0	
	7th	..	..	+0·0	
	8th	..	..	−0·1	
	9th	..	..	−0·4	
	10th	..	..	−0·1	
	$\frac{1}{100}$ in.				
No. 10. Beck stage micrometer on glass, divided into hundredths and thousandths of an inch. Spencer stand, Zeiss filar, and Leitz No. 2 objective. 1 div. = 0·302 μ	1st	842·8	+ 0·4	+0·1	Record Book, page 3. Total length not determined.
	2nd	843·8	− 0·6	−0·2	
	3rd	838·3	+ 4·9	+1·5	
	4th	844·9	− 1·7	−0·5	
	5th	846·1	− 2·9	−0·9	
	Mean	843·2			
	$\frac{1}{10}$ mm.				
No. 11. Beck stage micrometer on glass, divided into tenths and hundredths mm. Spencer stand, Zeiss filar, and Leitz No. 3 objective. 1 div. = 0·169 μ	1st	577·2	+ 4·2	+0·7	Record Book, page 30. Lines deteriorated. Total length not determined. Ten readings on each space (five on each end).
	2nd	578·4	+ 3·0	+0·5	
	3rd	583·4	− 2·0	−0·3	
	4th	581·5	− 0·1	−0·0	
	5th	586·5	− 5·1	−0·9	
	Mean	581·4			
	$\frac{1}{100}$ in.				
No. 11A. Beck stage micrometer on glass; same instruments except Leitz No. 2 objective. 1 div. = 0·302 μ	1st	849·3	− 5·8	−1·8	Record Book, page 30. Ruled on same slide as No. 11. Lines deteriorated. Total length not determined. Ten readings on each space.
	2nd	842·1	+ 1·4	+0·4	
	3rd	835·4	+ 8·1	+2·5	
	4th	843·3	+ 0·2	+0·1	
	5th	847·6	− 4·1	−1·2	
	Mean	843·5			
No. 12. Tolles stage micrometer on glass, divided into hundredths, thousandths, and half-thousandths of an inch; same instruments as in No. 11A. 1 div. = 0·302 μ	1st	840·3	+ 0·7	+0·2	Record Book, pages 30, 31. Total length not determined. Lines deteriorated. Ten readings on each space.
	2nd	839·5	+ 1·5	+0·5	
	3rd	838·7	+ 2·3	+0·7	
	4th	844·8	− 3·8	−1·1	
	5th	841·9	− 0·9	−0·3	
	Mean	841·0			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{100}$ mm.	div.	div.	μ	
No. 13. Tolles stage micrometer, divided same as No. 12; same instruments. 1 div. = 0·302 μ	1st	844·3	− 5·1	−1·5	Record Book, page 31. Lines deteriorated. Ten readings on each space. Total length not determined.
	2nd	837·3	+ 1·9	+0·6	
	3rd	840·3	− 1·1	−0·3	
	4th	836·8	+ 2·4	+0·7	
	5th	837·4	+ 1·8	+0·5	
	Mean	839·2			
	$\frac{1}{10}$ mm.				
No. 14. Glass micrometer by the Société Genevoise, divided into tenths and hundredths mm. Spencer stand, Zeiss filar, Leitz No. 3 objective. 1 div. = 0·169 μ	1st	580·2	+ 2·8	+0·5	Record Book, page 31. Ten readings on each space. Total length not determined.
	2nd	583·2	− 0·2	0·0	
	3rd	583·0	0·0	0·0	
	4th	585·6	− 2·6	−0·5	
	5th	583·2	− 0·2	0·0	
	6th	583·8	− 0·8	−0·1	
	7th	581·7	+ 1·3	+0·2	
	8th	583·8	− 0·8	−0·1	
	9th	582·8	+ 0·2	0·0	
	10th	582·3	+ 0·7	+0·1	
	Mean	583·0			
No. 15. Nachet micrometer on glass, divided into tenths and hundredths mm.; same instruments as in No. 14. 1 div. = 0·169 μ	1st	583·4	+ 1·0	+0·2	Record Book, page 32. Total length not determined.
	2nd	583·9	+ 0·5	+0·1	
	3rd	586·8	− 2·4	−0·4	
	4th	582·3	+ 2·1	+0·4	
	5th	583·9	+ 0·5	+0·1	
	6th	585·9	− 1·5	−0·2	
	7th	582·8	+ 1·6	+0·3	
	8th	586·1	− 1·7	−0·3	
	9th	585·9	− 1·5	−0·2	
	10th	583·0	+ 1·4	+0·2	
	Mean	584·4			
No. 16. Watson stage micrometer on glass, ruled to tenths and hundredths mm. Spencer stand, Zeiss filar, Leitz No. 3 objective. 1 div. = 0·169 μ	1st	611·2	+ 4·3	+0·7	Record Book, page 20. Total length not determined.
	2nd	617·1	− 1·6	−0·3	
	3rd	597·2	+18·3	+3·1	
	4th	624·4	− 8·9	−1·5	
	5th	621·9	− 6·4	−1·1	
	6th	620·7	− 5·2	−0·9	
	7th	607·7	+ 7·8	+1·3	
	8th	609·8	+ 5·7	+1·0	
	9th	617·9	− 2·4	−0·4	
	10th	627·0	−11·5	−1·9	
	Mean	615·5			
No. 17. Glass scale ruled on micrometer slide with dividing head manufactured by William Gaertner and Co., ruled without applying any correction; pitch of screw 0·5 mm.; same instruments as in No. 16. 1 div. = 0·169 μ	1st	581·6	− 1·3	−0·2	Record Book, page 11. Total length not determined. Six readings on each space.
	2nd	574·7	+ 5·6	+0·9	
	3rd	577·7	+ 2·6	+0·4	
	4th	583·6	− 3·3	−0·6	
	5th	584·1	− 3·8	−0·6	
	Mean	580·3			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks
	$\frac{1}{10}$ mm.	div.	div.	μ	
No. 18. Centimetre divided on silver into milimetres and tenths, by William Gaertner and Co. Bulloch stand No. 2, Zeiss filar, Bausch and Lomb 1 in. prismatic illuminating objective. 1 div. = 0·1986 μ	1st	535·9	−32·2	−6·4	This scale is intended for the use of schools, and does not profess to be of the highest accuracy, having been ruled automatically without applying corrections. Lines too coarse for high powers, and intended only for relatively coarse measurements. Total length not determined.
	2nd	500·1	+ 3·6	+0·7	
	3rd	504·7	− 1·0	−0·2	
	4th	507·4	− 3·7	−0·7	
	5th	467·6	+36·1	+7·2	
	6th	535·3	−31·6	−6·3	
	7th	502·7	+ 1·0	+0·2	
	8th	508·4	− 4·7	−0·9	
	9th	505·6	− 1·9	−0·4	
	10th	469·6	+34·1	+6·8	
	Mean	503·7			
No. 23. Micrometer on glass, ruled by Prof. J. H. Mulvey (Armour Institute) to tenths and hundredths mm. Spencer stand, Leitz filar, Leitz No. 3 objective. 1 div. = 0·6823 μ	1st	144·5	− 0·0	0·0	Five readings on each end of each space.
	2nd	144·8	− 0·3	−0·2	
	3rd	144·4	+ 0·1	+0·1	
	4th	144·3	+ 0·2	+0·1	
	5th	144·6	− 0·1	−0·1	
	Mean	144·5			
No. 24. Glass micrometer, ruled by H. J. Grayson, Melbourne. One millimetre divided into hundredths, tenths and quarters. Spencer stand, Leitz filar, and Leitz No. 5 objective. 1 div. = 0·2085 μ	1st	477·8	+ 1·0	+0·2	Ten readings on each end of each space.
	2nd	477·9	+ 0·9	+0·2	
	3rd	480·1	− 1·3	−0·3	
	4th	478·3	+ 0·5	+0·1	
	5th	477·9	+ 0·9	+0·2	
	6th	480·7	− 1·9	−0·4	
	7th	478·1	+ 0·7	+0·1	
	8th	480 8	− 2·0	−0·4	
	9th	477·8	+ 1·0	+0·2	
	10th	478·5	+ 0·3	0·0	
	Mean	478·8			
	$\frac{1}{100}$ mm.				
No. 1. Bausch and Lomb micrometer, above described. Spencer stand, Zeiss filar, Spencer 4 mm. ($\frac{1}{6}$ in.) objective. 1 div. = 0·0388 μ	1st	260·4	− 2·3	−0·1	Record Book, page 34. Ten readings on each space. Total length not determined.
	2nd	260·6	− 2·5	−0·1	
	3rd	265·0	− 6·9	−0·3	
	4th	245·2	+12·9	+0·5	
	5th	259·2	− 1·1	0·0	
	Mean	258·1			
	$\frac{5}{100}$ mm.				
Same scale and instruments, except Leitz No. 3 objective. 1 div. = 0·169 μ	1st	292·9	+ 2·3	+0·4	Record Book, page 34.
	2nd	297·5	− 2·3	−0·4	
	Mean	295·2			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{100}$ mm.	div.	div.	μ	
No. 2. Zeiss micrometer, above described. Same instruments as in No. 1 above. 1 div. = 0·0388 μ	1st	255·6	− 2·2	−0·1	Record Book, page 35. Ten readings on each space. Total length not determined.
	2nd	250·5	+ 2·9	+0·1	
	3rd	254·7	− 1·3	0·0	
	4th	256·0	− 2·6	−0·1	
	5th	250·1	+ 3·3	+0·1	
	Mean	253·4			
	$\frac{5}{100}$ mm.				
Same scale and instruments, except Leitz No. 3 objective. 1 div. = 0·169 μ	1st	287·3	In-	In-	
	2nd	287·4	sensible	sensible	
	Mean	287·3			
	$\frac{1}{100}$ mm.				
No. 6. Zentmayer micrometer, above described. Bulloch stand No. 1, Zeiss filar, Spencer 4 mm. objective. 1 div. = 0·03596 μ	1st	277·9	− 2·3	−0·1	Record Book, page 37. Ten readings on each space. Total length not determined.
	2nd	270·9	+ 4·7	+0·2	
	3rd	272·6	+ 3·0	+0·1	
	4th	274·7	+ 0·9	+0·0	
	5th	282·0	− 6·4	−0·2	
	Mean	275·6			
	$\frac{5}{100}$ mm.				
Same scale and instruments, except Leitz No. 3 objective. 1 div. = 0·157 μ	1st	318·4	− 0·7	−0·1	Record Book, page 37. Ten readings on each space.
	2nd	317·0	+ 0·7	+0·1	
	Mean	317·7			
	$\frac{1}{100}$ mm.				
No. 8. Powell and Leland micrometer, above described. Spencer stand, Zeiss filar, Spencer 4 mm. objective. 1 div. = 0·0388 μ	1st	252·7	+ 1·7	+0·1	Record Book, page 36. Ten readings on each space. Total length not determined.
	2nd	254·4	0·0	0·0	
	3rd	254·0	+ 0·4	0·0	
	4th	251·7	+ 2·7	+0·1	
	5th	259·3	− 4·9	−0·2	
	Mean	254·4			
	$\frac{5}{100}$ mm.				
Same scale and instruments, except Leitz No. 3 objective.	1st	287·9	+ 0·9	+0·1	Record Book, page 36. Ten readings on each space.
	2nd	289·7	− 0·9	−0·1	
	Mean	288·8			
	$\frac{5}{100}$ mm.				
No. 9. Fasoldt micrometer, above described. Spencer stand, Zeiss filar, Spencer 4 mm. objective. 1 div. = 0·0388 μ	1st	255·3	+ 2·1	+0·1	Record Book, page 42. Twenty readings on each space.
	2nd	259·1	− 1·7	−0·1	
	3rd	259·6	− 2·2	−0 1	
	4th	258·1	− 0·7	0·0	
	5th	255·1	+ 2·3	+0·1	
	Mean	257·4			
	$\frac{5}{100}$ mm.				
Same scale and instruments, except Leitz No. 3 objective. 1 div. = 0·169 μ	1st	292·3	− 0·2	0·0	Record Book, pages 41, 42.
	2nd	291·8	+ 0·3	0·0	
	Mean	292·1			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{100}$ mm.	div.	div.	μ	
No. 14 Société Genevoise micrometer above described. Same instruments used as in No. 9. 1 div. = 0·0388 μ	1st	256·3	− 1·1	0·0	Record Book, page 33. Twelve readings on each space. Total length not determined.
	2nd	256·7	− 1·5	−0·1	
	3rd	253·3	+ 1·9	+0·1	
	4th	251·8	+ 3·4	+0·1	
	5th	251·1	+ 4·1	+0·2	
	6th	259·6	− 4·4	−0·2	
	7th	254·1	+ 1·1	0·0	
	8th	255·9	− 0·7	0·0	
	9th	256·4	− 1·2	0·0	
	10th	257·2	− 2·0	−0·1	
	Mean	252·2			
No. 15. Nachet micrometer, above described. Spencer stand, Zeiss filar and Spencer 4 mm. objective. 1 div. = 0·0388 μ	1st	254·9	+ 2·6	+0·1	Record Book, page 32. Ten readings in each space. Total length not determined.
	2nd	257·8	− 0·3	0·0	
	3rd	256·6	+ 0·9	0·0	
	4th	254·9	+ 2·6	+0·1	
	5th	258·2	− 0·7	0·0	
	6th	260·7	− 3·2	−0·1	
	7th	255·1	+ 2·4	+0·1	
	8th	263·3	− 5·8	−0·2	
	9th	255·0	+ 2·5	+0·1	
	10th	258·6	− 1·1	0·0	
	Mean	257·5			
No. 16. Watson micrometer, above described. Bulloch stand No. 1, Zeiss filar, Spencer 4 mm. objective. 1 div. = 0·0359 μ	1st	279·0	+ 6·8	+0·2	Record Book, page 38. Ten readings on each space. Total length not determined.
	2nd	314·2	−28·4	−1·0	
	3rd	279·4	+ 6·4	+0·2	
	4th	259·2	+26·6	+1·0	
	5th	297·1	−11·3	−0·4	
	Mean	285·8			
	$\frac{5}{100}$ mm.				
Same scale and same instruments, except Leitz No. 3 objective. 1 div. = 0·157 μ	1st	328·0	+ 2·0	+0·3	Record Book, page 38. Ten readings on each space.
	2nd	332·0	− 2·0	−0·3	
	Mean	330·0			
	$\frac{1}{1000}$ in.				
No. 19. Bausch and Lomb micrometer on glass, divided into hundredths and thousandths inch. Spencer stand, Zeiss filar, and Leitz No. 3 objective. 1 div. = 0·169 μ	1st	157·2	− 8·2	−1·4	Record Book, page 10. Six readings on each space. Total length not determined.
	2nd	143·5	+ 5·6	+0·9	
	3rd	143·2	+ 5·8	+1·0	
	4th	153·9	− 4·9	−0·8	
	5th	154·0	− 5·0	−0·8	
	6th	141·9	+ 7·1	+1·2	
	7th	152·8	− 3·8	−0·6	
	8th	144·5	+ 4·6	+0·8	
	9th	154·2	− 5·2	−0·9	
	10th	145·1	+ 4·0	+0·7	
	Mean	149·0			

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{100}$ mm.	div.	div.	μ	
No. 20. Micrometer ("a I") on glass, ruled on the engine of the late W. A. Rogers to tenths and hundredths mm. Bulloch stand No. 1, Zeiss filar, Spencer 4 mm. objective. 1 div. = 0·03596 μ	1st	274·8	+ 3·4	+0·1	Record Book, page 39. Ten readings on each space. The first $\frac{1}{10}$ m. of "a I" = 100·1 μ.
	2nd	278·8	− 0·6	0·0	
	3rd	278·1	+ 0·1	0·0	
	4th	278·5	− 0·3	0·0	
	5th	281·0	− 2·8	−0·1	
	Mean	278·2			
	$\frac{5}{100}$ mm.				
Same scale and same instruments, except Leitz No. 3 objective. 1 div. = 0·157 μ	1st	317·8	+ 0·1	0·0	Record Book, page 39. Ten readings on each space. The first $\frac{1}{10}$ m. of "a I" = 100·1 μ.
	2nd	318·0	− 0·1	0·0	
	Mean	317·9			

No. 21. "Centimeter A," the standard of the American Microscopical Society, prepared in 1882 by the U.S. Bureau of Weights and Measures, and carefully verified by Professor C. S. Pierce. Surface of platin-iridium; centimetre divided into millimetres, the first millimetre into tenths, and the first tenth into hundredths. Three defining lines mark each sub-division, except the hundredths of a millimetre; the measurements of Professor Pierce were made from the mean position of one triplet of lines to that of another, except in the case of the hundredths of a millimetre, where the defining lines are single.

The following are the corrections of the separate hundredths of the first one-tenth millimetre as determined by Professor Pierce in 1882, including the hundredths mm., between the first and second and the eleventh and twelfth defining lines of the first one-tenth mm.

Space.	Total Correction, Professor Pierce, 1882.	Corrections of Spaces 2 to 11 as determined by Marshall D. Ewell in 1885 and 1889.	Mean of the two series.
$\frac{1}{100}$ mm.	μ		
1st	−0·08	..	
2nd	+0·34	+0·36	
3rd	+0·05	+0·02	
4th	+0·09	+0·06	
5th	−0·41	−0·42	
6th	+0·20	+0·18	
7th	+0·39	+0·29	
8th	−0·19	−0·19	
9th	−0·05	−0·08	
10th	+0·20	+0·16	
11th	−0·18	−0·19	
12th	+0·23	..	

The corrections above recorded as made by the writer were determined from six series of measurements, two of which were made in 1885, and the rest in 1889, with powers varying from 60 to 2250 diameters.

	Space.	Total Corrections.	Length, all Corrections applied.
	$\frac{1}{100}$	μ	μ
No. 22. A standard centimetre on speculum metal by the late W. A. Rogers, divided into millimetres, tenths and hundredths of a millimetre. Correction for the total length = + 0·25 μ. Correction for the tenth one-tenth of the tenth mm. = + 0·02 μ.	1st	+0·11	9·89
	2nd	+0·15	9·85
	3rd	−0·04	10·04
	4th	−0·01	10·01
	5th	+0·09	9·91
	6th	+0·07	9·93
	7th	0·00	10·00
	8th	+0·06	9·94
	9th	+0·15	9·85
	10th	+0·05	9·95

	Space Measured.	No. of Div. of Micrometer.	Relative Corrections. In Div. of Micrometer.	Relative Corrections. In Mikrons.	Remarks.
	$\frac{1}{100}$ mm.	div.	div.	μ	
No. 23. Glass micrometer by Prof. Mulvey, above described. Spencer stand, Leitz filar, and Spencer 4 mm. objective. 1 div. = 0·157 μ	1st	63·0	− 0·1	0·0	Five readings on each end. Total length not determined.
	2nd	62·0	+ 0·9	+0·1	
	3rd	62·9	0·0	0·0	
	4th	62·9	0·0	0·0	
	5th	63·9	− 1·0	−0·2	
	Mean	62·9			
No. 24. Glass micrometer by Grayson, above described. Spencer stand, Zeiss filar, Spencer 4 mm. objective. 1 div. = 0·0388 μ	1st	250·6	+ 5·9	+0·2	Ten readings on each space. Total length not determined.
	2nd	261·6	− 5·1	−0·2	
	3rd	256·2	+ 0·3	0·0	
	4th	257·8	− 1·3	−0·1	
	5th	257·7	− 1·2	0·0	
	6th	254·8	+ 1·7	+0·1	
	7th	256·6	0·0	0·0	
	8th	255·7	+ 0·8	0·0	
	9th	257·2	− 0·7	0·0	
	10th	257·2	− 0·7	0 0	

OBITUARY.

Francis H. Wenham, C.E.

Vice-President Royal Microscopical Society, 1870–1, 1873–4.
Died August 11, 1908. Aged 85.

Mr. Wenham was the originator of numerous mechanical inventions, one of which, his inverted Argand gas-burner, will be familiar to most of us. He devoted about thirty years of his long life to microscopical work, and it is with this portion of his activities that the Fellows of this Society are most concerned. We first meet with him in 1850, when he brought before this Society a metal parabolic reflector; one of these very rare pieces of microscopical apparatus, the first made, is in our cabinet of ancient instruments. In his second paper he described a binocular; this he subsequently improved in 1860, and later in that year he brought out the ortho-stereoscopic binocular, which is still used, and is the best that has ever been designed. In 1873 he designed a high-power non-stereoscopic binocular, which did not come into general use. In the Quarterly Journal of Microscopical Science, ii. (1854) Wenham published a paper on "The Theory of the Illumination of Objects." A perusal of this in the light of modern knowledge is of interest. On page 146 the author says:—"Attempts have sometimes been made to draw the undulatory theory of light into the subject of microscopic illumination, but without any substantial reason, as it has in reality very little or nothing to do with it." Again, on page 152, he says:—"There is one peculiar phenomenon attendant upon oblique illumination at certain angles in one direction, and may be described as a double image, or kind of overlying shadow, having in some instances markings equally distinct with those of the object itself. This appearance has been termed the 'diffracting spectrum' among men of science. Taking the name to be descriptive, I sought for an explanation in the known laws of the diffraction of light, but these did not account for it, for on this theory I attempted to find the clue in vain. I have since traced the cause entirely to the mutual dependence of the angles of illumination and aperture, detailed in this paper. One image is caused by the radiations from the object entering one portion of the object-glass, and a different one by the object being directly seen by intercepted light with the other extreme of the aperture, thus giving the appearance of a double image. In proof of this, hold a card over that side of the front lens of the objective which receives the light from the luminous source, and one image will disappear; on reversing the card, so as to cut off the other extreme, the first image will reappear again, and the second vanish." From this abstract we learn that Wenham thus early originates the celebrated Abbe experiment of cutting out first the inclined "dioptric beam," and then the first "diffraction spectrum." If Wenham had only assigned the origin of the phenomenon to diffraction, and the overlying of the image to spherical aberration, he would have anticipated much that was to follow twenty years later.

On page 150 he describes a method of obtaining a dark ground by cutting out the central rays by a stop placed in the object-glass, a device which has recently been re-invented. In the same year (1854) he designs the method of moving by the correction-collar the back lenses of an object-glass instead of the front, a plan now universally adopted. At that time there was a discussion in progress about apertometers, with reference to one designed by the learned Dr. Robinson (which consisted in illuminating the object-glass through the back, and of measuring the diameter of the disk of light projected upon a card held in front, from which data the tangent of half the angular aperture could be found). Wenham placed a block of glass $\frac{1}{2}$-in. thick, having one side coated by a thin film of bees'-wax. The object-glass to be measured was focused upon the clear side of the glass block, and the disk of light received upon the bees'-wax. The angle in glass was then measured. The following were the results he obtained:—"A $\frac{1}{12}$ having an aperture of 146° on an object mounted *dry*, was reduced to 75° on an object in *balsam*; a $\frac{1}{8}$ of 125° to 71°; a $\frac{1}{5}$ of 105° to 68°; and a $\frac{4}{10}$ of 90° to 56°. . . . These experiments will readily account for the difficulty of discovering the markings or structure of a severe test when mounted in balsam; for, as thus seen, it may be inferred that no aperture exceeding 85° can be made to bear upon it, and this is even supposing that the largest aperture object-glass that has ever been constructed is used." This rather long extract is inserted to show that Wenham was the first to measure the aperture of an object-glass with a glass apertometer, and also to acquaint the reader with the general trend of the argument, which runs through his numerous writings, viz. that resolution is due to the angular inclination of the beam proceeding from the object with the optic axis. Wenham argues that there is a loss in a balsam mount because the angle of the ray proceeding from the object is limited to 41°, whereas in a dry objective it may be 75° or 80°. This was the beginning of the celebrated aperture controversy, which eventually caused his rupture with this Society in 1879. The heated discussions, and amount of personal feeling brought into them, will be remembered by some, and regretted by all. Before dismissing this painful subject, it is greatly to Wenham's credit that, although his theory was physically wrong, and could not be maintained for a moment, his arguments and rejoinders were set forth in temperate language—even when invective and abuse were thrown at him by those who did not possess a tithe of his knowledge on microscopical optics, but were mere babblers of an elementary text-book, which they probably did not comprehend.

In 1855 he made electrotype casts of diatoms, and invented the plan of placing a biconvex lens at the back of an object-glass to correct for the actinic focus. So early as 1855* we find him experimenting with homogeneous immersion. He says:—"I first took a small *hemispherical lens* of about $\frac{1}{90}$ inch radius, and cemented it over a selected specimen of one of the Diatomaceæ (*N. sigma*) with Canada balsam. . . . It will be seen from the position of the object, that each ray of light passing from that point through the surface of the hemisphere, will be transmitted in straight lines, in a radial direction, without undergoing any refraction; the consequence of which is, that the full and undiminished aperture of the object-glass is made to bear upon the object." He placed the diatom, with this hemispherical lens optically connected with it, underneath a dry achromatic object-glass, and so viewed the object through a homogeneous immersion system. He notes the advantage of homogeneous immersion thus:—"I have a specimen of *P. formosum*, mounted in this manner, by which the markings are remarkably well displayed." He suggests that the substage condenser should also be made homogeneous. Although Professor Amici in 1844 experimented with an oil-immersion, Wenham was the first to use one in this country, and probably it was Wenham's writings that drew the attention of Tolles to the importance of this subject, and caused him to make his balsam-immersion objective. It is to Tolles that we are indebted for applying the word "homogeneous" to the immersion principle.

In the Transactions of this Society in 1856 we find a paper where Wenham describes several methods for illuminating microscopical objects by immersion condensers, the fluid used being oil of cloves. The principle here laid down, viz. that of total reflection from the inside of the cover-glass, has been lately re-invented.

In 1859 he designed a tank Microscope, and suggested friction gearing: within recent years his suggestion has been applied to stage movements with success.

Wenham was a very expert mechanic; he not only designed object-glasses, but made them, grinding and polishing the most minute lenses. In the Monthly Microscopical Journal, i. and ii. (1869) he published five valuable papers upon the practical construction of Microscope object-glasses, written from the standpoint of an amateur. In one of these papers he proposed the duplex

* Quart. Journ. Micr. Sci., iii. (1855) p. 303.

front, a form subsequently adopted. He says:—"A partial experiment with a $\frac{1}{4}$ having this 'doublet' front, has proved that perfect correction for colour is the result. But in the form tried, the spherical aberration was so considerable as to require an entire reconstruction, for which I have now no leisure; and though the entire success of the idea is yet unproved, I venture to record it, in case I may never be able to take up this subject again, as I am of opinion that a very perfect object-glass may be made of this form."

Wenham claimed to be the inventor in 1850 of the single front; this invention has been also ascribed to Professor Amici, but I am not aware of any published statement to upset Wenham's claim. All improvements in Microscope object-glasses were trade secrets, and it is at the present time a matter of no little difficulty to find out their true history.

In 1871 we find the aperture controversy still raging. Wenham says:—"The loss of aperture on balsam-mounted objects was demonstrated by me on correct optical laws known ages ago, and I am astonished that in the nineteenth century anyone can dare to dispute it as a fact."

Wenham was not, and never claimed to be, either a mathematician or a physicist. He explains his method of designing object-glasses by means of graphic delineation and of trial and error, which he had learnt from the personal teaching of Mr. J. J. Lister. The paths of the various rays were plotted down on an enlarged diagram of the object-glass; the sines of the angles of incidence and refraction were placed upon a large pair of proportional compasses, set to the index of refraction. This probably was the method employed by all Microscope object-glass makers at that time.*

Plotting may do fairly well for marginal rays, but with axial rays it fails altogether, and, so far as I am aware, axial rays can only be dealt with by trigonometry, or by the Gauss method, both of which were probably beyond Wenham's mathematical capabilities.

This lack of familiarity with elementary mathematics was a cloud which obscured his vision on many important points; if only it could have been lifted, what an inventor he would have been! For instance, the mere elements of algebra would have enabled him to turn his "duplex" front, which by itself is unimportant, into the "aplanatic" front, the main feature of the modern object-glass.

In 1872 his reflex illuminator appeared; this was a kind of immersion Nachet prism. It did not come into very general use, because it was soon superseded by immersion condensers.

In 1873 Wenham brought out an objective upon a new formula—a single front and back and a triple middle; a single flint cor-

* Wenham gives an interesting example in the Monthly Micr. Journ., v. (1871) p. 19, fig. 1.

recting the aberrations of the four crown convex lenses.* From an examination of one of these lenses, a $\frac{4}{10}$, in the author's possession, it appears that the lens has an initial power of 25 with an N.A. of 0·65. It is supplied with two stops, which reduce the aperture to 0·52 and 0·35 N.A. respectively. When full aperture is used, some spherical aberration is apparent, but when the 0·52 N.A. stop is inserted the lens performs very well indeed, and for its day it was quite a good glass: in fact, it was only superseded by the advent of the 12 mm. and 8 mm. apochromats.

In 1876 Wenham published an aperture table giving the N.A. values for dry lenses of various angular apertures, to show that there was not much more to be gained after an angle of 150° had been reached.†

Wenham's "button" was brought out in the English Mechanic.‡ This "button," or really half button, consisted of a semicircular disk of glass about ½ in. diameter and ⅓ in. thick. The circular edge was curved at right angles to the plane of the disk, and the flat diameter was oil-immersed to the underneath part of the slip, by which means light of great obliquity could be focused on a balsam-mounted object. This, so far as I know, was Wenham's last microscopical invention. He published several papers upon the microscopical examination of objects, notably upon the structure of the *Podura* scale. Wenham was optical adviser to Messrs. T. Ross and Co. for about ten years (1870–80).

In the above notice the author has given a fairly complete list of Wenham's microscopical inventions, designs, and methods of work, so that the reader may be able to form his own estimate of Wenham's influence upon the progress of "Microscopy."

EDWARD M. NELSON.

* A diagram with traced rays is given in the Monthly Micr. Journ., ix. (1873) p. 163. † Monthly Micr. Journ., xvi. (1876) p. 287.

‡ English Mechanic, xxx. (1879).

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology.†

Development of Mammalian Pituitary Body.‡—P. T. Herring has studied this in the cat and other mammals. In the cat the posterior lobe of the pituitary body remains hollow throughout development, whereas in most of the mammals that have been studied in this connection the posterior lobe becomes a solid structure at a comparatively early stage.

The epithelial portion is derived entirely from the ectodermic wall of the buccal invagination known as Ratke's pouch. Its origin is single and mesial. The epithelium is differentiated at an early stage into two parts, which show differences in arrangement, structure, and vascularity. One of these, the pars intermedia, is closely adherent to the wall of the cerebral vesicle from its earliest appearance, and remains in intimate association with it. The other portion of buccal epithelium gives rise to the anterior lobe proper. The lower portion of Ratke's pouch, which is not adherent to the brain, forms a solid mass of cells which grow into surrounding blood-channels and into the cavity of the pouch itself. The original cavity of Ratke's pouch persists as a narrow cleft separating the anterior lobe proper from the epithelial portion of the posterior lobe.

The infundibulum is an invagination of part of the wall of the thalamencephalon which is adherent to the anterior and upper wall of Ratke's pouch. It therefore possesses an epithelial covering derived from the latter. The infundibular process grows backwards, and, in the cat, retains its central cavity. It is lined by ependyma cells which

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, etc., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, Reproduction, and allied subjects.

‡ Quart. Journ. Exp. Physiol., i. (1908) pp. 163–85 (11 figs.).

during development become elongated, so that ependyma fibres run obliquely in its neck. The body of the lobe consists of ependyma and neuroglia cells and fibres; no true nerve-cells are present in it, and there is very little connective-tissue. The posterior lobe of the pituitary is, from the first, a composite structure of epithelium of the pars intermedia and of neuroglia and ependyma, and the relations between the two tissues become more and more intimate. Its vascular supply is derived from a different source from that of the anterior lobe; blood-vessels grow into it at its posterior-superior angle, and form the capillaries in the lobe.

The intimate nature of the connection between the wall of Ratke's pouch and the cerebral vesicle, and the maintenance of a close relationship between the cells of the pars intermedia and the cerebrospinal canal, render it probable that the pituitary body of Mammalia is to be regarded as the representative of an old mouth opening into the canal of the central nervous system. Such an arrangement exists in its simplest form in the Ascidian larva. A connection between Ratke's pouch or original mouth-cavity and the interior of the infundibulum is sometimes seen in the developing cat, and in the adult cat it is not uncommon to find epithelial cells, derived from the buccal cavity, lying inside the posterior lobe, in communication with the third ventricle of the brain.

The anterior lobe proper is a gland whose secretion must enter the blood directly, and so pass into the general circulation. The pars intermedia, on the other hand, appears to secrete into the brain tissue, and must be regarded as a brain gland. The nature of these secretions, and the question as to whether that of the pars intermedia is modified by its passage through brain-substance, await further investigation.

Orientation of Embryo in Hen's Egg.*—E. Raband finds that there is for every embryo a fixed orientation, at least during the first few days of development; that the mobility of the yolk does not allow of any rotation; and that there is never more than oscillation. During the first five or six days, at least, the position of the yolk remains practically fixed.

Apparent Anomalies in Mendelian Proportions.†—L. Cuénot considers a number of experiments in mice-breeding, where the numerical results do not at first sight seem to agree with Mendelian expectations, and shows that they are not difficult to explain. He maintains confidently that all the determinants known in mice illustrate Mendelian inheritance.

Inheritance in Canaries.‡—Charles B. Davenport has made observations on inheritance in domestic canaries, and shows that distinctive characters which have arisen during the 250 years or so of its controlled breeding (a short time compared with the 2000 years or more during which poultry have been bred) behave in Mendelian fashion.

Crest is dominant over plain head. Baldness is a unit-character and

* Arch. Zool. Exper., ix. (1908) Notes et Revue, No. 1, pp. i.–vi.
† Tom. cit., pp. vii.–xv.
‡ Publications of Carnegie Institution of Washington, 1908, pp. 1–26 (3 pls.).

is recessive to perfect crest. The yellow canary is derived from the original green canary by the loss of black. It carries a mottling factor. Consequently when the yellow canary is crossed with a pigmented canary or with a finch, the hybrids are mottled.

The mottling is not a fixed pattern. The spots vary in position and relative size ; they may cover nearly the whole body or they may form a mere "ticking." The degree of mottling is inheritable. Ticking behaves as a unit-character. Mottling is a heterozygous character and throws mottled, clear yellow, and self-greens.

The principle of localisation of the units of a complex plumage must be recognised. The cap of the Lizard canary, the red face of the goldfinch, the shoulder-striping of the green canary, are not only unit-characters, but they occur only at their proper localities and in their proper forms in the body plumage. In mottled canaries the presence of black on the shoulder means striping, on the wing it means dead black white-laced remiges, on the mid-breast it means a uniform olive colour. The plumage of a yellow canary may be compared with a letter that has been written with invisible ink. Wherever the developer acts (i.e. the black pigment of the green canary is added) that which is written appears with all of its idiosyncrasies.

Transmission of Coat-characters in Rats.* — G. P. Mudge finds that albinos breed true to albinism, whether their ancestry is pigmented or not. Albinos which appear to be identical in their coat-character may be in reality quite different. The author's experiments give "an ocular demonstration of the actual presence of the coat-pattern in albinos," and the interpretation is corroborated by breeding results.

It is further shown that when a piebald black rat is mated with a similar one, two classes of offspring may be obtained. One of these contains all black piebalds, and the other a mixture of black piebalds and albinos in nearly equal numbers.

When a piebald black rat is mated with an albino, it may be said that, so far as the author's experiments have gone, five different results may be obtained : (1) the offspring are all black piebalds ; (2) they may be a mixture of black piebalds and albinos ; (3) they may be all "Irish" forms (= black self-coloured) ; (4) they may be a mixture of albinos, black piebalds, and "Irish" ; (5) they may contain albinos, "Irish," and a grey form. "It can be shown that the divergence of the results obtained when two individuals apparently similar are mated is due to the gametic nature of the albino employed."

Transplantation of Ovaries.†—F. H. A. Marshal and W. A. Joly, experimenting chiefly with rats (in one case with a monkey), find that ovaries are more readily transplanted into the kidney than on to the peritoneum ; that homoplastic transplantation (within the same animal) is easier than heteroplastic transplantation (to another animal) ; that the latter seems to be easier when the animals are near relatives ; that the presence of an animal's own ovaries does not seem to exert any inhibitory influence on the successful attachment and growth of

* Proc. Roy. Soc., Series B, lxxx. (1908) pp. 388-93.
† Quart. Journ. Exp. Physiol., i. (1908) pp. 115-20 (1 fig.).

additional ovaries; and that the presence of a successfully grafted ovary in an abnormal position, whether from the same or from another individual, is sufficient to arrest the degenerative changes in the uterus which usually take place after complete extirpation of the ovaries. It may be concluded that the ovarian influence is chemical rather than nervous in nature.

Mendelian Characters among Short-horn Cattle.*—James Wilson maintains that the modern short-horns are descended from two races, the White Roman and the Red Saxon, the "red" including red, red with little white, and red and white. Statistics taken from the "Short-horn Herd-book" are summed up in the following table:—

			Reds.	Roans.	Whites.
438	reds crossed by	reds produce	413	25	—
3	whites	whites	—	—	3
135	whites	reds	7	128	—
514	roans	roans	152	278	84
1008	roans	reds	483	521	4
74	roans	whites	3	47	24

These figures do not come out in Mendelian ratios with perfect accuracy, but the discrepancies can be explained as the result of three causes: (1) that it sometimes requires a close examination to distinguish a red from a roan calf; (2) white short-horns, being of smaller money value than roans or reds, are often left unregistered; (3) among unscrupulous breeders the substitution of a coloured calf for a white one is not unknown, a white calf's pedigree being bestowed upon a roan or a red.

Another set of data—consisting of entries by careful breeders in vol. lii. of the "Herd-book"—shows an approximation to Mendelian ratios, bearing out the historical inference that the roan short-horn is a hybrid between two races, one white, the other "red." This second table is:

			Reds.	Roans.	Whites.
95	reds crossed by	reds produce	90	5	—
1	white	white produces	—	—	1
78	reds	whites produce	—	78	—
370	roans	roans	90	178	102
426	roans	reds	214	209	3
53	roans	whites	—	34	19
1023					

New Views concerning Fertilisation and Maturation.†—Julius Ries argues in favour of various new views, e.g., that the spermatozoon, as a whole, enters the ovum and moves there; that the astrospheres arise from the residue of the tail; that the division of the centrosome is associated with a division of the tail of the spermatozoon; that the ovum-centrosome passes out with the polar bodies.

Spermatozoa of Seals.‡—E. Ballowitz describes the minute structure of the ripe spermatozoa of *Phoca vitulina*, but he does not find any peculiarity. They closely resemble the spermatozoa of Carnivores, especially of the dog.

* Scient. Proc. R. Dublin. Soc., xi. (1908) pp. 317–24.
† MT. Nat. Ges. Bern, Nos. 1629–1664 (1908) pp. 43–57 (15 figs.).
‡ Anat. Anzeig., xxxiii. (1908) pp. 253–6 (6 figs.).

Development of Kidney in Teleosteans.*—L. Roule and I. Audigé have studied various Teleosteans, e.g., *Cepola rubescens*, and find that the kidney includes pronephros, mesonephros, and metanephros, or, rather, that this distinction is not valid, the series of tubules being really continuous both as regards space and time.

Development of Notochord in Fishes.†—Louis Roule has studied this in the perch. He finds that the notochord arises directly from the archenteron as a compact cellular axis, whereas in Tunicates it is due to a diverticulum of the archenteron, possibly comparable to the post-anal gut in higher Chordata. In fact, the notochord of Tunicates is not strictly homologous with the notochord of Fishes.

Embryonic Circulation in Goldfish.‡—P. Wintrebert has studied the transparent embryos of *Carassius auratus*, and finds that the blood from the caudal artery passes forwards by a median trunk vein, posterior cardinal veins, and the ducts of Cuvier. Between these and the auricle there is, in place of the sinus venosus, a very large lacuna, which spreads over the whole surface of the vitellus. There is no sub-intestinal vein. The first vitelline circulation is thus entirely venous, but subsequently there is a secondary arterial circulation.

Hybrid between Bream and Rudd.§—C. Tate Regan describes from Lough Erne what seem to be hybrids between bream and rudd (*Abramis brama* × *Leuciscus erythrophthalmus*), and compares them with hybrids between bream-flat (*A. blicca*) and rudd.

b. Histology.

Minute Structure of Mammalian Pituitary Body.‖—P. T. Herring has studied this in cat, dog, and monkey. The pituitary body may be divided into two parts, which show structural differences probably indicative of distinct functions. The anterior lobe, consisting of large granular cells and numerous blood-vessels, is a gland of internal secretion of undetermined function, but which may influence growth. The posterior lobe consists of two structures. The part developed from the brain, and consisting of neuroglia and ependyma cells and fibres, acts as a framework. It is more or less surrounded and invaded by epithelium, which is probably the active part. There is histological evidence of a secretion produced by the epithelial cells, which apparently passes into lymph-vessels, and is destined to enter the ventricles of the brain. The posterior lobe is a brain-gland, not by virtue of tissue of brain origin, but by the growth into it of epithelial cells of ectodermic origin. Extracts produce marked effects on cardiac and plain muscle-fibres, comparable in some respects to the action of the medulla of the supra-renal capsule; they have a selective action on the kidney, causing dilatation of the renal blood-vessels and diuresis. Disturbances of the posterior lobe of the pituitary are probably responsible for the occur-

* Comptes Rendus, cxlvii. (1908) pp. 275–7.
† Op. cit., cxlvi. (1908) pp. 1423–5.
‡ Comptes Rendus, cxlvii. (1908) pp. 85–7.
§ Ann. Nat. Hist., ii. (1908) pp. 162–5 (2 pls.).
‖ Quart. Journ. Exp. Physiol., i. (1908) pp. 121–59 (16 figs.).

rence of the diabetic conditions which have been frequently recorded in cases of acromegaly and of affections and lesions associated with the base of the skull.

Three types of Mammalian pituitary body are recognised. In one, e.g. the cat, the posterior lobe is hollow and in free communication with the third ventricle, while the epithelium of the anterior lobe forms an investment for the posterior lobe. In the second type, e.g. the dog, the body of the posterior lobe is solid, but the neck is hollow and communicates with the third ventricle, and the anterior lobe again forms an investment. In the third type, e.g. man, monkey, ox, pig, and rabbit, the body and neck of the posterior lobe are solid, although traces of a cavity are occasionally found in the neck; in this type the epithelium does not invest the posterior lobe so completely, but is aggregated around the neck and spreads over and into the adjacent surface of the brain.

The epithelial portion of the pituitary body is differentiated into (*a*) an anterior lobe proper, consisting of solid columns of cells, between which run wide and thin-walled blood-channels; and (*b*) an intermediate portion, which lies between the anterior lobe and the nervous tissue of the pituitary, forming a closely fitting investment of the latter.

The anterior lobe contains cells which are clear or hold in their protoplasm varying amounts of deeply staining granules. They are probably different functional stages of one and the same kind of cell, and the granules give rise to a secretion which is absorbed by the blood-vessels.

The intermediate portion consists of finely granular cells, arranged in layers of varying thickness closely applied to the body and neck of the posterior lobe and to the under surface of the adjacent parts of the brain. The part of it which is separated from the anterior lobe by the cleft is almost devoid of blood-vessels. In the cat the portion lying in front of the anterior lobe has a tubular appearance, and is very vascular. Colloid material occurs between the cells of the pars intermedia, and in most situations appears to pass into the adjacent nervous substance, to be absorbed by blood-vessels or lymphatics.

The nervous portion of the pituitary body is made up of neuroglia cells and fibres. Ependyma cells line the central cavity in the cat and send long fibres forwards and upwards towards the brain, most of which terminate in the outer part of the neck. There are no true nerve-cells, and the nerves supplying the pituitary probably reach it through sympathetic fibres accompanying the blood-vessels (Berkeley.) The nervous portion is invaded to a large extent by the epithelial cells of the pars intermedia. Columns of epithelial cells grow into it, especially in the neck, and islets of these cells occur frequently throughout the posterior lobe. In the pituitary of the cat, epithelial cells may even grow into its central cavity.

A substance histologically resembling the colloid of the thyroid gland, but probably of a different nature, occurs in large quantity in the nervous portion of the posterior lobe. It appears to be a product of the epithelial cells, and, in the cat at any rate, to be carried by lymphatics into the central cavity, and so into the third ventricle of the brain. In this respect the posterior lobe of the pituitary is an infundibular gland. Whether this substance is modified by its passage through the nervous substance or not is unsettled. Its distribution corresponds with the site of the tissue, the extracts of which have active physiological results when injected into the blood.

The anterior lobe of the pituitary is extremely vascular and its circulation sinusoidal. The posterior lobe is supplied for the most part by a central artery which enters it at its postero-superior angle, and runs forward, giving off branches; the veins begin immediately below the epithelial investment and run backwards in this situation, to emerge near the entry of the artery. The veins of both lobes enter large blood sinuses lying close to the sides of the pituitary body.

Histological evidence is against the statement of Bela Haller that the anterior lobe is a tubular gland which pours its secretion directly into the subdural space.

Spiral Muscle-fibres.*—Ivar Thulin describes in the hyoglossus muscle of *Bufo agua* and in the chamæleon's tongue-muscle the occurrence of fibres with spirally arranged muscle-columns. He has found similar structures in frogs and in the human uvula.

c. General.

Action of Extracts of Saccus Vasculosus and Pituitary Body.†—P. T. Herring has experimented with extracts of the saccus vasculosus and pituitary body in certain fishes. In Elasmobranchs, e.g. *Raia batis*, the saccus vasculosus is large and paired, and its lobes open by a common median passage into the infundibulum, and so into the third ventricle of the brain. In Teleosts it is single and situated in the middle line between the inferior lobes of the pituitary body. In both skate and cod the saccus vasculosus consists of a complicated sac lined by a single layer of columnar epithelium, which is separated from numerous large and thin-walled blood-vessels by a thin basement membrane. The wall is thrown into folds, especially in the cod.

Extracts of the saccus vasculosus made by boiling it in Ringer's fluid have no marked physiological action when injected into the blood-vessels of a cat. The results are practically those of an injection of Ringer's fluid.

The pituitary body of the skate, and, according to Gentes, of Elasmobranchs generally, has no posterior lobe. Nor does it possess the granular cells of the anterior lobe of higher Vertebrates. Yet it is a large body with the features of an internally secreting gland, and an injection of its extract produces a slight fall of blood pressure, a dilatation of the kidney, and some increase in urine flow. In Teleosts the pituitary body consists of an anterior lobe proper characterised by the presence in it of deeply staining granular cells, an intermediate part of smaller clear cells, and a nervous portion. The latter is surrounded and invaded by cells of the pars intermedia. Extracts of this portion of the pituitary body, pars nervosa and pars intermedia, produce in the cat

* Anat. Anzeig., xxxiii. (1908) pp. 241–52 (13 figs.).
† Quart. Journ. Exp. Physiol., i. (1908) pp. 187–8.

the typical effects of extracts of the posterior lobe of Mammals, namely rise of blood-pressure, dilatation of the kidney, and increase of urine.

Dancing Mouse.*—R. M. Yerkes has studied the behaviour of this domesticated animal, of unknown origin, which is characterised by its inability to move far in a straight line without whirling or circling about with extreme rapidity. The author can find no satisfactory grounds for regarding the dancer as abnormal or pathological. It is a peculiar variation which has been the subject of artificial selection. Yerkes has experimented as regards hearing, vision, educability, duration of habits, and individual differences in behaviour. He found no evidence of the transmission of an acquired habit of behaving advantageously.

Though able to squeak, and though capable of ear movements as of listening, the dancing mouse is quite deaf, except, in some instances, during the third week of life. Brightness-vision is fairly acute ; colour-vision is poor—most of their apparent discrimination of colour is due to differences in brightness ; form is not clearly perceived ; movement is readily perceived.

The mice learn to use a swinging door that has to be pushed on one side and pulled on the other ; they are not helped by seeing other mice do a thing, but are helped by being put through it themselves ; certain acquired habits were remembered after 2–8 weeks of disuse ; if forgotten, re-learning was easier. Initiative and plasticity do not decrease up to an age of 18 months, the oldest studied.

Yerkes' method consisted in a sort of "Lady or the Tiger" alternative presented to the unsuspecting mouse. He is invited to enter one of two doors : one leads to an electric shock, the other to freedom and food. The doors are marked by different signs—cards of different shapes, markings, colour, brightness, odour, etc.—and these can be readily alternated. The mouse tries at first the plan of returning to the right or left door according as he has found that to be correct ; when he finds that the correct portal is being alternated, he learns to alternate in his choices ; when there is no regularity in the changes, the mouse uses all its senses in determining which is the correct door to enter, and learns finer and finer shades of discrimination.

"Most Mammals which have been experimentally studied have proved their eagerness and ability to learn the shortest, quickest, and simplest route to food without the additional spur of punishment for wandering. With the dancer it is different. It is content to be moving—whether the movement carries it directly to the food-box is of secondary importance. On its way to the food-box, no matter whether the box be slightly or strikingly different from its companion box, the dancer may go by way of the wrong box, may take a few turns, cut some figure-eights, or even spin like a top for a few seconds almost within vibrissa-reach of the food-box, and all this even though it be very hungry."

* The Dancing Mouse: a Study in Animal Behaviour. New York: The Macmillan Co., 1907, xxi. and 290 pp. (33 figs.). See also Amer. Naturalist, xlii. (1908) pp. 207–10.

What is a Species ?—S. W. Williston * says that there is no answer and never will be any answer to the question, What is a species? which has been asked continuously since the time of Linné. "As we have long since learned that species, like Topsy, just 'grew,' we have and always shall have as great difficulty in deciding when varieties and races become species as we have in determining when a puppy becomes a dog or a lamb a sheep."

"The only biological entity is the individual, and the individual is inconstant." . . . "Accumulated heredity may outweigh natural selection or environment, and vice versa." . . . "New phyla arise from crescent phyla, never from decadent or even dominant ones." . . . "Senility and decadence are the attributes of species, families, and orders, as well as of the individual." . . . "The older the genus or allied group of species, the more restricted, apparently, is fertile hybridity." . . . "Secondary sexual characters are transmitted to the opposite sex, unless of positive disadvantage." . . . "Secondary sexual characters are more numerous and less stable in the male than in the female." . . . "An organ once functionally lost is never permanently regained." . . . "Gigantism is an indication of approaching decadence." . . . "Fertility depends chiefly upon the inheritance of physiological characters."

The author is a taxonomist who has named and described a thousand or more species. What rules has he? "Forms of animals which present distinct assemblages of characters, in form, colour, and arrangements of parts under natural conditions, which are recognisable from descriptions and figures, should receive distinctive names and be catalogued, provided, of course, that the assemblage of characters includes all ontogenetic changes. If, in the examination of abundant material from different natural environments, we find these characters fairly constant, the forms may properly be called species, if not varieties or races."

Functions of Membranes.†—H. Zangger has made a study of the role of membranes in normal and abnormal functioning. He discusses the formation and critical thickness of membranes, the reversible and irreversible changes in permeability, and similar questions, showing how very important membranes are in the economy of the body.

New Horse from Lower Miocene.‡—F. B. Loomis describes *Parahippus tyleri* sp. n., closely related to *P. nebraskensis*, which helps to fill in part of the gap between the rich Oligocene *Mesohippus* fauna and the Upper Miocene *Protohippus* group, just where the transition from the Brachydont uncemented teeth to the Hypsodont cemented ones occurs.

Occasional Luminosity of White Owl.§—R. J. W. Purdy brings forward the testimony of many observers in North Norfolk to the effect that two birds in the district—almost certainly owls (*Strix flammea*)—are occasionally luminous.

* Amer. Nat., xlii. (1908) pp. 184–94.
† Viert. Nat. Ges. Zürich, lii. (1908) pp. 500-36.
‡ Amer. Journ. Sci., xxvi. (1908) pp. 163–4 (1 fig.).
§ Trans. Norfolk and Norwich Nat. Soc., viii. (1908) pp. 547–52.

Pecten in Bird's Eye.*—V. Franz publishes a note on discoveries made in regard to the pecten in the course of his study of the bird's eye. The pecten is not a derivative of the choroid, but, with the exception of the vessels which arise from the ophthalmic artery, it consists entirely of nervous tissue, and is derived from the optic nerve. Even the walls of the vessels are, with the exception of the endothelium, of nervous origin. On its surface the pecten bears sensory hairs and sensory papillæ. It is, therefore, an intra-ocular sense-organ, and all the peculiarities of its structure, macroscopical and microscopical, indicate that it serves for the perception of the intra-ocular fluctuations of pressure which arise from the movements of the lens in accommodation. It is highly probable that the distant objects seen are more clearly perceived by its means.

New Jerboa from China.†—Oldfield Thomas describes a three-toed species of jerboa from Shensi, China. The only jerboa hitherto known from China has been the five-toed *Allactaga mongolica* Radde, and the finding of this species greatly enlarges the known range of the three-toed jerboas, which had hitherto not been recorded east of Central Asia. The species in question is a distinct form, closely related to *Dipus sagitta* and its ally *D. deasyi*, but considerably larger than these species. The author fully describes the new species, to which he gives the name *D. sowerbyi*, in honour of its discoverer.

Experiment with the Oviduct of the Hen.‡—R. Pearl and F. M. Surface describe one of a series of experiments being carried on with a view to gaining more complete and definite information concerning the functions and normal physiological activity of the different parts of the oviduct in the hen. A relatively large portion of the glandular, albumen-secreting portion of the oviduct—actively functioning, and therefore highly vascular—was removed, and a perfect end-to-end anastomosis, without loss of function, was obtained. The first egg laid after the operation was slightly abnormal in shape, but all subsequent eggs were normal both as to form and contents, though they were slightly smaller than the average for the same breed.

Asiatic Red-bellied Newt.§—E. R. Waite writes a note on the breeding habits of the Red-bellied Newt (*Molge pyrrhogastra*), which he succeeded in inducing to breed in captivity. It does not appear to differ markedly from the European *M. cristata*. The first eggs were laid in October, and incubation, in water, at a temperature of 55–65° F., took sixty days. Various plants were kept in the tank, but *Vallisneria* was always the one selected to receive the eggs. A floating portion of a terminal leaf was folded over on itself, the single egg being glued within it. If removed from the plant the egg sinks, but develops normally at the bottom of the tank. The larvæ grow rapidly after hatching, but will probably require years to mature, as do those of *M. cristata*.

* Biol. Centralbl., xxviii. (1908) pp. 449–67 (24 figs.).
† Ann. Nat. Hist., ii. (1908) pp. 307–8.
‡ Amer. Journ. Physiol., xxii. (1908) pp. 357–61 (1 fig.).
§ Proc. Linn. Soc. N.S.W., xxxiii. (1908) pp. 66–7.

Anatomy of Australian Amphibia.* — Georgina Sweet has investigated the anatomy of eight Australian Amphibians: *Hyla aurea, H. lesueurii, Notaden bennetti, Pseudophryne australis, Crinia signifera, Heleioporus pictus, Chiroleptes alboguttatus, Lymnodynastes dorsalis*, with special reference to the opening of the nephrostomes from the cœlom, and the connection of the vasa deferentia with the kidney. Nephrostomial openings were found in all the forms. There was considerable evidence that, in the course of their disappearance in the adult condition, during the evolution of the group, the nephrostomes have been subjected to well-marked modifications, their original connection with the kidney tubules being transferred to the renal vessels. Likewise, their function has changed from that of conducting fluid from the body-cavity to the exterior, to that of lymph-vessels. Moreover, their degree of development seems to be, to a great extent, individual, or characteristic of the species, varying greatly in harmony with their functional importance, both in turn being associated apparently with differences in the habits of the animal. In *Notaden bennetti*, along with the greater development in one direction, there seems to have been a check to the harmonious development of these structures in all parts of the kidney, since there are still present along the edges nephrostomial tubules in various stages of modification as to their internal connections.

In all the species studied, of which male specimens were obtained, it was found that the separation of the male reproductive ducts from the excretory ducts has not begun, the condition being comparable to that found in *Rana esculenta*, the higher stage found in *Rana fusca* not being present in the Australian species so far examined. They are, therefore, far less specialised than are the corresponding parts in *Alytes obstetricans*, which are the most specialised known in the Anura.

Corpora adiposa in Frog.†—R. Robinson brings forward some evidence to show that these bodies play an important, still undefined rôle in the economy of the frog.

Function of Optic Lobes in Fishes.‡—José Gómez Ocaña brings forward some evidence, based on experiments on goldfish, to show that the optic lobes are concerned not only with visual impressions, but are important in connection with the movements and equilibrium of the body.

Mimicry in the Common Sole.§—A. T. Masterman describes the habits of the two common species of weever (*Trachinus*), and suggests that the black patch of the pectoral fin in the sole is a case of mimicry in relation to the black dorsal fin of the weever, which is supposed to act as a danger signal. The sole shares with the plaice, turbot, and some other flat-fish, the habit of lying concealed in the mud at the approach of an enemy. But, unlike them, it does not, when concealment becomes useless, scurry away with rapid, striking movements, in which the fins

* Proc. Roy. Soc. Victoria, xx. (1908) pp. 222–49 (2 pls.).
† Comptes Rendus., cxlvii. (1908) pp. 277–9.
‡ Bull. Soc. Españ. Hist. Nat., viii. (1908) pp. 247–9 (1 fig.).
§ Journ. Linn. Soc. (Zool.) xxx. (1908) pp. 239–44.

are seen to take part. The upper pectoral fin is erected sharply and spread out, and is not employed as a motor fin. It thus forms a motionless black flag, held up conspicuously, like that of the weever, and with exactly the same menacing attitude. The following considerations are urged in support of the hypothesis. 1. That the geographical distribution of *Solea vulgaris* and its nearest allies is closely similar to, if not identical with, that of the two common species of *Trachinus*. 2. That the sand-loving and sand-hiding habits of the two forms are closely similar, and that they actually inhabit the same grounds, the young soles with *T. vipera*, and the adults in deep water with *T. draco*. 3. That on disturbance each type holds its black fin erect in a menacing manner; that of the sole is held at right angles to the normal position for the Pleuronectidæ. 4. That the pectoral fin of other Pleuronectidæ, or even Soleidæ, is not coloured black, and is not held erect in the same manner.

Production of Sound in Drum-fishes.*— R. W. Tower gives an account of a series of experiments undertaken with a view to determining the cause of the production of sound in the drum-fishes (Sciænidæ), in the sea-robin (*Prionotus carolinus*), and the toad-fish (*Opsanus tau*). The structure of the swim-bladder in these forms is described and figured, and an account is given of hitherto recorded observations and theories on the subject. The experiments show that the scianoid fishes which make a drumming noise have specific sound-producing muscles, which are only superficially attached to the swim-bladder. For this drumming-muscle the name of "musculus sonificus" has been proposed and adopted. The chief cause of the drumming noise is the contraction of the musculus sonificus, which produces a vibration of the abdominal walls and organs, especially of the swim-bladder.

The sea-robin and the toad-fish, which make a "grunting" noise, have muscles which are intrinsically connected with the swim-bladder, and are known as intrinsic muscles. The noise is caused by a contraction of these muscles, which produce a vibration in the walls of the air-bladder. The mechanism in the Sciænidæ is adapted to the production of rapidly repeated sounds. That in the sea-robin and toad-fish is adapted to the production of sounds at more or less long intervals.

Tunicata.

Californian Ascidians.†—W. E. Ritter gives an account of the Ascidians collected by the 'Albatross' off the Californian coast. He deals with fourteen species, twelve of which are new. The new genus *Halomolgula* has a test beset with processes containing calcareous spicules; the new genus *Benthascidia* is long and pedunculate, with a non-closable branchial orifice, with a very delicate branchial membrane without true stigmata.

Winter-buds of Clavellina Lepadiformis.‡— H. Kert gives a detailed account of the formation, structure, and history of the winter-

* Ann. New York Acad. Sci., xviii. (1908) pp. 149–80 (3 pls. and 5 figs.).
† Univ. California Publications, Zoology, iv. (1907) No. 1, pp. 1–52 (3 pls.).
‡ Arch. Mikr. Anat., lxxii. (1908) pp. 386–414 (1 pl.).

buds—analogous to statoblasts in Bryozoa and gemmules in Sponges—in this Ascidian. He discusses the difficult fact that the bud arises from ectoderm and mesenchyme, and yet forms an entire animal. The conception of homology breaks down in the case of buds; organs may be isomorphic and analogous, and yet not homologous, being heterogenetic.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Defensive Pallial Glands in Scaphander.* — Rémy Perrier and Henri Fischer find that *Scaphander lignarius* shows a high degree of differentiation as regards pallial glands. When the animal is irritated it emits a yellowish viscous fluid which appears to be defensive. The secretion is produced by glands in the mantle. There are two kinds, (1) the glands of Blochmann (described in *Aplysia*, etc.) along a zone on the under surface of the mantle parallel to its margin; and (2) the intra-pallial glands immediately in front of the anterior lip of the pallial aperture.

Sense of Taste in Fresh-water Snails.†—Henri Piéron has experimented with *Limnæa auricularis* and *L. stagnalis*, and finds that the sense of taste, of "alimentary discrimination," as he calls it, is localised in the most anterior part of the foot. The same region shows sensitiveness to strong odours, but this olfactory sensitiveness is demonstrable over a wider area than the gustatory sensitiveness. It is found on the margins of the foot to the posterior end, on the head, and at the osphradium.

Feeding Habit of Fulgur and Sycotypus.‡ — H. S. Colton has studied the behaviour of these Gastropods, which live well in captivity. *Fulgar* probably attacks any Lamellibranchs; *Sycotypus* will attack any except *Venus*. Oysters are eaten in less than one hour, clams in $1\frac{1}{2}$ hour, quahogs (*Venus mercenaria*) in from seven hours to three days. The animals do not bore the shells with the radula. They open shells of oysters by wedging their own shell between the valves, and tear out the flesh with the radula. Some shells are partly broken in this way.

The meals of *Fulgur* and *Sycotypus* are few and far between. The time between meals is spent buried in the sand. No clear evidence of intelligence was discovered.

Arthropoda.

α. Insecta.

House-fly.§—C. G. Hewitt publishes the second of three papers on the house-fly (*Musca domestica*). The present paper deals with the breeding habits and with the structure of the larva. Horse-manure is preferred by the female as a nidus for the eggs, but all sorts of excrementitious matter, as well as rotting cloth, decaying vegetables, and the like, may

* Comptes Rendus, cxlvi. (1908) pp. 1163–6.
† Op. cit., cxlvii. (1908) pp. 279–80.
‡ Proc. Nat. Sci. Philadelphia, 1908, pp. 3–10 (5 pls. and 1 fig.).
§ Quart. Journ. Micr. Sci., liv. (1908) pp. 495–545 (4 pls.).

be used. Temperature is the most important factor in development, a high temperature accelerating it. Other factors are the nature of the food, and moisture, and the author indicates the effect of these. Fermentation is also an important factor. The shortest time occupied in development, that is, from the deposition of the egg to the exclusion of the imago, is eight days, but this period is only attained at a constant temperature of 35° C.; under unfavourable conditions the development may extend over several weeks. There are three larval stages, and the shortest times for the development of each stage is: egg, from deposition to hatching, 8 hours; first larval instar, 20 hours; second larval instar, 24 hours; third larval instar, 3 days; pupal stage, 3 days. House-flies breed from June to October, but if the necessary conditions of temperature and suitable food are present, they are able to breed practically all the year round: these conditions are not, as a rule, satisfied in winter, except in such places as warm stables, etc. The flies become sexually mature in ten to fourteen days after emergence from the pupa, and they may begin to deposit their eggs as early as the fourteenth day after emergence. Each fly lays from 120–150 eggs in a single batch, and it may lay as many as six batches during its life.

The second part of the paper deals with the structure of the mature larva. The body is composed of thirteen segments, including the remnant of the cephalic region, or "pseudocephalon." The apparently single second segment the author regards as of a double nature. The muscular system is described in detail, and the series of muscular actions which probably takes place during locomotion is discussed. The only sensory organs are two pairs of tubercles situated on the dorsal sides of the oral lobes. By their structure they indicate an optical function. The alimentary tract is very long, and consists of pharynx, œsophagus, proventriculus, ventriculus, intestine, and rectum. In addition to a pair of salivary glands, whose ducts unite to form a single duct opening at the anterior end of the pharynx, and a pair of bifurcating Malpighian tubes, the larva possesses four cæca at the anterior end of the much-convoluted ventriculus. The tracheal system, the vascular system, and the imaginal disca are also fully described.

Protandry in Insects.*—R. Denioll discusses the meaning of the protandry of bees and other insects. There may be difference of a month between the appearance of the males and the appearance of the females. He thinks that the males are thereby subjected to a process of selection. Good nutrition for several weeks will have an important influence in the struggle for the females. The older males have the most efficient mouth-parts, and they tend to reproduce sooner and with more result than those less well-equipped. Thus the mouth-parts of the females, which are all-important, are improved by the paternal inheritance.

Gastrophilus Larvæ in Human Skin.†—N. Cholodkovsky calls attention to more than one case of the occurrence of larvæ of *Gastrophilus* (*G. pecorum* Fabr. or *G. hæmorrhoidalis* L.) burrowing in the human skin, and causing "creeping disease."

* Zool. Jahrb., xxvi. (1908) pp. 620–8.
† Zool. Anzeig., xxxiii. (1908) pp. 409–13 (2 figs.).

Reflexes of Silkworm Moths.*—Vernon L. Kellogg records some very interesting facts in the behaviour of the newly hatched moths of *Bombyx mori*. They are then sexually mature, and eager to mate. The males find the females exclusively by the odour of the protruded scent-glands of the female. If they find the cut-off glands, they vainly endeavour to copulate with them, even when the mutilated female is lying quite near. Blinded males find the females readily, but not so those whose antennæ have been removed. "The behaviour of males with the antenna of only one side removed is striking. A male with left antenna off when within three or four inches of a female (with protruded scent-glands) becomes strongly excited, and moves energetically around in repeated circles to the right, or rather, in a flat spiral, thus getting (usually) gradually nearer and nearer the female, and finally coming into contact with her, when he is immediately controlled by the contact stimulus. A male with right antenna off, circles or spirals to the left. . . . This behaviour is quite in accordance with Loeb's explanation of the forward movement of bilaterally symmetrical animals." Various experiments were made with moths without cephalic or thoracic ganglia. Females with head and thorax cut off (and even part of the abdomen) can be mated with by males, and this fractional part of the female can fertilise and deposit a few eggs which begin normal development. One such fragment "lived," flexible and responsible to stimulus and capable of extruding the ovipositor and laying eggs, for forty hours. Males without heads cannot find females, nor can they mate if placed in contact with them. An experiment on equilibrium showed that the equilibrating organs are not on the antennæ; they are on some other part of the head.

The author appears to regard much of the behaviour of complexly organised forms, such as the moths in these experiments, as "inevitable" in relation to physico-chemical stimuli and reactions.

Inheritance in Silkworms.†—V. L. Kellogg publishes a first account of data and results derived from a prolonged experimental study of silkworm inheritance. This study has served to test for the silkworm the Mendelian principles of inheritance, as well as the actuality of the potency in heredity of vigour, of sex, and of special characters, and finally, the hypothesis of individual and race idiosyncrasies in matters of inheritance. His conclusions are as follows :—

Silkworms exhibit some characteristics which are alternative in inheritance and which follow in their transmission exactly, or with more or less approximation, Mendelian proportions. But some of these characteristics are not very stable in their alternative and Mendelian behaviour. Some other characteristics are not discontinuous or alternative in character or inheritance, but are of the nature of fluctuating variations, and are strongly obedient to Galton's law of regression. Larval colour-pattern differences are consistently and rigorously alternative and Mendelian in inheritance ; cocoon colours tend to be alternative and Mendelian in behaviour, but are inconsistent as to dominancy and

* Proc. Stanford Univ., California, 1906, pp. 152–4.

† Leland Stanford Junior University Publications, University Series, i. (1908) 89 pp., 4 pls.

recessiveness, and numerical proportions, and may even break down and blend, or one colour be otherwise influenced or modified by the presence, in a mating, of another. Larval pattern and cocoon colour characters do not, except as coincidences, follow the same parent in dominance. In cross-mating, combining opposed larval and cocoon characters, dominance in larval pattern may be with the paternal type, in the cocoon colour with the maternal, or *vice versa*, or both dominances may rest with the paternal or the maternal type. Dominance is a function of the characteristic, not of the parental influence. Dominance is not a function of sex or of bodily vigour.

While in larval colour-pattern characters the inheritance behaviour is rigorously alternative and Mendelian, dominance always being consistent in relation to a given colour-pattern as related to another, this is not true of cocoon colours. With these, characteristic differences peculiar to strain (or race) and individual are marked. Strain and individual idiosyncrasies are real and important, and thus, sweeping generalisations concerning the inheritance behaviour of the cocoon colours, tending to class them unreservedly in the Mendelian category, cannot be made. The tendency is for them to behave in Mendelian manner, but it is a tendency subject to numerous, marked, and various inconsistencies and irregularities. In double matings, i.e. matings of one female with more than one male, these males representing different types of larval and cocoon characters, interesting modifications and interactions of influence are to be noted. The reality of strain potency over character potency is made manifest in these double matings. Quantity and quality of silk, subsidiary larval marking, wing-pattern and wing-venation variations, and degree of adhesiveness of eggs, are all fluctuating, non-alternative characters. Double cocooning is a phenomenon determined by ontogenetic circumstances. Crowding is not the causal circumstance. Of various sport appearances of larval "cocoon" and imaginal characters only one, namely, larval melanism or "monicaudness," is of prepotent or dominant nature when crossed with the normal condition. All other sport characteristics, including various larval colour and structural abnormalities, active flight of moths, absence or rudimentary condition of wings, unusual colour-patterns, including melanism of moths, are extinguished by cross-mating. Fertility is not affected by the age of the egg-cells, but seems to be unfavourably affected by the age of the spermatozoa. Old spermatozoa seem less potent than younger ones.

A scientific study of inheritance in silkworms may be of service to commercial silk-culture.

Treatise on Insects.*—A. Berlese continues his great treatise on insects, the last published fasciculi dealing with the fatty bodies, the respiratory system, and the reproductive organs.

Galleria melonella.†—S. Metalnikov gives an account of a series of experimental observations on the nutrition and excretion of the caterpillars of this moth, which feed entirely on bees' wax. The female lays her eggs on pieces of wax or wood within the hive. The littl

* Gli Insetti. Milan: 1908, i. fasc. 28–30, pp. 801–96 (figs. 1002–1197)
† Arch. Zool. Expér., viii. (1908) pp. 289–383 (5 pls.).

white grub-like caterpillars emerge in about eight days, and almost immediately begin to construct a shelter of silk, spun from a special opening on the lower surface of the head, and strengthened with pieces of wax. This shelter, which serves to protect them from the stings of the bees, is gradually enlarged with the caterpillar's growth until it becomes a kind of gallery connected with the exterior of a honeycomb. The caterpillar creeps backwards and forwards along the gallery, but never leaves it until it is about to spin its cocoon, when it makes its way to the entrance opening of the hive. There it spins a cocoon, which it attaches to the wall of the hive, generally beside many others, so that they form a large compact mass. The winged insect emerges in ten, fifteen, or eighteen days according to temperature, the optimum temperature being apparently between 30° and 40° C.

In regard to nutrition, it was found that the caterpillars fed chiefly on the old broken-down pieces of honey-comb, and that this contained larval skins, excrement of the bees, and other nitrogenous matter to the amount of about 20 p.c. Artificially reared larvæ, supplied only with chemically pure wax, did not gain in weight or size, but went through their whole metamorphosis, while those fed wholly on the nitrogenous matter extracted from the wax, or on other substances, died very soon, so that bees' wax is apparently the most indispensable element of their dietary. One of the two constituent parts of wax, myricene and cerine, was sufficient to keep the caterpillars in normal health, and either seemed equally effective.

The paper contains a full account of the structure and functions of the digestive organs, and the anatomy and physiology of the three systems of excretory organs—the Malpighian tubes, the pericardial cells, and the phagocytes. In regard to these last, an interesting series of experiments was made to determine how far the relative immunity of the caterpillars to various pathogenic microbes was due to phagocytosis. The results showed three different cases :—1. Phagocytosis absent, or very feeble. In this case the caterpillars perished with surprising rapidity. 2. Phagocytosis strong, but the phagocytes were unable to digest the intruding bacteria. In this case the caterpillars survived for a longer time, but ultimately succumbed to the disease. 3. Phagocytosis very vigorous, and destruction of the microbes within the phagocytes. In this case the organism easily got over the disease, and normal metamorphosis took place.

Destruction of Book-worms.*—F. Secques discusses various methods of destroying *Anobium bibliothecarum*, *Dorcatoma bibliothecarum*, without spoiling the books, and of sterilising books. He finds that exposure in a metal box to vapour of formol is most effective.

Flies in Amber.†—F. Meunier has studied more than 1500 specimens of Baltic amber containing Diptera, and gives a monographic account of the numerous genera and species of Empidæ. All the species seem to be extinct, but most of the genera are now represented in Prussia and North Europe generally. Among the most interesting genera may

* Bull. Soc. Zool. France, xxxiii. (1908) pp. 112-14.
† Ann. Sci. Nat. (Zool.) vii. (1908) pp. 81–135 (10 pls.).

be noted *Phoneutisca*, now nearctic; *Palæoleptopeza*, which is related to *Œdalea* and *Leptopeza*; the genera *Euthyneuriella*, *Meghyperiella*, and *Parathalassiella*.

Nervous System of Larva of Corydalis cornuta.*—A. G. Hammar gives a detailed account of this. It is of a very generalised type. There is a ganglion for practically every segment; only in the last abdominal segments is there a fusion, of two or possibly three ganglia. The author deals with the central nervous system, in head, thorax, and abdomen, and with the sympathetic nervous system, and gives a very careful analysis.

Genitalia as Indications of Relationship.†—W. Wesché gives a number of illustrations showing the importance of a study of the genitalia in connection with phylogeny. The male genitalia always furnish specific characters, and in certain cases those of both sexes may be relied on as indices of wider relationships.

δ. Arachnida.

Geographical Distribution of Oribatidæ.‡—C. Warburton notes that these minute free-living vegetarian mites may be transported in moss in hermetically-sealed tins from very distant localities, and that it should thus be possible for a worker in Britain to build up an extensive knowledge of the geographical distribution of these forms. Some of the facts he reports are very interesting. Himalayan material contained twenty species (in twelve genera) and twelve of these species were British. Yet there does not seem to be a single spider common to England and India. British forms were obtained from Madagascar, South Nigeria, Uganda, Madeira, Canada, British Guiana, and Hawaii.

The most cosmopolitan of the Oribatidæ are neither the most primitive (to all appearance) nor the most active. The genus *Oribata* is apparently the most specialised of the Oribatidæ, and seems also to be the most widely distributed, *O. alata* being the most cosmopolitan of all. *Nothrus* has all the appearance of a primitive genus, as its adults often resemble the larvæ of *Oribata*, but only one British species was obtained from the localities noted. Hardly any representatives of the large long-legged active mites of the genus *Damæus* have been received from abroad, and the only known jumping Oribatid, *Zetorchestes*, common on the Continent, has not even made its way to England.

New Species of Kænenia.§—P. de Peyerimhoff describes *K. hispanica* sp. n. from a cave in Aragon, and gives a useful comparison of the six Mediterranean species of this remarkable genus.

North American Lycosidæ.‖—Ralph V. Chamberlin discusses this family of wolf-spiders, or running spiders, and gives definitions of the eight genera and descriptions of the species. The Lycosidæ are among

* Ann. Entom. Soc. America, i. (1908) pp. 105–27 (2 pls.).
† Trans. Entom. Soc. London, 1908, pp. 295-305.
‡ Proc. Camb. Phil. Soc., xiv. (1908) pp. 532-4.
§ Arch. Zool. Exper., ix. (1908) pp. 189–93 (2 figs.).
‖ Proc. Acad. Nat. Sci. Philadelphia, 1908, pp. 158-318 (16 pls.).

the most familiar and widely distributed of spiders, living close to the earth, usually chasing their prey, often protectively coloured. "The high arched cephalothorax and the long stout legs plainly bespeak strength and speed. . . . The arrangement of the eyes is such as to make the animal aware of movements within its limit of vision in front, at the sides, and through a considerable arc behind. . . . Other characters serving to distinguish members of this family are the three claws of the tarsi, the notching of the trochanters at the outer end beneath, and the excavation of the posterior piece of the superior lorum of the abdominal pedicel." The eggs are carried in cocoons attached to the spinnerets; the hatched young are carried for some time on their mother's back.

New Mite.*—E. Trojan observed that the flies (*Musca vomitoria*) in his house showed signs of epidemic disease. They were thin and shrivelled looking, their flight and movements generally were languid, and they continually stroked their bodies with their legs. Examination showed that they were infested with ecto-parasites, each fly bearing two, three, or five. When a fly was killed, the parasites immediately left it and moved away. Sixty of the parasites were collected and examined, and proved to be mites of the genus *Holostaspis*, closely resembling *H. badius*, described and figured by Berlese, occurring on the same host. The form in question, however, differs from *H. badius* in regard to the arrangement of teeth on the mandibles, in certain details of the epistom and hypostom, and in bodily size. The finder, therefore, regards it as a new species, and names it *H. sita*. All the specimens collected were females, and well-developed larvæ were found within nearly all.

ε. Crustacea.

Lamippidæ.†—A. de Zuluetta discusses this peculiar family of parasitic Copepods, which infest Alcyonarians. The minute body is fusiform, soft-skinned, without differentiated regions or segments. There are three kinds of cuticular structures—uncinate setæ, subulate setæ, and hair-like setæ. The appendages consist of antennules, uniramose antennæ, a degenerate oral apparatus, two pairs of thoracic limbs. There is a terminal furca. The females show a pair of ventral genital openings, but the males show none.

The author describes several new species of *Lamippe* (from *Sympodium*, *Alcyonium*, *Pennatula*, *Pteroïdes*, *Veretillum*, etc.), and establishes a new genus, *Linaresia*, with a prominent rostrum, with a papillose cuticle, without mouth appendages, with very long furcal lobes.

Classification of Scalpelliform Barnacles.‡—H. A. Pilsbry compares his conclusions as to classification with Hoek's. He recognises four genera—*Calantica*, *Smilium*, *Euscalpellum*, and *Scalpellum*—and gives a key. The structure of the little males is correlated with certain features of the hermaphrodites, especially the development of a subcarina. The least specialised males belong to hermaphrodite forms,

* Arch. Natur., i. (1908) pp. 1–12 (1 pl. and 5 figs.).
† Arch. Zool. Exper, ix. (1908) pp. 1–30 (26 figs.).
‡ Proc. Acad. Nat. Sci. Philadelphia, 1907, pp. 105–11 (1 fig.).

which are known by morphological and palæontological evidence to be old generalised types. The most modified males are those of the highly-evolved hermaphrodite, or female forms. A classification fully supported by the characters of both sexes rests on a broader basis than one that ignores the males.

Headless Spermatozoa of Cirripeds.*—E. Ballowitz finds that the ripe spermatozoa of *Balanus* and *Lepas* are without "heads." He has studied in particular the spermatozoa of *B. improvisus*, which are simple, slightly curved threads, with a terminal piece but with no differentiated "head." It is possible that the chromatin of the spermatocyte nucleus is in one of the two (light and dark) fibres that make up the spermatozoon.

New Devonian Isopod.†—George H. Carpenter and Isaac Swain describe *Oxyuropoda ligioides* g. et sp. n., a fossil Isopod from Kiltorcan Hill, County Kilkenny. It is superficially like *Ligia*, but seems to show affinities with the Chelifera. It may be a palæozoic link between Chelifera and Oniscoidea, and in certain features it resembles Serolidæ.

Annulata.

Breeding of Nereis japonica.‡—Akira Izuka gives an interesting account of the breeding habits and development of *Nereis japonica*, a Lycorid Annelid, closely allied to *N. diversicolor*, but differing in the arrangement of the paragnathi, in the greater size of the falcate bristles, and in the possession of a distinct lens in the eye. The breeding habit is also different, and the author regards the Japanese worm as a new species. *N. japonica* occurs very abundantly in the Kojima Gulf, and in the rivers leading into it. It is extensively used, in its mature state, for manure, and in some localities it is used for bait. The worms burrow in the sand to a depth of about a foot or more, but emerge from their retreats at flood-tide, and creep actively about the bottom, feeding voraciously on aquatic animals and plants. When disturbed they swim rapidly with a wave-like movement. Fully mature worms attain a length of 110–120 mm. The number of segments does not exceed 120. The sexes are easily distinguishable, the females being deep green on the dorsal surface, and a greenish-yellow on the ventral surface, while the males are light greenish-yellow dorsally, and pinkish-white on the under surface. The eggs, or spermatozoa, are discharged when the worm is swimming at the surface, and sink gradually to the bottom. The spermatozoa are found adhering in large numbers to the gelatinous envelope of the ovum. The cleavage process agrees in general with that described by E. B. Wilson for *N. limbata*, but it seems to proceed much more slowly. With respect to the swarming habit of the mature worm, the author's observations confirm what has long been known from the experience of fishermen, that swarming occurs in December, usually in one period, lasting a few days; that it begins on the night before the new or full moon in the middle or latter part of the month, and that it invariably takes place at midnight just after flood-tide. Very

* Zeitschr. wiss. Zool., xci. (1908) pp. 420-6 (1 pl.).
† Proc. R. Irish Acad., xxvii. Section B (1908) pp. 61-71 (1 pl, and 1 fig.).
‡ Ann. Zool. Japon, vi. (1908) pp. 294-305 (4 figs.).

rarely it occurs in two periods close to the consecutive new and full moons. In 1906 the observer saw the first worms a quarter of an hour after midnight. Three quarters of an hour later they "covered the whole water as with a sheet," and reached to a depth of five or six feet below the surface. An hour and a half later they had begun to disappear, and by 2.15 a.m. there was not a single worm to be seen.

Studies on Australian Leeches.*—E. J. Goddard describes two new species of *Glossiphonia* (syn. *Clepsine*), and a new genus *Semilageneta*. In the latter the body is thick and pear-shaped, with convex dorsal surface and flat ventral surface; the somites are denoted partly by papillæ, partly by sulci; they are triannulate in the greater part of the body, and twenty in number.

Nematohelminthes.

Note on Filaria immitis.†—Thos. L. Bancroft thinks it most likely that the young filariæ pass out from the apex of the mosquito's proboscis or labium. He gives a diagram depicting the escape of a young filaria into the skin alongside the stylets. The author has also tried to ascertain how long a time must elapse before an infected dog shows embryo filariæ in its blood. He finds that about nine months must elapse.

Platyhelminthes.

New Human Tapeworm.‡—N. Leon describes what seems to be a quite new tapeworm from man. It may be referred to the sub-family Ligulinæ, but it requires a new genus, and the name *Braunia jassyensis* is proposed.

New Tapeworm in a Dog.§—N. Cholodkovsky describes *Tænia punica* sp. n. from a Tunisian dog. The scolex is very large (1·5 mm. broad), unarmed, with four strong suckers (slightly unsymmetrical) and a small apical elevation.

Cestodes of Birds.‖—O. Fuhrmann has done good service in bringing together the results of eleven years' work on the tapeworms of birds. Particular species may occur in many hosts, but always in hosts belonging to the same group. About 300 species are dealt with, and these are referred to fifty genera, of which a systematic account is given.

Yellow-brown Cells of Convoluta paradoxa.¶—F. Keeble has made a study of the yellow-brown cells of *Convoluta parodoxa*, a small brown acœlous Turbellarian which occurs within a narrow belt of sea-weed on the shore. It exhibits tidal migrations within this belt. The migratory movements are the resultant reactions to the various directive stimuli to which, in its changing environment, it is subject. The egg-laying and hatching are periodic. The periods synchronise with those of the neap

* Proc. Linn. Soc. N.S.W., xxxiii. (1908) pp. 320–42 (13 figs.).
† Journ. R. Soc. N.S.W., xxxvii. (1903) (received 1908) pp. 254–7 (2 figs.).
‡ Zool. Anzeig., xxxiii. (1908) pp. 359–62 (3 figs.).
§ Tom. cit., pp. 418–20 (4 figs.).
‖ Zool. Jahrb., 1908, Supplement 10, Heft 1, pp. 1–232.
¶ Quart. Journ. Micr. Sci. liv. (1908) pp. 431–79 (3 pls. and 3 figs.).

tides. The eggs and the newly hatched larvæ contain no yellow-brown cells. If kept in filtered sea-water they remain free from them, but when they are brought into contact with sea-weed from the *paradoxa* zone, infection is induced. The infecting organism is an alga different from the zooxanthella of Radiolarians; its free stage is unknown. In the ingested state it is characterised by many ingested chloroplasts, a colourless anterior end, and by the possession of fat-globules in its colourless protoplasm. Once introduced into the body of *C. paradoxa* the infecting organism multiplies rapidly. The fat-globules of the algal cells are food-reserves. They arise as the result of the photo-synthetic activity of the algal cells. The reserve fat of the algal cells is transferred from these cells to the animal tissues, and serves these tissues as food-material. The ingested yellow-brown algal cells become physiologically an integral part of the animal, contributing towards its nutrition and incapable of a separate existence.

The yellow-brown algal cells are indispensable to the animal; without them it fails to develop. Nevertheless, starved animals digest their algal cells until no trace of them remains. Such animals may be reinfected, and they then begin to grow again.

The yellow-brown cells utilise in their constructive metabolism the waste products of the nitrogen-metabolism of the animal. The waste nitrogen of the animal is not excreted, but is stored in the body, probably in the form of urates. Animals deprived of solid food, but kept in the light in filtered sea-water to which uric acid has been added, conserve their yellow-brown cells and maintain their lives longer than do animals not supplied with uric acid. Those supplied with uric acid lay many more eggs than those kept without it, but under conditions otherwise similar.

The interpretation of the relation between yellow-brown cells and the animal, the author says, depends on the point of view. From that of the animal it is a case of obligate parasitism. From that of the species "infecting organism," it is an insignificant episode, involving the loss of that proportion, probably small, of its members which are ingested. From that of the individual ingested yellow-brown cell it is a solution of the nitrogen problem, a successful method of obtaining large supplies of nitrogen.

Memory in Convoluta.*—Louis Martin finds evidence of definite correspondence between the behaviour of *Convoluta roscoffensis* in artificial conditions and the tidal movements. It seems that this Planarian has a memory for the tides ("*pallirimnesia*") but certain conditions bring about *amnesia*, for instance electric currents.

Maturation and Cleavage in Paravortex candii.†—Paul Hallez describes in this Rhabdocœl the fertilisation of the ovum, the liberation of two polar bodies, the reduction of the ovum-nucleus to two V-shaped chromosomes, the equatorial plate in the fertilised ovum with its four chromosomes, which soon divide longitudinally, the peculiar lobulated (as if amœboid) nucleus seen in the blastomeres on to stages of 150–200, and the formation of a multinucleate embryonic plasmodium.

* Comptes Rendus, cxlvii. (1908) pp. 81–3. † Tom. cit., pp. 314–16.

Cell-division in Cerebratulus.*—N. Yatsu has made experimental studies on the egg of *Cerebratulus*, which seem to him to throw some light on the mechanism of cell-division. He finds that an enucleated fragment with the aster shows a disturbance of surface tension, at the end furthest from the aster. An enucleated fragment without the aster often shows a division activity, and in some cases it is completely divided into two. A mass of cytoplasm has in itself, or acquires under certain conditions, the power of dividing itself, without the aid of either rays or centrosomes. Cleavage goes on normally even after one of the centres is cut off at an anaphase. After the cleavage is fixed, i.e. after the formation of the diasteme, the cleavage furrows proceed normally, notwithstanding the removal of a portion of the cytoplasm. Cleavage between two asters with a spindle takes place perpendicularly to the middle point of the spindle, irrespective of the position of the asters. One-sided constriction of the first division may occur as in some Cœlenterates and *Petromyzon*. The karyomeres may fuse and form a daughter-nucleus, even when the chromosomes have been separated from the aster. The same observer † publishes a note on the adaptive significance of the sperm-head in the same form, *Cerebratulus lacteus*. From the fact that it took the spermatozoa "considerable time and not a little effort" to bore through the thick membrane in order to reach the egg, he concluded that the long, slender, slightly-curved head of the spermatozoon of *C. lacteus* might have evolved in correlation with the thick egg-membrane characteristic of the species. A study of the relation of sperm-head and egg-membrane in another species bore out this conclusion.

Incertæ Sedis.

New Species of Dolichoglossus.‡—Richard Assheton describes *D. serpentinus* sp. n. from the littoral zone off Mull. Its total length was 200 mm. and upwards; the contracted proboscis was 25–35 mm. long. The proboscis is cylindrical rather than conical, and capable of great extension. It is bright rosy red, the collar a deeper and more orange red, the trunk from orange to yellow. There are about 60 pairs of respiratory clefts in a large specimen; there is no backward prolongation of the collar over the gill-clefts.

The animal has a strong "iodoform" scent. It is found in fine sand at low-water mark, and is only very rarely uncovered by the tide. It secretes much mucus, which forms tubes with the sand. Specimens were kept alive for six months; they never came entirely out of the sand, and the collar was only once seen protruding; the proboscis was frequently protruded, especially at night, sometimes waving and curling in the water, more usually lying along the surface of the sand, first in one direction then in another. The only other *Dolichoglossus* recorded from Great Britain is *D. ruber*, found by Tattersall on the West of Ireland.

Colour Markings in a Devonian Brachiopod.§—D. K. Greger describes *Cranæna morsii* sp. n., which retains the original colour-markings, sometimes in a very perfect condition.

* Ann. Zool. Japon, vi., part 4, 1908, pp. 267–76.
† Biol. Bull., xiii. (1907) pp. 300–1 (2 figs.).
‡ Zool. Anzeig., xxxiii. (1908) pp. 517–20 (2 figs.).
§ Amer. Journ. Sci., xxv. (1908) pp. 313–14 (7 figs.).

New Fresh-water Polyzoon from South Africa.*—Igerna B. J. Sollas describes *Lophopus capensis* sp. n., from near Cape Town. It is the ninth species of Polyzoa from South Africa. The new species is referred to the genus *Lophopus* on account of its thick gelatinous ectocyst and the form of its statoblasts, which are elliptical and rendered pointed by the possession at each end of a long process. The process is expanded at the base and beset on each side with a double row of recurved hooks, which extend with the expanded base along the edge of the statoblast. A description is given of the germination of the statoblast, the young individuals, the budding, and a young colony.

Echinoderma.

Hermaphroditism in a Sea-urchin.†—G. Gadd reports a case of hermaphroditism in *Strongylocentrotus drœbachiensis*, O. F. Müll. There was in one of the gonads an apical ovarian portion, and an oral testicular portion, the latter the riper.

Antarctic Holothurians.‡—Clement Vaney reports on the important collection made by W. S. Bruce on the Scottish Antarctic Expedition. It includes two species of Synallactidæ, eleven of Elasipoda (4 Elpiidæ and 7 Psychropotidæ), and ten of these are new. There are also numerous Cucumariidæ, chiefly from the South Orkneys, and ten of these are new.

Vaney notes that *Psolidium coatsi* and *Cucumaria psolidiformis* and *C. conspicua* are interesting transitional forms connecting the two genera. Another species, *C. armata*, has great affinities with the genus *Colochirus*.

Glands of Crinoids.§—A. Reichensperger has studied *Antedon rosacea*. *Actinometra parvicirra*, and *Pentacrinus decorus*. He finds glandular cells in the epithelium of the ambulacral grooves in females of *Antedon*, the secretion of which fastens the liberated egg to the pinnules. In all the three forms mentioned there are glandular cells in the tentacular papillæ. possibly with some protective function.

New Antarctic Crinoid.‖—F. A. Bather describes *Ptilocrinus antarcticus* sp. n., which was dredged by the Belgian Antarctic Expedition from about 480 metres in 82° 47′ W., 70° 23′ S. A diagnosis of the genus and of the species is given.

Cœlentera.

Green Bodies of Hydra viridis.¶—D. D. Whitney finds that if a green hydra be placed in a weak glycerin solution (1·5–5 per cent.), the "algæ" pass from the endoderm-cells into the gut cavity and pass out at the mouth when the animal contracts. The clear *Hydra* placed in pure water will live and feed and bud. If the pale animal be kept for a time in well water and then put into a basin with green hydra and algæ, it does not become infected again, but remains pale.

* Ann. Nat. Hist., ii. (1908) pp. 264–73 (8 figs.).
† Trav. Soc. Nat. St. Petersbourg, xxxviii. (1907) pp. 211–18 (1 pl.). See also Zool. Zentralbl., xv. (1908) p. 543.
‡ Trans. R. Soc. Edinburgh, xlvi. (1908) pp. 405–41 (5 pls.).
§ Zool. Anzeig., xxxiii. (1908) pp. 363–7 (3 figs.).
‖ Bull. Classe Sci. Acad. Roy. Belgique, 1908, No. 3, pp. 296–9 (1 fig.).
¶ Biol. Bull., xiii. No. 6, 1907. See also Zool. Zentralbl., xv. (1908) p. 468.

Hydroids from Natal.*—Ernest Warren describes a collection of 31 species (14 new) of hydroids made on the Natal and Zululand coasts. He establishes two new genera:—*Asyncoryne* (with scattered filiform tentacles, moniliform in structure, terminating in a kind of rudimentary capitulum); *Paragattya* somewhat near *Gattya humilis* Allman, and exhibiting a remarkable mixture of characters typical of the Eleutheroplea and Statoplea.

Protozoa.

Blastodinium.†—E. Chatton describes three new species of this genus, which he established in 1906 for certain remarkable Dinoflagellate parasites from the intestine of pelagic Copepods and Appendicularians. A large cell or macrocyte, which in its resting state is the equivalent of the vegetative form of free Peridinians, is surrounded by several (as many as six) zones or generations of microcytes.

New Order of Protozoa.‡—B. Zarnik describes a new species of *Gromia*, which he names *G. solenopus*, in virtue of its peculiar pseudopodia. These are branched, anastomosing structures of absolutely hyaline protoplasm, which from their origin and behaviour he believes to be of fluid consistence at first, but taking on a more resistant character wherever their surface comes in contact with the surrounding water. Zarnik suggests that the "Waben-struktur" of the protoplasm in the pseudopodia of *Gromia* as described by Bütschli, was no other than a criss-cross wrinkling of this hardened surface, following on a contraction of the still fluid content of the pseudopodia.

The author further describes within the outer "shell" of the organism a peculiar internal skeleton of minute brownish silica plates—"phäcochondria"—structures that have hitherto always been regarded as chloroplasts. Other invariable inclusions are the "kinochondria," highly refractive bodies dancing within minute vacuoles: these are probably of an excretory nature. Reproduction by formation of flagellate spores was very frequently observed.

Zarnik maintains that the structure of *Gromia* is of a nature so different from that of other Rhizopods that it cannot be included in any of the groups known hitherto. The inner silica skeleton and the sac-like pseudopodia are peculiarities that necessitate the erection of a new order, for which the name Solenopoda is suggested.

Schizogony in Amœba.§—L. Mercier has studied *Amœba blattæ* from the food-canal of the cockroach, a species marked by its large and characteristic nucleus. He finds that the nucleus divides by a process of constriction, and then the cytoplasm follows. But although the constriction of the nucleus seems on the whole a simple process, the chromatin presents a succession of appearances which recall some mitotic figures.

* Ann. Natal Museum, i. (1908) pp. 269–355 (4 pls. and 23 figs.).
† Bull. Soc. Zool. France, xxxiii. (1908) pp. 134–7 (4 figs.).
‡ SB. Phys.-Med. Ges. Würzburg, 1907, pp. 72–8 (1 fig.).
§ Comptes Rendus, cxlvi. (1908) pp. 942–5.

Have Trypanosomes an Ultra-Microscopical Stage?*—David Bruce and H. R. Bateman have made a number of experiments to test this. From five experiments it would appear that the blood or organs of rabbits suffering from nagana does not contain ultra-microscopical forms of *T. brucei*. From eleven experiments it seems that the blood of nagana rats, filtered through a Berkefeld filter, is not infective. From other experiments it may be concluded that the blood of white rats suffering from nagana, and treated for varying times with antimony salts, does not contain ultra-microscopical forms of *T. brucei*. Cultures of *T. lewisii* on blood-agar do not give rise to ultra-microscopical forms which are capable of passing through a Berkefeld filter. The final conclusion arrived at is that neither *T. brucei* nor *T. evansi* develop in the body of animals forms so small as to be capable of passing through the pores of a Berkefeld filter, and that in cultures of *T. lewisii* on blood-agar such small forms are also absent.

Budding in Acineta gelatinosa.†—B. Swarczewsky observed the formation of amœboid buds of various sizes, moving actively by pseudopods, and fixing themselves after liberation to the stalk of the parent. This is quite a different mode of budding from the production of "ciliospores" with peritrichous cilia which has been described by various observers of the Acinetæ.

* Proc. Roy. Soc., Series B, lxxx. (1908) pp. 394–8.
† Biol. Centralbl., xxviii. (1908) pp. 441–5 (8 figs.).

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Structure and Development.

Vegetative.

Xerophytic Adaptations of Leaf-structure.* — J. F. McClendon gives an account of his studies of the leaf-structure in *Agave*, *Hesperaloe*, *Dasylirion*, *Nolina*, and *Yucca*. The simplest type of stoma occurs in *Yucca aloifolia*: the guard-cells are sunk but little, and are reached by an air-passage which pierces the thick epidermis. Beneath the stoma is a system of air-cavities, the upper part being lined with cutin. In *Agave yuccæfolia* the air-passage is shorter, and there is less cutin in the air-cavities. The genera examined show a gradual increase in the complexity of the supra-stomal air-passage. In addition to being sunk below the epidermis, the stomata are often placed in grooves which close over them and prevent transpiration. The stomata in this position have less complex air-passages than are found in the more exposed ones, but have more effective arrangement of air-passages to promote rapid respiration of the deeper tissues. The leaves of *Yucca* and its allies have a thick cutinised epidermis, and the vascular bundles and internal mechanical tissues are arranged with special reference to protection of the stomata. The shape and method of protection of the stomata vary according to habitat. The above adaptations to a xerophytic habitat disappeared when the plants were placed under conditions of increased moisture and diminished sunlight.

Extra-floral nectaries.†—K. Ono has examined a number of plants with the view of throwing light upon the anatomy and physiology of extra-floral nectaries. The author finds that there are two forms of such nectaries, one being represented by *Polygonum sachalinense*, and the other by *Prunus yedoensis*. The first type is epidermal in origin, while the second develops from both epidermis and hypodermis. When these nectaries occur on leaves, they are situated on the under surface, but when on petioles they are on the upper surface. They consist of true secretory glands on the surface, and subglandular cells of indirect importance. External conditions, of which moisture appears to be most important, are of small importance relative to internal conditions. Epidermal nectaries do not secrete so actively as do those derived from hypodermis and epidermis. These nectaries are attractive to ants.

* Amer. Nat., xlii. (1908) pp. 308–16 (25 figs.).
† Journn. Coll. Sci. Tokio, Japan, xxiii. (1907) pp. 1–28 (3 pls.).

Reproductive.

Relation of Megaspores to Embryo-sacs.* — J. M. Coulter contributes a short account of the present state of knowledge of the embryo-sac in relation to the megaspore. The author observes that genesis of the embryo-sac begins with the division of the mother-cell, and that the two first divisions cannot be omitted if fertilisation is to be brought about; by these divisions the formation of megaspore nuclei is accomplished. Several exceptional cases are then discussed. In *Lilium* the reduction-divisions are only followed by one other division, thus reducing the customary five divisions to three. This condition is more common in monocotyledons than in dicotyledons. In *Cypripedium* also the five divisions are reduced to three, but while in *Lilium* four megaspore nuclei are used, in *Cypripedium* only two are involved. *Peperomia* is to be regarded as intermediate between ordinary Angiosperms and *Lilium* and *Cypripedium*, since without reduction there would have been thirty-two nuclei in the embryo-sac. Insufficient details are known at present to explain the irregularities in the Araceæ. The only case in which there is any evidence of free nuclear division is in the Penœaceæ, and even this is doubtful. The author concludes that the nuclear divisions from mother-cell to complete embryo-sac must be studied before safe conclusions can be made. There is a tendency to eliminate the divisions following the reduction-divisions, but among the Sympetalæ this tendency does not appear to exist, and it cannot even be regarded as very general among Angiosperms.

Monospermous Capsules.†—A. de Candolle has investigated a large number of plants bearing monospermous capsules, and finds that they may be roughly classified into two groups—(1) monospermous fruits derived from uniovular ovaries; (2) monospermous fruits resulting from the abortion of one or more ovules. The author does not favour the view that all monospermous fruits are derived from polyspermous fruits, and he considers that the facts already known as to the biological significance of such fruits are too incomplete to justify any hypotheses in this direction. Dehiscence may be regarded as of importance with respect to seed-dissemination, but no monospermous capsule has yet been found having seeds with hairs or hooks, or other means for insuring transport by animals or other agents. The author regards monospermous capsules as among those indifferent peculiarities of which a plant might be deprived without suffering any inconvenience.

Physiology.

Irritability.

Influence of Light on the Growth of Rhizopus nigricans.‡ — L. Raybaud has grown specimens of this fungus on artificial media under different coloured glasses, and records his first observations. Under dark conditions the filaments grow in an upright direction;

* Bot. Gazette, xlv. (1908) pp. 361–6.
† Arch. Sci. Phys. Nat. Geneva, xxv. (1908) pp. 228–48.
‡ C.R. Soc. Biol. Paris, lxiv. (1908) pp. 1172–4.

under clear glass, after 48 hours, they bend over towards the light. The same result was obtained with yellow glass, though the effect was more delayed. In a red light the filaments become oblique about the third day, then lower themselves to the substratum, where they creep along the surface. With other colours, green, blue, or violet, they become horizontal, but do not bend downwards. The number and size of the sporangia were also affected by different coloured lights, the yellow being the most favourable to the development of the fungus.

CRYPTOGAMS.

Pteridophyta.

(By A. Gepp, M.A. F.L.S.)

Cytology of Reproduction in Nephrodium.*—S. Yamanouchi has studied *Nephrodium molle* "in order to understand the characteristics of the nuclear behaviour of the species." The present work is introductory to a study of apogamy, and hence special attention is given to the chromosomes. The author disagrees with Farmer and Digby, and is of the opinion that there is a constant number of chromosomes in *N. molle* in the sporophyte generation, and also that there is reduction of the chromosomes in the normal life-history.

In a second paper † the author publishes his results in connection with the spermatogenesis, oogenesis, and fertilisation. Two important points are made out in the present account, viz. that it is possible to count the chromosomes in the gametophyte, and that the number of chromosomes is constant, being about sixty-four or sixty-six.

In a third paper ‡ he publishes his latest conclusions with respect to apogamy in this plant. The author is of the opinion that the nuclear condition in the normal life-cycle favours the antithetic theory of the alternation of generations. Apogamy appears to be abnormal, but tends to show that the number of chromosomes is not the only factor serving to determine the characters of the sporophyte and gametophyte. *N. molle* presents the first instance known among plants where the sporophyte generation possesses the haploid number of chromosomes.

Origin of Ulodendron Impressions of Bothrodendron.§—A. Renier contributes a note upon the *Ulodendron* impressions of *B. punctatum*. The author has studied a new specimen recently acquired by the University of Liège, and finds that the view put forward by Watson as to the branch origin of the scars is perfectly correct with regard to *B. punctatum*, and in the absence of further evidence it is reasonable to suppose that similar scars on *Ulodendron* and *Lepidodendron* may have had a similar origin.

Leaf-trace in Gyropteris and Tubicaulis.‖ — P. Bertrand, after a careful study of *Gyropteris* and *Tubicaulis*, concludes that these two genera belong to the Zygopterideæ. The author believes that *Gyropteris* may have been derived from the genus *Diplolabis* by loss of the plan of

* Bot. Gaz., xlv. (1908) pp. 1–30 (4 pls.). † Tom. cit., pp. 145–75 (3 pls.).
‡ Tom. cit., pp. 289–318 (2 pls. and 3 figs.).
§ Comptes Rendus, cxlvi. (1908) pp. 1428–30. ‖ Tom. cit., pp. 208–10.

symmetry and by atrophy of the anterior portions, while *Tubicaulis* is derived from *Gyropteris* by accentuation of the characters of the latter genus. It is also possible that Anachopterideæ may have been derived from the Zygopterideæ by loss of the accessory plan of symmetry, such a view being favoured by the characters of the *Clepsydropsis* series, and this will account for a certain resemblance between *Tubicaulis* and *Anachoropteris*.

Conditions affecting Prothalli of Polypodiaceæ.*—G. Perrin has investigated the external conditions which affect the development and sexuality of the prothalli of the Polypodiaceæ. Unisexuality is more common than is generally admitted. The antheridia appear early at the base and spread upwards in the lower half. The archegonia appear later upon the median cushion and spread gradually towards the upper notch. They vary from one to eighteen. Unisexual prothallia are abundant in certain species of *Adiantum*, *Aspidium falcatum*, and *Pteris cretica*, but they are generally male. The attempt, carefully made, to connect variations in size or shape of spores with these differences in the sexuality of the prothallia failed. It is in external conditions that the cause must be sought. The principal agents appear to be—(1) nutritive medium ; (2) light ; (3) temperature ; (4) moisture ; (5) time of sowing. A poor medium dwarfs the prothallus and prevents it from producing archegonia. A medium rich in nitrates favours the production of hermaphrodite prothalli. Weak light also has the latter effect, while strong light induces male prothalli. Red light induces exuberant vegetation and a tendency to unisexuality. The optimum temperature for development is about 25° C. Moisture is indispensable. The time of sowing is important ; the best cultures arise from spring sowing. Summer and autumn sowings induce unisexuality.

North American Ferns.—W. N. Clute† discusses the question of change of function in dimorphic fronds, namely the appearance of sterile pinnæ on the fertile frond, and *vice versâ*, as in *Botrychium virginianum*. He reproduces ‡ C. E. Bessey's classification of the families of ferns and fern-like plants, both living and fossil. He gives a brief account § of *Cystopteris fragilis*, and describes a new variety, *tenuifolia*. Having completed his check-list of North American fernworts with some supplementary additions, he gives a summary ‖ showing a total of 304 ferns and fern-allies, and 214 forms. F. C. Greene ¶ supplies some notes on the ferns of Bloomington, Indiana, indicating the habitats of 25 species. A. A. Eaton and W. N. Clute** discuss a question of nomenclature which is provided for in Article 49 of the Vienna Code, namely, whether a varietal name should be retained for a plant when raised to specific rank. A. E. Scoullar†† gives briefly the results of her observations of the fruiting of *Botrychium* in Maine. Having carefully marked robust plants of *B. matricariæfolium*, *B. obliquum*, and *B. obliquum* var. *dissectum*, she observed them during four summers (1904–7), and found the first

* Comptes Rendus, cxlvii. (1908) pp. 433–5.
† Fern Bulletin, xvi. (1908) pp. 65–8 (1 pl. and 1 fig.).
‡ Tom. cit., pp. 70–4.
§ Tom. cit., pp. 75–7.
‖ Tom. cit., pp 81–4.
¶ Tom. cit., pp. 68–9.
** Tom. cit., pp. 77–81.
†† Tom. cit., pp. 84–5.

species with fertile spikes in mid-June, the others at the beginning of September; but where in one year a plant fruited heavily (that is, bore two fertile spikes), it was sterile in the following year. H. W. Jewel * describes *Polypodium vulgare* f. *elongatum*, a new form discovered by him in Maine, and recalls how he was the first to discover the rare var. *auritum* of the same species some years ago also in the State of Maine. S. B. Parish † figures a remarkable instance of foliar fission in *Polystichum munitum* growing in California. Some fronds of the plant are nearly normal, others are greatly modified. B. L. Robinson ‡ publishes a description of a new fern—*Woodsia Cathcartiana*—collected in Minnesota thirty-four years ago, and referred by D. C. Eaton to his *W. scopulina*, from which it differs in its glandular puberulence. Robinson also alters the names of two North American ferns, and utters a word of warning against the readiness evinced by some pteridologists to discard the generic name *Aspidium* in favour of *Dryopteris*, despite the probability that *Aspidium* will be placed on the list of nomina conservanda at the Nomenclature Congress in 1910. W. L. Bacon § reports the occurrence of *Cryptogramma Stelleri* (*Pellæa gracilis* Hook.) in Maine, not on limestone but on a coarse granitic formation containing traces of lime. A. A. Eaton ‖ alters the names of two North American species of *Isoëtes* in accordance with the Vienna Code. The New England Botanical Club ¶ publish a list of the fern-allies in their district, namely, *Marsilia* (1 species), *Equisetum* (6), *Lycopodium* (7) *Selaginella* (2), *Isoëtes* (8).

Some Fern Hybrids in North America.**—R. C. Benedict gives some general facts about fern hybrids. Hybrids are sterile, usually larger than their parents, sometimes abnormal, and in many characters they are intermediate between the parent species. Two hybrids which occur in nature can be produced culturally—*Asplenium platyneuron* × *Camptosorus rhizophyllus* and *Dryopteris cristata* × *D. marginalis*. Another, not found wild, has also been produced—*D. Filix-mas* × *D. marginalis*. It seems reasonable to interpret as hybrids other forms (principally in *Dryopteris*), which are sterile and similarly intermediate between two species. For example, sterile intermediates are known between *D. marginalis* and six other species. There would be twenty-one possible combinations among the seven units. Some thirteen of these appear to have been found, and descriptions of them are being prepared.

Ophioglossaceæ of the United States.††—R. C. Benedict publishes some brief studies in the Ophioglossaceæ: (1) A descriptive key to *Ophioglossum* in the United States. Having described the genus, and having attempted to find a better term than "common stalk" in place of the unsatisfactory term "petiole," he gives an analytical table in which the six native species are grouped, distinguished, and shortly defined; (2) a descriptive key to *Botrychium* in North America: group of *B. lan-*

* Fern Bulletin, xvi. (1908) pp. 85, 91.
† Torreya, viii. (1908) pp. 164–5 (fig.).
‡ Rhodora, x. (1908) pp. 29–31.
§ Tom. cit., p. 35.
‖ Tom. cit., p. 42.
¶ Tom. cit., pp. 59–62.
** Torreya, viii. (1908) pp. 81–2.
†† Tom. cit., pp. 71–3, 100–3.

ceolatum. This genus, less well known, and more difficult in the limitation of its species, is divided into two groups: (1) that of *B. lanceolatum*, containing ten North American species, which ripen their spores in the early summer; and (2) that of *B. ternatum*, maturing in the late summer. The modes adopted by Milde and by Prantl for grouping the species do not seem to Benedict to be natural. He gives an analytical table of the ten species of the first group.

Lycopod with a Seed-like Structure.* — M. Benson publishes her full paper on *Miadesmia membranacea* Bertrand, a new palæozoic Lycopod with a seed-like structure. This small herbaceous plant had sporophylls akin to those of the ligulate Lycopodiaceæ, especially *Selaginella*. The megasporangium produced a single thin-walled spore, which germinated *in situ*. Around the sporangium was an integument provided with a micropyle; from the surface of the integument arose several long processes, giving the organ a fringed appearance. At the time of maturity the sporophyll was detached, and the whole structure resembled a winged and fringed seed.

Sporangium-bearing Organs of the Lycopodiaceæ.†—M. G. Sykes has studied the sporangium-bearing organs of the Lycopodiaceæ, and has arranged the different species of *Lycopodium* in a continuous series according to the shape and structure of the sporophyll, the position of the sporangium, and the position of the line of dehiscence. It is suggested that the genus *Lycopodium* should be regarded as a reduction series, also that the sporangium-bearing organ is to be regarded as an axial structure, morphologically equivalent to a reduced branch.

Lycopodium squarrosum and its Allies.—R. Pampanini ‡ gives a résumé of what has been written by previous authors concerning *Lycopodium squarrosum* Forst, *L. epiceæfolium* Desv. and *L. ulicifolium* Vent. The first species occurs from Tahiti to Ceylon, the second in the Mascarene Islands, the third in India, Malay Islands, Mascarene Islands, and Madagascar. The author points out what the three species have in common, and adds a distinctive diagnosis for each, for he prefers Pritzel's view (that they are distinct) to Clarke's view (that they are forms of one species). Pampanini then gives a detailed description of an allied new species *L. pseudo-squarrosum*, recently described briefly and figured, § which probably came from the East Indies and is in cultivation in the Botanic Garden at Florence, and which is synonymous with *L. squarrosum* Drake del Castillo.‖

Bryophyta.

(By A. Gepp.)

Sphagnum and Sphagnology.—G. Roth¶ replies to some of C. Warnstorf's criticisms, and publishes descriptions of twenty-five new forms of *Sphagnum*, including five new species.

* Phil. Trans. Roy. Soc. London, B. 199 (1908) pp. 409–25 (5 pls.).
† New Phytologist, vii. (1908) pp 41–60 (2 pls.).
‡ Bull. Soc. Bot. Ital., 1908, pp. 66–77.
§ Bull. R. Soc. Tosc. di Orticult., xiii. (1908) p. 99 (pl.).
‖ Fl. Polyn. fr. 1892, p. 327. ¶ Hedwigia, xlvii. (1908) pp. 321–9 (figs.).

J. Röll * discusses at some length the old and the new method of research among the Sphagnaceæ. The following are contrasts between Warnstorf's views and his own:—1. Against Warnstorf's constant specific types are placed Röll's groups of forms. 2. Forma typica of Warnstorf (i.e. a middle-point) is not accepted by Röll. 3. Warnstorf for his specific type lays little stress upon the numerous varieties and forms; whereas Röll for his system lays stress upon abundance of forms, their study in the field, and in different countries and numerous stations. 4. Röll does not mistake the value of the specific type of the diagnosis for naming specimens, but regards it only as an aid to scientific investigation. 5. Röll considers it practical to cite only the characteristic differences in the diagnosis of a group of forms. 6. Röll regards the pores of the branch-leaves as unessential specific characters, and attaches a greater importance to the shape of the stem-leaves. 7. Röll claims to observe the Vienna international code, in opposition to Warnstorf's practice of manipulating fragments of form-groups, and renaming this and ignoring that. 8. In doubtful cases Röll prefers the diagnosis drawn from numerous varieties and forms, rather than that which is founded on a single specimen.

Grimaldia and Neesiella.†—V. Schiffner gives a morphological and biological account of the genera *Grimaldia* and *Neesiella* (or *Duvalia*), with special reference to the rare alpine species *Grimaldia carnica*, which is known only from five scattered stations. He shows in parallel columns the chief differences between the two genera, as indicated by the leading authorities, and criticises these generic differences point by point. He finds that the typical species of *Grimaldia* (*G. dichotoma* and *G. ragrans*), with *G. carnica*, and its very near ally or possibly synonym, *G. pilosa*, differ in no essential way from *Neesiella rupestris* in structure of female receptacle and rudiments of involucre. The differences which he considers sufficient to keep the two genera separate he draws up in parallel columns; they mainly concern the external appearance and the structure of the frond. *G. carnica* and *G. pilosa*, whether or not distinct from one another, agree point by point with *Neesiella*, and must be included in that genus. In *Grimaldia* remain the following species:—*G. dichotoma*, *G. fragrans*, *G. capensis*, *G. californica*, *G. graminosa*. *Neesiella carnica* stands in closest phylogenetic relationship with *N. rupestris*. In an appendix he adds some observations about *G. dichotoma* and the effect upon it of altered conditions of life.

Spermatogenesis in Mosses and Liverworts.‡—W. and J. van Leeuwen-Reijnvaan have studied several specimens of *Reboulia*, *Preissia*, *Fegatella*, and *Conocephalus*, with special regard to centrosomes and to reduction-divisions. Their conclusions are based upon *Fegatella conica*, but the results obtained with other genera appear to be confirmatory of those given by this genus. There appears to be no doubt that centrosomes are present during reduction-divisions in the antheridia of Liverworts. A species of *Mnium*, also examined, confirms the state-

* Hedwigia, xlvii. (1908) pp. 330–53. † Tom. cit., pp. 306–20 (1 pl.).
‡ Ber. Bot. Gesell. xxvi*a*. (1908) pp. 301–9 (1 pl.).

ments made by Arens. There are eight chromosomes of different lengths, and during the last division there is a two-fold chromosome-reduction. Centrosomes are found and also an extra-nuclear mass of chromatin, which ultimately disappears.

Arctic Mosses.*—P. A. Rydberg gives a digest of the bryological report of the second Norwegian arctic expedition in the 'Fram' (1898–1902). The collection of mosses was very large and was determined by N. Bryhn, B. Kaalaas, and E. Ryan. The number of specimens was about 1700, and the material was very difficult to work up, owing to the changed and peculiar growth of the far arctic mosses. Most of them are diminutive and congested into dense tufts, with thread-like innovations and shortened leaves. They are often strongly coloured, yellow, red, brown, or crimson. Very few produce fruit, and when they do (as the bisexual species of *Bryum*), the capsules are torn off by the snow-bunting, which thereby obtains its principal food. Very few species occur in pure tufts; they are usually mixed, even as many as twenty or thirty together in a tuft, and all indistinguishable save under the Microscope. Specimens were gathered on the west coast of Greenland, on Ellesmere Land, North Lincoln, King Oscar's Land, North Devon, and North Kent—all of them localities in Smith's Sound or Jones's Sound. Two hundred and ninety species were collected, and among them are thirty-five new species and twenty-two new varieties. The names and stations of the novelties are cited.

North American Mosses.—J. F. Collins † gives an account of a small packet of mosses collected in Caribou Bog in the Aroostook County, Maine, by M. L. Fernald. It contained four pleurocarpous mosses, a *Sphagnum* and an hepatic, all new to the State of Maine. J. F. Collins ‡ publishes some additions and corrections for insertion in his tabulated distributional list of mosses of New England in "Rhodora" two years ago. C. Warnstorf § describes *Sphagnum Faxonii*, found seventeen years ago in Massachusetts by E. Faxon, part author of the "Sphagna Boreali-Americana Exsiccata." The species is allied to *S. cuspidatum*. H. H. Bartlett, ‖ having borrowed the type of *Sphagnum Faxonii* Warnst., has searched the Faxon herbarium and found that the type-locality of the species is not Massachusetts but Sunken Heath, Mount Desert Island, Maine, where it was collected by Faxon and Rand (June 29, 1891). Examination of Rand's herbarium affords the same evidence. In each case the plants are mixed with *Lophozia inflata*. E. G. Britton ¶ gives some notes upon *Zygodon*. *Z. viridissimus* is a rare species in the United States; it is usually sterile, and is propagated by means of septate brood-bodies, borne in clusters in the axils of the leaves. Fruiting specimens, discovered in Virginia, reveal an absence of peristome. Specimens collected by Drummond near Hudson Bay belong to *Z. rupestris*, regarded in Europe either as a species or as a variety of *Z. viridissimus*. *Z. gracilis*

* Bryologist, xi. (1908) pp. 77–83.
† Rhodora, x. (1908) pp. 37–8.
‡ Tom. cit., pp. 71–2.
§ Tom. cit., pp. 40–2.
‖ Tom. cit., pp. 113–14.
¶ Torreya, viii. (1908) p. 172.

has recently been found sterile in North Carolina. *Z. excelsus*, unknown with fruit, appears to be more closely related to *Leptodontium* than to *Zygodon*.

British Mosses.*—The Moss Exchange Club publish their thirteenth annual report, giving an enumeration of the species and varieties of mosses and hepatics found by the members, and interspersed here and there with critical notes by the leading members. Descriptions of five new or rare species recently added to the British moss-flora are translated from the originals and inserted in an appendix.

Muscineæ of the Jura Range.†—C. Meylan gives the results of his bryological researches in the chain of the Jura during 1907, and is able to add seven species and several forms and varieties to the flora. In all he enumerates 76 mosses and 22 hepatics.

Italian Mosses.‡—A. Bottini insists upon the importance of a new bryological exploration of Italy. He gives a brief sketch of what has already been done, and shows in a table the relative numbers of sphagnaceous, acrocarpous and pleurocarpous mosses ascertained to occur in the whole of Italy and in its several provinces in 1887, and again in 1907. In another table he shows the relative numbers of species recorded for each of the twenty-four smaller islands off the coast of Italy. As remarkable instances of moss-distribution, he cites the occurrence of the Scandinavian *Brachythecium gelidum* Bryhn on the Graian Alps; and he adds descriptions and figures of the following new species: *Calymperes Sommieri*, a member of a tropical genus, discovered in the volcanic part of the island Pantelleria; *Barbella strongylensis*, another member of a tropical genus, found upon the volcano of Stromboli; and *Thamnium cossyrense* and *T. mediterraneum*, found respectively on Pantelleria and Giglio.

New Mosses of Japan and Corea.§—J. Cardot publishes a further series of descriptions of new mosses of Japan and Corea, where they were collected by Abbé Faurie. There are in all thirty-two species and varieties, and they fall into the acrocarpous group. Six of them belong to the genus *Grimmia*, and fourteen to *Rhacomitrium*.

Muscineæ of French China.‖—E. G. Paris gives an account of some Muscineæ collected by R. P. Courtois at various stations in the province of Kiang Sou last February. Altogether thirteen mosses and three hepaticæ are enumerated: and eight of them are described by Paris and Brotherus as new to science.

Bryological Notes.¶ — J. Cardot publishes various bryological notes:—1. On *Campylopodiella*, a new genus of the family Dicranaceæ, containing one species found in Darjeeling. It shows affinity with

* York: Coultas and Volans, 1908, pp. 267–94.
† Bull. Herb. Boiss., viii. (1908) pp. 353–62.
‡ Nuov. Giorn. Bot. Ital., xv. (1908) pp. 179–88 (4 pls.).
§ Bull. Herb. Boiss., viii. (1908) pp. 331–6.
‖ Rev. Bryolog., xxxv. (1908) pp. 125–9.
¶ Bull. Herb. Boiss., viii. (1908) pp. 90–2, 163–74 (figs.).

Campylopodium and with *Brothera*. 2. On the Japanese species of *Leucobryum*. These are twelve; and two of them are easily distinguished (*L. scabrum* and *L. glaucum*). Another true species is *L. Bowringii*. But the rest pass insensibly into one another, and are considered by the author to constitute a group of forms of *L. neilgherrense*, showing wide and complex variability. 3. On a small collection of Mosses from New Caledonia, twenty-six in number, and gathered some years ago by Deplanche and Vieillard. Among them are five species and two varieties new to science. 4. On *Dicranum novæ-hollandiæ* Hornsch. This Australian moss has, through the copying of an error, been referred by several authors as a synonym to *Hemiragis aurea*, a West Indian pleurocarpous moss. It is in reality related to *D. dicarpum*, and Cardot gives a diagnosis and figure of its details, as it has never been described.

Subfamilies of Hypnaceæ.* — V. F. Brotherus publishes another part of his Musci in Engler and Prantl's "Die natürlichen Pflanzenfamilien." After treating of the remaining genera of Thuidieæ, he passes on to Amblystegieæ (with 11 genera), Hylocomieæ (12), both of which are classed among the sub-families of Hypnaceæ. The new genera among the Thuidieæ are *Duthiella* C. Muell. (with 2 species), *Actinothuidium* Broth. (1); among the Hylocomieæ *Puiggariella* Broth. (2), *Gollania* Broth. (9 or 10).

European Species of Oncophorus.†—C. Meylan has studied hundreds of specimens of *Oncophorus*, and has come to the conclusion that *O. virens* and *O. Wahlenbergii* are two very distinct species, but are certainly descended from a common stock. They are very near neighbours, especially in their compact forms found in the high Alps. Meylan discusses the structure of the stems, leaves, and capsules, describes all the varieties, and gives an analytical table to the species and their varieties.

Pohlia annotina and Allied Species.‡—G. Dismier publishes notes upon the four species, *Pohlia proligera* S. O. Lindb., *P. annotina* Loeske, *P. Rothii* Broth., *P. bulbifera* Warnst., which have resulted from the modern splitting of the old species *Webera annotina* Hedw. He is now persuaded that they are four good species, though three years ago he published in the same periodical his reasons for regarding them as of no higher than sub-specific rank. At that time he maintained the generic name *Webera*, but now he gives reasons for the use of *Pohlia*. He cites papers by Loeske and Warnstorf, which give the results of careful investigations of the validity of these species and satisfactorily establish their validity.

Grimmia andreæoides.§—R. Sebille highly recommends Pralognan, situated at an elevation of 4750 ft. in the Tarentaise, as a collecting ground for Muscineæ, and gives a list of 17 rare species in proof of his

* Leipzig: W. Engelmann, lief. 231 (1908) pp. 1009–56, figs. 733–57.
† Bull. Herb. Boiss., viii. (1908) pp. 469–82 (figs.).
‡ Rev. Bryolog., xxxv. (1908) pp. 115–20.
§ Tom. cit., pp. 120–5 (figs.).

contention. One of these species, *Grimmia andreæoides* Limpr., otherwise recorded only from Tyrol and Salzburg, he discusses critically. It is a peculiar moss, showing some of the characters of *Andreæa*; but it is a *Grimmia* in view of its anatomy. Its nearest European ally is *G. torquata*. The differential characters of these two species are shown in parallel columns. The distinguishing characters of *G. funalis* var. *epilifera*, *Schistidium teretinerve* and *G. Holzingeri* are made clear.

Jungermannia in New England.*—A. Lorenz records four species of *Jungermannia* as growing at Waterville, New Hampshire, a non-calcareous region; and these four are the only species known to occur in New England. The commonest is *J. lanceolata*, reported from all the New England states. Living on rocks or humus, it is independent of the subsoil. The other three species grow on rock or talus, and avoid limestone. The subalpine species of *J. sphærocarpa* occurs on wet granite ledges, facing north, at 2500 ft. altitude, mixed with *Marsupella emarginata*, *Lophozia alpestris*, etc. *J. pumila* grows on large granite stones in a river just above the water-line. *J. cordifolia* occurs at the same station, which is at an elevation of 1500 ft. It is thought that other species of the genus remain to be discovered in the White Mountains.

New Descriptions of Hepaticæ.†—F. Stephani continues his Species Hepaticarum, that is, his series of descriptions of new species and re-descriptions of old species under the successive genera, namely, *Chiloscyphus* (137 species described), *Geocalyx* (3), *Saccogyna* (10), *Jackiella* (4), *Wettsteinia* (1), *Protocephalozia* (1), *Pteropsiella* (1), *Schiffneria* (2), *Zoopsis* (9), *Cephalozia* (133), *Nowellia* (3), *Alobiella* (13), *Hygrobiella* (6), *Pigafettoa* (1), *Pleuroclada* (2), *Lembidium* (5), *Odontoschisma* (29), *Adelanthus* (10), *Marsupidium* (8), *Calypogeia* (62), *Mastigobryum* (103) (of this genus about 230 species remain over to be described). Nearly 140 of these descriptions represent new species.

New West Indian Lejeuneæ.‡—A. W. Evans supplements the series of papers, in which during the past six years he has presented detailed studies of more than fifty species of Lejeuneæ collected in Puerto Rico, by publishing detailed descriptions of six new species of Lejeuneæ gathered in the West Indies other than Puerto Rico. One species from the Blue Mountains of Jamaica is made the type of a new genus, *Leiolejeunea grandiflora*. The other species treated are: *Trachylejeunea dilatata*, *Harpalejeunea reflexula*, *Odontolejeunea longispica*, *Brachiolejeunea bahamensis*, *Symbiezidium laceratum*.

Thalloid Hepaticæ of Java.§—D. H. Campbell gives an account of his trip to Java in search of thalloid hepaticæ. His collecting grounds were chiefly in the vicinity of the botanic garden of Buitenzorg (altitude under 1000 ft.) on Mount Gedeh, at the mountain garden of

* Torreya, viii. (1908) pp. 55–6.
† Bull. Herb. Boiss., viii. (1908) pp. 49–64; 125–48; 205–20; 267–82; 371–5; 426–36; 483–514; 561–608; 661–96; 745–76.
‡ Bull. Torrey Bot. Club, xxxv. (1908) pp. 371–89 (3 pls.).
§ Torreya, viii. (1908) pp. 103–10.

Tjibodas (4600 ft.), and on Pangerango, the highest peak (about 10,000 ft.). Near Buitenzorg he obtained interesting species of *Riccia*, *Marchantia*, *Dumortiera*, *Pallavicinia*, *Metzgeria*, *Riccardia*, *Cyathodium*, *Dendroceros*, *Notothylas*, *Anthoceros*. A species of the latter contained multiple chromatophores, and has been made the type of a new genus, *Megaceros*. At the cooler altitude of Tjibodas the hepaticæ run riot. The paths and banks are overgrown with *Marchantia* and *Anthoceros*. But it was in the forest that the majority were found—*Treubia* in thick mats, the rare *Calobryum Blumei* and *Calycularia*, *Riccardia* in abundance, *Pallavicinia*, *Metzgeria*, *Zoopsis*, *Marchantia*, *Wiesnerella*. Upon the peak of Pangerango were the alpine *Pallavicinia Zollingeri* and *Fimbriaria Zollingeri*.

Development of Sexual Organs and Sporogonium of Marchantia.* E. J. Durand points out that, though *Marchantia polymorpha* has long been a favourite object for class study, and has been made the subject of numerous investigations, yet nowhere has there ever been published an even approximately complete account of the development of its antheridia, archegonia, and sporogonia, nor anything approaching a complete series of figures illustrating these phenomena. Accordingly he has prepared a brief account of the development of these organs accompanied by a series of 103 drawings made with the camera-lucida to show the successive stages. The microtome sections were stained with Delafield's hematoxylin.

Thallophyta.

Algæ.

(By Mrs. E. S. Gepp.)

Italian Characeæ.—A. Béguinot and L. Formiggini † publish some further notes upon variations of Italian Characeæ founded upon an examination of the collections preserved in the botanical institutes of Pisa, Rome, and Palermo.

L. Formiggini ‡ gives a revised list of Sicilian Characeæ comprising eighteen species and numerous varieties, six species and six varieties being new for that island. For the preparation of this list he has consulted the herbaria of Palermo, Rome, and Genoa, and the works of the only four authors who have treated the subject.

Original Meaning of Chara.§—C. B. Robinson shows that the name *Chara*, as understood by the Latins, had a very different significance from that which it bears in modern botany. The earliest record of its use in literature occurs in Julius Cæsar's "De Bello Civile," book iii., chap. 48, where it is stated that a kind of root called *Chara* was found in the valleys, and when mixed with milk it greatly lessened the feeling of hunger. It was made into the likeness of bread. Robinson suggests *Carum Carui* as the root intended.

* Bull. Torrey Bot. Club, xxxv. (1908) pp. 321–35 (5 pls.).
† Bull. Soc. Bot. Ital., 1908, pp. 78–81.
‡ Tom. cit., pp. 81–6. § Torreya, viii. (1908) pp. 29–30.

Cell-wall Structure and Ring-formation in Œdogonium.*—C. van Wissenlingh gives a detailed account of the ring and the cell-wall of *Œdogonium*. He summarises previous work on the subject, and describes his own methods of investigation. He finds that the cell-wall consists of two layers which are chemically quite distinct, the inner lamellate and rich in cellulose, the outer containing little cellulose and much special material. The outer layer also consists of a cylindrical portion and of one or several ring-shaped portions, to which in the apical cell is added a cup-shaped portion. When a cell is about to divide, a ring (or, in certain cases, a sort of apical cup with a thickened edge) is formed at the upper end, and is of similar chemical constitution to that of the outer layer of the cell-wall, with a preponderance of cellulose on the inner side. The origin and growth of the ring can only be explained by intussusception. Upon the splitting of the ring (or of the thickened edge of the above-mentioned apical cup) different results follow, according to whether the cellulose part alone splits, or the outer layer also splits; upon this depends the presence or absence of the persistent outer ring-fragments. The young transverse wall is a loose plate, free from cellulose, and grows centrifugally. In a supplement the author points out wherein his observations differ from those of Kraskovits, Hirn, and others.

Observations on the Germination of some Phæophyceæ.—C. Sauvageau † publishes some further observations on the germination of *Cladostephus verticillatus*. Having previously described the germination of the zoospores of the unilocular sporangia, he describes that of the zoospores of the plurilocular sporangia. These are of one sort only. They are very active, and settle down in a few hours, round themselves off, and become clothed with a membrane. After ten days, during which they lose their red spot and become deep brown owing to multiplication of the single chromatophore, they divide and branch and form a little round flat disk. From this the erect filaments subsequently arise. The germination is indirect. These zoospores then are asexual like those of the unilocular sporangia, and the product of their germination is the same.

He describes ‡ further results of his cultivations of the zoospores of *Aglaozonia melanoidea*. These he has carried out for the third time by means of cellular cultures. Dehiscence of the sporangia occurred in mid-January. Among the thousands of germinations obtained, about 1 p.c. were *Aglaozonia* (that is, asexual plants), and the rest *Cutleria* (sexual plants).

He gives § the results of his cultivation of *Cutleria adspersa*, which show that, contrary to the opinion of Reinke, Falkenberg, and Janczewski (that in the Mediterranean the unfecundated oospheres do not germinate), the oospheres of *Cutleria adspersa* do germinate by parthenogenesis in the Mediterranean (at least at Banyuls) as well as they do in the Atlantic. A priori, *Zanardinia* and *Cutleria multifida* ought to present the same phenomenon. His experiments also show that his

* Beih. Bot. Centralbl., 1te Abt., xxiii. (1908) pp. 157-90 (4 pls.).
† C.R. Soc. Biol. Paris, lxiv. (1908) pp. 695-7.
‡ Tom. cit., pp. 697-8.
§ Tom. cit., pp. 698-700.

previously stated view is correct, viz., that the oospheres produce now *Cutleria*, now *Aglaozonia*. They prove it for the parthenogenetic oospheres only, but *a priori* the same applies to the fecundated oospheres.

The ordinary methods of studying the germination of the reproductive bodies of algæ are unsatisfactory, affording much doubt as to the purity of the culture. Sauvageau's method * is as follows. He employs only small fragments of the plant, carefully selected, cleaned and washed, and placed in a drop of filtered water in a moist chamber (a Van Tieghem cell). He used a cover-glass for conjugating spores, etc., and an ordinary slide for advanced stages of germination. But as the latter are too smooth, and allow the young plants to peel off after a time, he has found it better to take the polish off the surface previously by exposing the particular area on the slide to the fumes of hydrofluoric acid. The finely roughened surface obtained permits the plants to attach themselves very firmly, and does not interfere much with microscopic observation.

He describes † the development of *Halopteris* (*Stypocaulon*) *scoparia*. The germination of the zoospores is indirect, as in *Cladostephus*, but in a different manner. The rather intricate stages of development, described in detail, are not due to malformations, but were followed out in hundreds of plants. *Halopteris* is heterogamous; and possibly the development of the oospore, if it contains sufficient reserve material, will turn out to be direct.

He adds ‡ some further observations to his recent account of *Fucus lutarius*, which living partly in mud, multiplies itself by producing there an abundance of adventive shoots. The plant can also live an almost aerial and epiphytic life. On salt marshes at Arcachon it lies concealed among stems of *Spartina*; it hangs on the branches of *Salicornia* and other plants, protected from desiccation at low tide by a covering of *Enteromorpha*. Further, it is no longer to be regarded as a sterile species; for Sauvageau has lately found numerous specimens bearing receptacles, especially among those with sub-aerial growth. All the fifty receptacles examined were exclusively female; no sign of dehiscence was found in any of them. The plant is apogamous (sensu De Bary); possibly it may rarely be parthenogenetic.

He publishes § some further observations on the parthenogenetic germination of *Cutleria adspersa*. A fresh set of cultures showed after some months a nearly equal proportion of *Aglaozonia* and *Cutleria* plantlets. The germination of the zoospores, as well as of the oospheres, of this plant gives in the same culture asexual or sexual plants, the latter indifferently male or female. And in nature, although conditions may seem to facilitate the development of this or that form (the sexual state is very rare or absent in the northern seas), yet they do not provoke it. The effect of warm weather upon the cultures was to encourage the *Aglaozonia* (asexual state), and nearly destroy the *Cutleria* (sexual state). The antheridia were dead; but the indehisced

* C.R. Soc. Biol. Paris, lxiv. (1908) pp. 700–1.
† Op. cit., lxv. (1908) pp. 162–3.
‡ Tom. cit., pp. 163–5. § Tom. cit., pp. 165–7.

oogonia were alive, as though in a state of arrest, and capable of germinating subsequently.

Leathesia crispa.*—A. D. Cotton records the little-known *Leathesia crispa* Harvey from Swanage, and shows that it is synonymous with *L. concinna* Kuckuck. The distribution of the alga is remarkable—Alderney, Heligoland, one locality each in England, Scotland, and Ireland, and two in France. A full diagnosis of the species is given in the present paper, together with some interesting notes, which enable a collector to distinguish it in the natural state. It appears to be invariably epiphytic on narrow forms of *Chondrus crispus*.

Some Errors of Nomenclature in Phæophyceæ.† —C. Sauvageau exposes some current errors of spelling connected with *Scytosiphon*, *Litosiphon*, and *Pylaiella*. Though most authors write *Scytosiphon lomentarius*, the correct representation of the species is *S. Lomentaria*, as was pointed out by Le Jolis in 1896. *Lomentaria* was first employed by Lyngbye as a generic name, who in the same work invented *Chorda Lomentaria*. Greville by an error (in his "Algæ britannicæ") wrote *C. lomentaria*, and his error was copied by most subsequent algologists. Passing on to *Litosiphon*, he shows that though Harvey took the trouble to make the derivation clear as meaning small or narrow tube, yet the name is often written *Lithosiphon*, as if it had something to do with stone. As a fact, the plant is not stony, and does not grow on stone, but is an epiphyte. Then as to *Pylaiella*, Bory de Saint-Vincent proposed the name of *Pilayella* in 1823. Five years later he indicated *Conferva littoralis* L. as the type of the genus, and shortly afterwards corrected the spelling to *Pylaiella*, stating that he had dedicated it to Bachelot de la Pylaie. From that date till 1896, when Kjellman revived the name *Pylaiella*, it was only cited in two printed works.

North American Algæ.—F. S. Collins ‡ gives an account of the little that is known of *Œdogonium Huntii* Wood (1869). He feels fairly certain that it was this species which he had under observation for two years, but which, with its station, was utterly destroyed last year, whilst its fruits were still immature. The terminal hairs of the plant are very peculiar.

He gives § a new definition of Kützing's genus *Pilinia*, and describes six North American species, two of which occur also in Europe, and two others are new to science; figures of these latter are supplied. A key is appended to help in the identification of the species.

He gives descriptions ‖ of two new species of *Acrochætium*: *A. minimum* epiphytic on *Desmarestia viridis* in Massachusetts, and *A. Hoytii* on *Dictyota dichotoma* in North Carolina.

Italian Diatoms.¶—A. Forti publishes a preliminary list of the fossil diatoms contained in the Miocene deposits of Bergonzano (Reggio

* Journ. of Bot., xlvi. (1908) pp. 329–331.
† Journ. de Bot., xxi. (1908) pp. 11–14.
‡ Rhodora, x. (1908) pp. 57–8. § Tom. cit., pp. 122–7 (1 pl.).
‖ Tom. cit., pp. 133–5. ¶ Nuov. Notar., xxiii. (1908) pp. 130–33.

d'Emilia). The full paper is destined to appear in the transactions of the Reale Istituto Veneto. The great part of the deposit investigated is constituted of characteristic fragments of *Coscinodiscus Gazellæ* Jan. The list contains eight Raphideæ, four Pseudoraphideæ, sixty-five Cryptoraphideæ.

Genus Micrasterias in New England.*—J. A. Cushman publishes a synopsis of the New England species of *Micrasterias*, twenty-two in number, and several varieties. Fourteen of these species occur in the British Isles. The author gives a description with synonymy, references, measurements, and notes under each species and variety, and adds a key to aid in the identification of the species.

Zygospores of Spirogyra in Relation to Theories of Variability.†
L. B. Walton has studied the zygospores of *Spirogyra quadrata* to obtain data as to the causes tending to produce variability. Over 400 zygospores were studied, including those formed by scalariform and by lateral conjugation. Scalariform conjugation yields the products of union between remotely related cells belonging to different filaments. Lateral conjugation gives the results of union between sister or adjacent cells of the same filament. According to Weisemann the former case should favour variability of offspring, and the latter case should afford a decreased variability. Walton's studies, however, yielded results directly contrary to this theory; for the zygospores of lateral conjugation were about 21 p.c. more variable, both in length and in breadth, than those of scalariform origin. Support is thereby given to the theory of Hatschek (1887) that sex exists for the purpose of limiting and not for the purpose of increasing variability.

Index of Desmideæ.‡—C. F. O. Nordstedt issues a supplement to his Index Desmidiacearum, which was published in 1896. Much material having accumulated since that date, a large supplement became necessary. The new bibliography provided cites about 500 papers by 120 authors.

Fresh-water Algæ of Java.§—C. Bernard publishes an illustrated account of the Protococcaceæ and Desmidieæ gathered by him in fresh-water at Buitenzorg and some other localities in Java. Finding that the literature previously published was insufficient to enable him to determine all the specimens he collected, he set to work and figured his specimens and described all the novelties himself. He gives a list of 326 species and varieties, and illustrates them with 580 figures. He describes two new genera: *Steiniella* and *Treubaria*, and 87 new species and varieties, and makes numerous additions to the Javan flora. He appends a bibliography of ninety-three works, and sketches briefly the condition in which he found the fresh-water algology of Java. In other chapters he discusses his methods, the variability of the organisms, their

* Rhodora, x. (1908) pp. 97–111. † Torreya, viii. (1908) p. 228.

‡ Index Desmidiacearum. Supplementum. Berlin: Gebr. Borntraeger, 1908, 150 pp.

§ Protococcacées et Desmidiées d'eau douce recoltées à Java. Dept. de l'Agriculture, Batavia, 1908, 230 pp. (16 pls.).

adaptations, the cosmopolitanism of aquatic plants. And in a combined table of 326 species and varieties he indicates those which have been recorded by Nordstedt, Möbius, Wildeman, Gutwinski, Lemmermann, and himself in their respective lists.

Phytoplankton off the Coast of Normandy.*—L. Mangin has, during the greater part of 1907, analysed the plankton obtained twice monthly from the surface of the sea at about a mile out from the Tatihou laboratory at Saint Vaast la Hougue. He gives a list of the species found on each of the dates, together with a statement of the weather then prevailing. In a synoptical table he shows the comparative frequency of each species on each date during 1907. And in another plate he gives sample photomicrographs of the contents of six of the gatherings. He adds some comments upon the results obtained. The Peridinieæ were very rarely found in the gatherings.

Irish Algæ.†—J. Adams publishes a synopsis of Irish algæ, fresh-water and marine, and includes in it a total of 2213 species, 1370 fresh-water and 843 marine. In a short introduction he gives an account of the work already done on Irish algæ, and adds remarks on the suitability of the climate, and provincial distribution. Ten species have been found on the Irish coast that are not so far known to occur in Great Britain, among them being *Codium elongatum*. *Halosphæra viridis* Schm., a warm-water species, occurs in the plankton of the west coast; while *Odonthalia dentata* and *Ptilota plumosa*, which are recorded from Greenland and Iceland, are found on the coast of Ulster, though they are entirely absent from the southern half of Ireland. *Alaria esculenta* is common on the north and west coasts, but is much more limited on the east side. The paper closes with a list of bibliography.

Algæ from Hudson's Bay.‡—W. A. Setchell and F. S. Collins give an enumeration of four green, nine brown, and fifteen red algæ from Hudson's Bay, apparently the first list of algæ ever published for that sea. A few distributional notes are added. Most of the species are circumpolar.

Algæ of Barbadoes.§—A. Vickers and M. H. Shaw publish a volume of 93 coloured quarto plates illustrating the green and brown marine algæ of Barbadoes. A. Vickers collected algæ during two visits to the island; and with the intention of publishing an iconography of the subject she studied the species and made drawings of their structure. Her work was but half completed when she died. Her drawings supplemented by life-size coloured figures of the plants have been worked up into plates and edited by M. H. Shaw. The scientific descriptions, which were to have been written, were never prepared. To the Chlorophyceæ are allotted 57 plates, to the Phæophyceæ 36. The Rhodophyceæ and Myxophyceæ are not included, A. Vickers having left no material for the purpose.

* Bull. Soc. Bot. France, lv. (1908) pp. 13–22 (2 pls.).
† Proc. Roy. Irish Acad., xxvii. (1908) pp. 11–60.
‡ Rhodora, x. (1908) pp. 114–16.
§ Phycologia Barbadensis. Paris: Klincksieck, 1908, 30 pp. (93 pls.).

Algæ of Dutch West Indies.*—C. P. Sluiter publishes a list of algæ collected by J. Boeke during his inspection of the Dutch West Indian fishery of Curaçao. Sixty-four species are enumerated, and among them are several Siphoneæ and Dictyotaceæ. Among the Florideæ is a new species, *Zellera Boekei*, allied to, but distinct from, *Z. tawallina* Martens, a Moluccan species.

Illustrations of Japanese Algæ.†—K. Okamura continues his "Icones of Japanese Algæ," giving five plates in each part. The plates have been drawn by the author, and afford ample illustration of the species treated. Though the text is mainly in Japanese, the more important parts, for example the descriptions, are also printed in English. Two new species are described.

Studies of Oceanic Algæ.‡—A. Mazza continues his studies of types of oceanic algæ, and gives descriptions of species of *Botryoglossum* and *Holmesia*. He then treats *Delesseria* on modern lines, accepting the various genera propounded by J. Agardh and other authors for its subdivision, and describes species of *Hypoglossum*, *Phitymophora*, *Apoglossum*, *Delesseria* (including *Hydrolapathum*), *Pteridium*, *Hemineura*.

Origin of the Plant Kingdom.§—G. T. Moore gives his reasons for thinking that the evidence points clearly to *Chlamydomonas* as the most primitive living representative of the ancestors of the plant kingdom. Ten years ago Chodat derived the green algæ from the simplest unicellular non-motile forms then known, the Palmellaceæ, whose simple life-history showed three principal stages or "conditions," from which developed the three important and ruling tendencies which have dominated the lower green algæ. These are (1) the zoospore condition, unicellular, motile; (2) the sporangium condition, unicellular, non-motile; (3) the tetraspore condition, where the non-motile cells are connected at right angles by the increasing consistence of the walls, giving rise to the formation of a tissue or filament. More recently Blackman expressed the view that the three tendencies had their origin, not in the non-motile *Palmella* form, but in the motile *Chlamydomonas* type. Moore has studied *Chlamydomonas* for some years. It has a non-sexual reproduction by means of zoospores; a sexual reproduction by conjugation of naked motile gametes of similar size, but also in some cases by conjugation of unequal motile gametes, and in one case of dissimilar gametes, the larger of which comes to rest before conjugation. The various species of *Chlamydomonas* taken collectively exhibit tendencies towards (1) a *Volvox* type, (2) a *Tetraspora* type, (3) an *Endosphæra* type. It is from the *Tetraspora* type that the higher green plants have arisen, and mostly through the Palmellaceæ; the Conjugales are traceable to *Chlamydomonas Braunii*.

Fossil Girvanella: a plant.||—F. Chapman discusses the relationship of the genus *Girvanella*, a tubular organism, the fossil remains of

* Rec. Travaux Bot. Néerland., iv. (1908) pp. 231–41 (1 pl.).
† Tokyo: 1908, i. Nos. 7–8, pp. 147–208, plates 31–40.
‡ Nuov. Notar., xxiii. (1908) pp. 109–29.
§ Proc. Amer. Phil. Soc., xlvii. (1908) pp. 91–6.
|| Australasian Assoc. for Adv. Sci., Adelaide (1907) 10 pp., 3 pls.

which have been found in calcareous strata in Scotland, North America, the Baltic, England, and in Australia. The author reviews the evidence as to the animal or vegetable nature of the organism, and concludes that the genus *Girvanella*, which has been variously assigned to the Foraminifera, sponges, stromatoporoids, and calcareous or encrusted algæ, is here shown to have no claim to be regarded as one of the Foraminifera, but to have strong affinity with the algæ, and especially with the Cyanophyceæ, or blue-green algæ.

EDWARDS, A. M.—**The Upper Neocene Deposit of Bacillaria around Boston, Massachusetts.**
[A discussion of the fossil diatoms in relation to the strata from which they come.] *Nuov. Notar.*, xxiii. (1908) pp. 134–7.

Fungi.

(By A. LORRAIN SMITH, F.L.S.)

Study of Mortierellæ.*—J. Dauphin has selected the genus *Mortierella* for examination chiefly from the biological standpoint. He, however, treats first of all their classification, and passes under review the species that have been described in this genus; he considers that a number of these are to be ranked as small forms, others as only varieties; he adds a new variety and two new species. Throughout his classification he has followed Van Tieghem in making the method of branching of the sporangiophores of importance. He studied *M. polycephala* more especially for the biology of the group, and by growing it from one spore to the production of zygospores he proved its homothallic nature. Germination and growth were more rapid when a large supply of air was provided for the fungus. The effect of temperature was also noted, the optimum for germination being somewhat higher than for the production of sporangia and spores. Growth went on slowly in the dark, more quickly in light, but in the latter case only stylospores were formed; violet and ultra-violet rays were found to be indispensable; X-rays retarded development: radio-active bodies had a paralysing effect; spores and mycelium remained in a resting condition under the influence of radium, and high atmospheric pressure arrested growth. The nutritive medium was a factor of extreme importance, and many experiments were made with different cultures, results of which are given. Dauphin found that if other conditions were favourable, the fungus would develop without oxygen. He considers that it probably liberates oxygen from the medium in which it is grown in sufficient quantity for its life-process.

Development of Achlya polyandra.†—M. Mücke undertook a study of this fungus, to decide on the number of nuclear divisions in the oogonium and the nature of the fertilisation process. He cultivated the species on ants' eggs, and gives his methods of culture, staining, etc. The number of nuclei in the newly formed oogonium is very large, and they are rather small; they decrease by degeneration; those that remain

* Ann. Sci. Nat., ser. 9, viii. (1908) pp. 1–112 (45 figs.)
† Ber. Deutsch. Bot. Gesell., xxvi. (1908) pp. 367–78 (1 pl.).

increase in size and divide; the chromosomes could not be accurately counted; the oospheres are formed round each nucleus by a heaping up of the protoplasm round the nuclei; there are usually 10–15 oospheres in each oogonium. The antheridia arise from the stalk, or from neighbouring filaments; the fertilising hyphæ penetrate the oogonium, and may branch inside, each branch travelling towards an oosphere; the male nucleus was seen in close proximity with the female, but actual fusion was not observed.

Sexuality in the Ascomycetes.*—A. Guilliermond concludes his long review of this subject by a study of mitosis. He gives the results obtained by various authors as to the number of chromosomes that are present in the different stages of division. There is undoubtedly a reduction of these, similar to reduction in the sexual mitosis of the Phanerogams. The first division in the ascus is heterotypic, the second homotypic, the third typical. A note is added on some systematic work and on the phylogeny of the group. He finds that the asexual sporangium has been transformed into a conidiophore; the gametangium is replaced by a gametophore, and the sporocyst has been developed into an ascus in the adaptation of the Ascomycetes to an aerial life.

Penicillium as a Fruit Parasite.†—Decaying fruits almost invariably show more or less abundant growths of *Penicillium*. This has been considered to be *P. glaucum*, and treated as a saprophyte. O. Schneider-Orelli has studied the whole subject, and gives us his results. He insists on the exact recognition and definition of *P. italicum* and *P. olivaceum* as distinct from *P. glaucum*; *P. italicum* being the form found most frequently on oranges. Schneider-Orelli had some mandarin oranges sent to him from Italy, with due precaution against any risk of infection after they were plucked. He soaked the skins in water, with which he inoculated subsequent cultures, and obtained therefrom a series of spore-germinations, yeasts, *Dematium*, *Cladosporium*, and *Penicillium italicum*. He thus proved that the latter came with the fruits from the south, and with favourable conditions it develops on and penetrates the oranges, which it finally destroys. He further proved that *P. italicum* attacks apples and pears in more northern countries, though it is essentially a southern form, and will not develop at low temperatures. *P. glaucum* grows in extreme cold; it acts as a destructive parasite of stone fruits in northern lands, but it also attacks oranges, etc., from the south. *P. glaucum* is easily recognised by its round conidia. The conidia of the other two forms are much larger and ellipsoid in form.

Vegetation of Morchella.—L. Matruchot ‡ has already published an account of the development of *Morchella* spores, and of the conidial form *Costantinella cristata*. He noted at that time the sclerotia-like masses in the cultures that were formed by the agglomeration of hyphæ. He has recently found in nature that similar sclerotia occur in the soil. At the base of the *Morchella* on the surface of the soil there is a fleshy

* Rev. Gen. Bot., xx. (1908) pp. 364–78 (figs.).
† Centralbl. Bakt., xxi. (1908) pp. 365–74.
‡ Comptes Rendus, cxlvii. (1908) pp. 431–2.

tubercle from which the fungus arises; it is of a spongy texture, and incloses particles of soil, etc.; attached to this tubercle are various cords of hyphæ, which travel in the soil and form here and there the sclerotia-like bodies; these are clearly in contact with the roots of the higher plants, especially of the elm, of which they form the mycorhiza.

Cytology of the Ascomycetes.*—H. C. T. Fraser and E. Welsford have investigated nuclear fusion in *Peziza vesiculosa* and *Otidea aurantia.* In the former they were unable to recognise an ascogonium, nor were the nuclei in the ascogenous hyphæ conjugately arranged; the divisions of these nuclei are normal, and show about eight chromosomes on the equatorial plate. Fusion in the ascus took place about the time of the first meiotic contraction. In *Otidea aurantia* traces of a probable functionless ascogonium were found; in the ascogenous hyphæ there was no conjugate arrangement of the nuclei. In both species the first and second divisions in the ascus are meiotic; longitudinal splitting of the spireme was observed in *Otidea aurantia.* A second reduction or brachymeiosis occurs in the third division, the number of chromosomes being finally two in *Otidea* and four in *Peziza.* The two stages of meiosis are cited by the authors as additional evidence of the occurrence of two fusions in the life-history of the Ascomycetes, a phenomenon which has recently been disputed by Claussen. They also studied spore formation, and have confirmed their previous view that the spore is limited by the astral rays, but that these represent currents flowing out from the centrosome. They suggest that the centrosome is the seat of fermentative activities and alters the cytoplasm, causing it to form the spore-limiting layer.

Notes on the Parasitism of Botrytis.†—F. T. Brooks has conducted cultural experiments on living plants of lettuce with this fungus. He found that with *Botrytis* conidia he was unable to infect healthy green leaves, nor even partially weakened leaves; but wounded leaves, or those turning yellow, were penetrated by the fungus. He found also that if mycelium nourished saprophytically was placed on the same leaves infection took place and spread rapidly.

Mould of Fermenting Grain.‡—L. Mangin and N. Patouillard describe three kinds of altered grain produced in Algeria by placing it in silos and allowing it to ferment. One of these products, called Catonag grain, becomes injured in the process; the moulds destroy its nutritive value and communicate toxic properties to it. The authors examined the mould and made cultures, by which they proved it to be *Monilia Arnoldi* sp. n. They were able to produce the conidial form and the sclerotia, but not the ascus form. Full accounts are given of the development of the fungus.

Conidial Formation in Aspergillus.§—L. Mangin has grown species of *Aspergillus* on various media and under varying conditions to determine the constancy of the factors that are considered of importance in

* Ann. of Bot., xxii. (1908) pp. 465–77 (2 pls.).
† Proc. Camb. Phil. Soc., xiv. (1907) p. 298.
‡ Bull. Soc. Mycol. France, xxiv. (1908) pp. 156–64 (4 figs.).
§ Comptes Rendus, cxlvii. (1908) pp. 260–3.

classification. These are generally the form and size of the reproductive organs. He finds, however, that all these are subject to considerable variation, and chiefly the conidia, which differ in size and in appearance, varying from smooth to distinctly echinulate. These phenomena are not confined to the Aspergillaceæ, and should have an important bearing on the determination of species.

Study of Nuclear Divisions in Rusts.*—Edgar W. Olive gives a short preliminary sketch of the views held by successive workers on the origin of the binucleated condition of cells of the Uredineæ up to the date of Blackman's and Christman's papers on the subject. These two writers disagree as to the explanation of the conjugation process; Blackman holding that it is oosporic, a large female cell receiving the nucleus from a smaller male cell. Christman views it as zygosporic, consisting of the union of two equal gametes, and resulting in a non-resting zygospore. Christman finds also that nuclear migration occurs in *Puccinia Podophylli* in the teleutospore sorus, when there could be no sexual process, and he is inclined to interpret all such migrations as pathological. A history of work on nuclear division is also given.

As a result of his own work, chiefly on *Triphragmium ulmariæ*, Olive concludes that the fusing gametes, as well as the nuclei, are approximately equal, corresponding thus to Christman's view, and he regards the upper sterile cell as merely a degenerating tip-cell, and rejects Blackman's interpretation that it is an abortive trichogyne. Conjugation of the two gametes takes place through a larger or smaller pore. He also found multinucleate cells at the base of the æcidium cup, which Blackman considered abnormal; as he has detected them in eight or ten species of rusts, he concludes that they are of regular occurrence, and are the result of repeated nuclear division without cell-formation. He suggests that they belong to the sporophytic generation, and arise owing to the stimulated growth that follows the sexual cell-fusion.

The vegetative nuclear division is constantly mitotic, each nucleus apparently in entire independence of its associated neighbour. He was unable to count the chromosomes in the dividing nucleus, but the chromatic radiations, which are regarded as corresponding to the chromosomes, are eight in number, and are segregated into two groups of four, each group being attached to a distinct centrosome, thus giving a double character to the daughter-nucleus.

Uredineæ.—Alfred Hasler † publishes a preliminary notice of his work on the *Pucciniæ* of *Crepis* and *Centaurea*. In the former genus he worked with about twenty species, making inoculation cultures with different forms of *Puccinia*. Some of these grew on a number of *Crepis* species such as *P. praecox*, others, such as *P. Crucheti*, were specialised to one species alone. Similar cultures were carried on with *Centaurea*, and the results are shortly given.

P. Dietel ‡ describes a second series of Uredineæ from Japan and

* Ann. of Bot. xxii. (1908) pp. 331–60 (1 pl.).
† Centralbl. Bakt., xxi. (1908) pp. 510-11.
‡ Ann. Mycol., vi. (1908) pp. 222–9 (1 fig.).

establishes a new genus, *Blastospora*. The teleutospores resemble those of *Uromyces*, but on germination the whole upper end of the spores grows out to form the promycelium. It formed uredospores and teleutospores on *Smilax Sieboldi*. A number of new species are also recorded and described. A figure is given of the new genus.

C. v. Tubeuf* has found that the pear-tree rust persisted through the winter at the base of the leaves, etc., and in spring produced spermogonia on the bud-scales, and later æcidia in large numbers; in the following year these parts of the tree died after two successive æcidium formations.

In a discussion as to the appearance of new forms of plant life Ed. Fischer† selects the Uredineæ to illustrate his theme. He describes the life-history as now understood from recent researches, presenting a change of generation from one with uninucleate cells to another with binucleate, and he draws attention to the modifications that may occur in either, so that in the sporophore generation the æcidium or uredo, or both, may be omitted, and in the sexual generation the spermogonia may have entirely disappeared. These variations he concludes represent a young type phylogenetically, and such curtailed forms may be regarded as still in a state of development.

Identity of Polyporus applanatus of Europe and North America.‡—This rather common bracket-fungus has been stated by some fungologists to be different from the one known by that name in the American States. G. F. Atkinson has therefore made a study of the species, and decides that they are identical in the form and appearance of the pileus, and in the colour, form, and marking of the pores. He cites all the different authorities who have written on the subject, and sums up the synonymy of the species, placing it in the genus *Ganoderma* and giving it an earlier specific name, *G. lipsiensis*.

Monographs of the Higher Fungi.—Fr. Bataille§ has issued a flora of the Asterosporæ, that is of *Lactarius* and *Russula*, 78 species of the former and 99 of the latter. He has drawn up keys to the species based on the more easily observed characters, form, colour, stalk, etc.

A second monograph‖ deals with *Boletus*, for which he has also drawn up keys, dividing the species into genera or sub-genera. Colour of spores and the form of the pores are the determining characters, so that in section *Tubulati* there are 3 series: (1) Porphyrospori (with the genera *Eriocorys*, *Phæosporus* and *Rhodoporus*; (2) Eupori, including *Trachypus*, *Coelopus* and *Œdipus*; and (3) Heteropori, with the genera *Xerocomus*, *Ixocomus* and *Chalciporus*. The section Alveolati is divided into 3 genera, *Uloporus*, *Phylloporus*, and *Euryporus*.

Form-development of Pileate Fungi.¶—Werner Magnus has published a paper on this subject, the results of observation and experiment

* Nat. Land. Forstw., iv. (1907) pp. 217–19. See also Bot. Centralbl., cviii. (1908) p. 187.

† Mitt. Nat. Gesell. Bern, 1907 (1908) pp. 136–54.

‡ Ann. Mycol., vi. (1908) pp. 179–91 (3 pls.).

§ Extr. Mém. Soc. Émul. Doubs, sér. 8, ii. (1907) 100 pp. See also Bot. Centralbl., viii. (1908) pp. 330–1.

‖ Bull. Soc. Hist. Nat. Doubs, No. 15 (1908) 30 pp. See also Bot. Centralbl., cviii. (1908) pp. 331–2.

¶ Arch. Biontol., i. (1906) pp. 85–161 (6 pls.).

carried out by himself. He discusses the effect of wounding the plants at different stages of growth and their manner of regeneration; he compares this with normal growth, and pays special attention to the monstrous forms that are occasionally met with, and the conditions that have induced their growth. Finally, he discusses various phylogenetic problems.

Note on Phallus impudicus.*—G. de Coutouly describes how he managed to root out this very disagreeable fungus from a small plantation near a dwelling-house. A careful watch was kept, and as soon as the "egg" was visible it was removed, and the ground was trenched round the spot and treated with quicklime. The following season there was no recurrence of the fungus.

Mushroom Culture.†—P. M. Biers has written a description of the culture as it is carried on in caves in France. These caves occur or have been made in chalk or limestone districts, and the method of culture dates from the beginning of the eighteenth century. The caves must not be too damp or too dry, or the spawn will not develop properly. Biers describes the making of the beds, the culture of fresh spawn, and the different operations necessary in the culture. He also gives statistics of the enormous extent and commercial importance of the industry.

Mycological Notes: IV.‡—F. von Höhnel continues his useful examination of published species, whereby he has weeded out many redundant species. *Cleistotheca papyrophila* Zukal he finds to be synonymous with the very common *Pleospora herbarum*. He also gives a review of his new family Pseudosphæriaceæ, giving a list of the genera and species that should be placed in it. A new genus of Sphæropsideæ, *Plectophoma*, with somewhat peculiar sporophores, is described; he considers it to be the pycnidial stage of some small Discomycete. Descriptions of several new species are also published.

Fungicides.§—Hermann Burmester has made an experimental study of the different reagents employed to destroy fungus spores, especially of smut and bunt on seeds. His work had special reference to the influence, good or bad, of the fungicides on the vitality of the seeds. Copper sulphate, formalin, hot air, and picric acid were tested both on seeds and spores, and the results are tabulated under each heading. He concludes that copper sulphate and formalin are both almost equally effective, and much more to be recommended than either hot air or boiling water; but the choice ultimately rests with the agriculturalist, who must select the method that is most practicable for him.

Yorkshire Fungi.‖—C. Crossland selected the study of fungi in Yorkshire as the subject of his presidential address to the Naturalists' Union at Halifax. The oldest record of a Yorkshire fungus is from

* Bull. Soc. Mycol. France, xxiv. (1908) pp. 181–2.
† Tom. cit., 189 96 (4 pls.).
‡ SB. k. Akad. Wiss. Wien, Math.-Nat. Kl., cxvi. (1907) pp. 615–47. See also Hedwigia, xlvii. (1908) Beibl., pp. 167–9.
§ Zeitschr. Pflanzenkr., xviii. (1908) pp. 154–87.
‖ Naturalist, 1908, pp. 81–96 and 147–56.

Hampole Wood, near Hutton Pagnall, in 1650. James Bolton's "History of Fungusses growing about Halifax" receives special attention. There follows an account of all the different fungologists, writers, or collectors connected with Yorkshire, which includes the names of nearly all the British workers in this field, as they each seem to have joined in the Yorkshire forays at one time or another.

Diseases of Plants.*—M. C. Potter reports on "deaf-ear" of barley, a disease in which the ears of the cereal are deficient, or almost empty. He has proved that this is due to the presence of the fungus *Helminthosporium*, which also causes stripe-disease of the leaves. The conidia of the fungus find a lodgment in the chaff inclosing the grain, and on germination of the seed the fungus germinates also and grows in the tissue of the host, in the same way as Smut (*Ustilago*). Cleaning the grain is recommended to destroy the conidia, either by hot-water treatment or by the use of chemicals. Low temperature at the time of sowing favours the growth of the fungus.

Transactions of the British Mycological Society.†—These form a record of the work done during the year by the society through its members, the account of the annual foray being the first item. The members met at Newcastle in October, and made a series of excursions to places in the neighbourhood that offered good ground for their particular harvest. An account of these excursions is given, and a list of the fungi collected, two being new to the British flora. Plowright publishes an account of a case of poisoning at Ipswich, due to the eating of *Amanita phalloides*, a very poisonous species. M. C. Cooke furnishes a reply to Boudier's criticism of his "illustrations": some of the statements Cooke accepts or explains; others he rejects. D. A. Cotton continues his notes on British Clavariæ; for *C. vermicularis* he substitutes the name *C. fragilis* as having a prior claim, and he finds that *C. rufa* must be deleted from the flora as being only a synonym of *C. inæqualis*. A list of new or rare British fungi is prepared by A. Lorrain Smith and Carleton Rea, and contains many species new to Britain, published in other journals or recorded here for the first time. It also contains a number new to science. They are well illustrated by one uncoloured and two coloured plates. The presidential address by A. Lorrain Smith gives an historical account of microfungi, especially in this country, from the earliest drawings and observations by Hooke in his Micrographia (1677) down to the present time. Hooke's illustrations of the two species noted by him are reproduced by photography.

Case of Poisoning by Amanita junquillea.‡—J. Jeanmaire describes his own experiences in collecting and eating various species of fungi, which affected more or less the persons who ate of them. He found that *A. junquillea*, usually an edible fungus, was occasionally harmful, though not seriously so. The fungi were collected after heavy rains in the month of May.

* Newcastle, 1908, 8 pp. (1 pl.)
† Worcester: E. Baylis and Son (1908) iii. pt. 1, 46 pp. (4 pls.).
‡ Bull. Soc. Mycol. France, xxiv. (1908) pp. 178–81.

New Fungi from South America.* — C. Spegazzini has recently issued papers on new fungi, including many new species and genera. The first is devoted to parasites on *Theobroma cacao*, where he finds one new genus *Hysteriopsis* (Hysteriaceæ) with muriform spores.

In a second paper † he describes a number of Pyrenomycetes and Sphæropsideæ collected by A. Usteri in San Paulo; the new genera are *Dimerosporiella*, *Hyalotheles*, *Dimeriella*, *Phæodimeriella*, *Eudarluca*, *Lonchospermella*, and *Phæoseptoria*. Many of the plants described are parasites, and the name of the host has been omitted.

In a third paper ‡ he gives the parasitic fungi of *Ilex paraguayensis*, 72 in number, most of them new species, with the following new genera: (Pyrenomycetes) *Acanthonitschkea* and *Phæobotryosphæria*; (Discomycetes) *Stilbopeziza*; (Fungi imperfecti) *Macrodiplodiella*, *Phæomarsonia*, and *Spermatoloncha*.

Mycothecea of the School of Pharmacy. XXVIII.—G. Bainier§ continues his studies of filamentous fungi: he finds that the mould, which he described as *Cephalomyces nigricans*, should be placed in the genus *Cephaliophora*. The species of the genus inhabit warm countries, but can easily be cultivated in the laboratory. Descriptions and plates of those already described are added.

He describes ‖ also a mould, *Haplographium fuscipes*, which has been recorded on leaves of Scotch pine, and was found by him on decaying leaves of *Epicea excelsa*. The genus resembles the brown form of *Penicillium*, and many of the species have been found on leaves of Conifers. Bainier gives a careful description of the mould, and of the cultivations of it that he made.

Diseases of Plants.—O. Fallada¶ gives a review of diseases of sugar-beet due to parasitic fungi; in Italy there was an attack of the plants by *Cercospora beticola*. In other places *Phoma Betæ* was signalled, though not always the cause of the drying up of the beet. *Cladosporium herbarum* and *Clasterosporium putrefaciens* occurred frequently, and seriously affected the quantity of sugar in the beet.

T. Petch** records the diseases of tobacco in Dumbara; he finds a *Cercospora* and an *Oidium* on the leaves, and a somewhat serious root trouble caused by a species of *Fusarium*.

In West Virginia the apple trees suffered badly from loss of leaf. J. L. Sheldon†† has examined into the cause of this, and finds it to be

* Fac. Agr. Vet. Univ. Nac. La Plata, ii. (1907) pp. 303–11 (figs. A–E). See also Ann. Mycol., vi. (1908) p. 280.

† Rev. Mus. La Plata, xv. (1908) pp. 7–68 (8 figs.). See also Ann. Mycol., vi. (1908) pp. 280–1.

‡ Ann. Mus. Nac. Buenos Aires, xvii. (1908) pp. 111–41. See also Ann. Mycol., vi. (1908) p. 281.

§ Bull. Soc. Mycol. France, xxiv. (1908) pp. 147–51 (2 pls.).

‖ Tom. cit., pp. 152–5 (2 figs.).

¶ Oesterr-Ungarr. Zeitschr. Zuckerind. Landw., i. (1908) pp. 28–37. See also Hedwigia, xlviii. (1908) Beibl., p. 37.

** Journ. Roy. Bot. Gard. Ceylon, iv. Nos. 7, 8 (1907) pp. 41–8 (1 pl.). See also Ann. Mycol., vi. (1908) pp. 282–3.

†† Torreya, viii. (1908) pp. 139–41. See also Ann. Mycol., vi. (1908) p. 283.

due to a fungus, *Illosporium malifoliorum* ; it forms characteristic leaf-blotches.

P. Bacarini* has described a parasitic fungus, *Botrytis Pistiæ* sp. n., that attacks and destroys the leaves of *Pistia stratiotes* at the end of the summer. The conidial form alone was observed ; a diagnosis is given.

K. Kornauth and G. Köck† give an account of the gooseberry mildew in Austria, where it has spread very largely. They describe the difference between the American and European mildews on *Ribes*, and suggest remedies.

Griffon and Maublanc‡ have published a note on the very serious mildew of oaks. Specimens of affected leaves have been received this last season from all over France, though it was scarcely known until the previous year. The suggestion is that it is an indigenous species, *Microsphæra Alni*, that has suddenly attacked a new host : on the other hand, it may be an exotic form of the same fungus that has been introduced. (It has also recently appeared in England.)

Ed. Bureau § writes in a later issue of the same journal an account of the disease as he has observed it. In some of the woods the whole of the oak leaves had become grey and hung down, recalling the foliage of the Australian *Eucalyptus*. He made an examination of the oaks attacked, and found that while in *Quercus pedunculata* and others the whole of the leaves were attacked, in *Q. sessiliflora* only the young shoots suffered. *Q. rubra*, a North American species, was similarly affected, only the young shoots being mildewed. The beech has also been attacked by the same mildew, but only the young shoots, and usually only in hedges, the forest trees having escaped. The chestnut is immune, and so also is *Q. suber*, the cork oak.

E. S. Salmon ‖ records a disease on cherry trees caused by *Exoascus minor*, which is not to be confounded with *E. cerasi*. The former attacks the young wood, and the mycelium persists during the winter. Judicious removal of the twigs affected will soon stamp out the disease.

A disease of coconut palm in Travancore has been investigated by E. J. Butler.¶ It showed itself by withering of the leaves and the bud, finally the crown falls off. The tree does not die at once, but few nuts are produced, and these few do not ripen. A parasitic fungus on the roots was probably the cause of the evil. Infection experiments are proposed.

A stem disease of the same palm, called "bleeding disease," has been found by T. Petch** to be probably due to the fungus *Thielaviopsis ethaceticus*, as it is always present on the diseased tissue. Cutting out the injured parts, scorching and sterilising with hot tar, have given good results in stamping out the disease.

* Bull. Soc. Bot. Ital., 1908, pp. 30–1.

† Monats. Landw., 1908, p. 50. See also Bot. Centralbl., cviii. (1908) pp. 179–80.

‡ Comptes Rendus, cxlvii. (1908) pp. 437–9.

§ Tom. cit., pp. 571–4.

‖ Gard. Chron., xliii. (1908) pp. 209–10.

¶ Agric. Res. Inst. Pusa, Bull. 9, 23 pp., Calcutta, 1908. See also Bot. Centralbl. cviii. (1908) p. 299.

** Agric. Journ. Roy. Bot. Gard. Ceylon, iv. (1907) pp. 49–53. See also Bot. Centralbl. cviii. (1908) p. 303.

H. M. Quanjer * records the occurrence of cucumber leaf-spot (*Corynespora Mazei*) in South Holland. It causes the leaves to become yellow and die. Inoculation by spores induced the disease in healthy leaves.

C. v. Tubeuf † writes that the cherry-leaf disease has broken out badly in Bavaria. The fungus *Gnomonia erythrostoma* causes the leaves to dry up before the autumn, and they hang on the trees all winter. He notes that the ascospores are always 2-celled.

The same writer also draws attention to the leaf disease of Weymouth Pine caused by the fungus *Hypoderma brachysporum*. The disease has been very prevalent lately, and an account is given of the various localities where the trees have been attacked.

BATAILLE, F.—**Notes sur quelques Russules.**
[Several species of *Russula* are carefully described.]
Bull. Soc. Mycol. France, xxiv. (1908) pp. 172–7.

BIANCHI, G.—**Micologia della Provincia di Mantova.** (Mycology of the Province of Mantua.)
[The author enumerates 196 microfungi; three forms are new to science.]
Atti Ist. Bot. Univ. Pavia, ser. 2, ix. (1907) pp. 289–319.
See also *Bot. Centralbl.*, cviii. (1908) p. 298.

BOYD, D. A.—**On the Occurrence of Sclerotinia baccarum in Stirlingshire.**
[The first record of the fruiting form of these sclerotia in Britain.]
Journ. Bot., xlvi. (1908) pp. 299–300.

FISCHER, ED.—**Zur Morphologie der Hypogaeen.** (Morphologie of the Hypogeæ).
[A discussion of subterranean Ascomycetes; one new genus, *Pseudobalsamia*, has been instituted.] *Bot. Zeit.*, viii. and ix. (1908) pp. 141–68 (1 pl.)

FOEX, E.—**Les Rouilles des Ceréales.** (Rusts of cereals.)
[An account of the Uredineæ of cereals, and of methods for dealing with them.] Montpelier: Coulet et Fils, 1908, 116 pp.

FRON, G.—**Note sur le Micropera abietis Rostrup.** (Note on *Micropera abietis*.)
[This species of Sphæropsideæ was on branches affected by *Fusicoccum abietinum*; the connection with it was not proved.]
Bull. Soc. Mycol. France, xxiv. (1908) pp. 169–71 (4 figs.).

HENNINGS, P.—**Einige neue parasitische Pilze aus Transvaal.** (Some new parasitic fungi from the Transvaal.)
[The fungi are chiefly Uredineæ; they were collected by T. B. R. Evans.]
Engler's Bot. Jahrb., xli. heft 4 (1908) pp. 270–3.
See also *Bot. Centralbl.*, cviii. (1908) pp. 332–3.

" " **Fungi S. Paulenses. IV.**
[Fungi from Brazil, collected by Puttemans; many of the species are new.] *Hedwigia*, xlviii. (1908) pp. 1–20.

" " **Fungi Philippinenses. I.**
[A list of microfungi. Many new species are described, and one new genus of Xylariæ, *Merilliopeltis*, found on the stalks of a *Calamus*.]
Op. cit., xlvii. (1908) pp. 250–65; and
Philippine Journ. Sci., iii. (1908) pp. 41–58.

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* Tijdschr. Plantenz., (1908) p. 78. See also Bot. Centralbl. cviii. (1908) p. 304.
† Nat. Zeitschr. Land. Forstw., vi. (1908) pp. 330–2 (3 figs.), and pp. 327–30 (3 figs.). See also Bot. Centralbl., cviii. (1908) p. 365.

Höhnel, Fr. v., & V. Litschauer—**Oesterreichische Corticieen.** (Austrian Corticeæ.)
[A review of European species, and a list of 136 known in Austria.]
Festschr., 1908, pp. 56–80. See also *Ann. Mycol.*, vi. (1908) p. 277.

Jaap, Otto.—**Dritter Verzeichniss zu meinem Exsiccatenwerk. Ser. IX.–XII** (List and description of "Fungi selecti exsiccati," 201–300.)
[Notes are added on interesting or unusual forms.]
Abh. Bot. Ver. Prov. Brandenb., l. (1908) pp 29–51.
See also *Bot. Centralbl.*, cviii. (1908) pp. 334–5.

„ „ **Beiträge zur Pilzflora der österreichischen Alpenländer.** (Contribution to the fungus-flora of the Austrian alpine countries.]
[Fungi from South Tyrol and Carinthia; a few species are new.] *Ann. Mycol.*, vi. (1908) pp. 192–221.

Murril, W. A.—**Additional Philippine Polyporaceæ.**
[A large number of new species are described, and one new genus, *Whitfordia.*)
Bull. Torrey Bot. Club, xxxv. (1908) pp. 391–416.

Pantanelli, E.—**Ueber Pilzrevertase.**
[A study of plant enzymes, as illustrated in the growth of filamentous fungi.] *Ber. Deutsch. Bot. Gesell.*, xxvi. (1908) pp. 494–504.

Patouillard, N.—**Champignons de la Nouvelle-Calédonie.** (Fungi from New Caledonia.)
[Several new species are described.]
Bull. Soc. Mycol. France, xxiv. (1908) pp. 165–8 (1 fig.).

Peter, A.—**Die Pyrenomyceten und Tuberaceen der Göttingen Flora.**
[A review of these fungi in the University Herbarium, with notes, etc.]
Nach. k. Ges. wiss. Göttingen Math.-Phys. Kl., (1908) i. pp. 28–52.
See also *Hedwigia*, xlviii. (1908) Beibl., p. 24.

Rytz, Walther—**Beiträge zur Kenntniss der Pilzflora des Kientales.** (Contributions to a knowledge of the fungus-flora of the Kien valley, in the Bernese Oberland.
[A list of microfungi, largely Uredineæ.
Mitt. Nat. Ges. Bern, 1907 (1908) pp. 71–86.

Spegazzini, C.—**Mycetes argentinenses.** (Argentine fungi, ser. v.)
[Detailed descriptions of various species. A new genus is recorded, *Cypellomyces.*] *Ann. Mus. Nac. Buenos Aires*, ix. (1908) pp. 25–33 (3 figs.).
See also *Bot. Centralbl.*, cviii. (1908) p. 303.

Wilson, Guy W.—**Studies in North American Peronosporales. III.**
[New or noteworthy species. New species of *Albugo* and *Peronospora*.]
Bull. Torrey Bot. Club, xxxv. (1908) pp. 361–5.

Lichens.

(By A. Lorrain Smith, F.L.S.)

Chemical Examination of Lichens.* — Emanuel Senft finds that the ordinary methods of extracting acids from lichens by chloroform, etc., are too rapid in action, and that they evaporate too quickly. He has discovered, however, a method which he recommends of using fat oils for the purpose, and applying heat to the saturated object. From the oil he subsequently extracts the acids. This method is further to

* Pharm. Praxis, vi. heft 12 (Vienna and Leipzig, 1907) 9 pp. and figs. See also Hedwigia, xlviii. (1908) Beibl., pp. 24–5.

be recommended because so little of the lichen thallus is required for the experiment. Details are given of the experiments.

JATTA, A. — **Species novæ in excelsis Ruwenzori in expeditione Ducis Apruti lectæ. IV. Lichenes.** Lichens from Ruwenzori.)

[Among the lichens collected by the expedition of the Duke of the Abruzzi are several new species.] *Ann. Bot.*, vi. (1908) pp. 407–9.
See also *Bot. Centralbl.*, cviii. (1908) p. 188.

KERNSTOCK, E.—**Index nominum receptorum et synonymorum Lichenographiæ Scandinavicæ Friesianæ.**

[An index of Th. Fries's work on Scandinavian lichens.]
Ann. Mycol., vi. (1908) pp. 230–67.

ZAHLBRUCKNER, A.—**Beiträge zur Flechtenflora Brasiliens.** (Contributions to the lichen flora of Brazil.)

[Several new species are included in the list.]
Bull. Herb. Boiss., ser. 2, vii. (1908) pp. 459–68.

ZACHACKE, HERMANN—**Beiträge zu einer Flechtenflora des Harzes.** (Contributions to a lichen flora of the Harz.)

[A list of species found by the writer.]
Hedwigia, xlviii. (1908) pp. 21–44.

Mycetozoa.

(BY A. LORRAIN SMITH, F.L.S.)

Spongospora Solani.*—T. Johnson regards this organism as a slime-fungus akin to *Plasmodiophora*. It causes scab of potato tubers and very seriously damages the crops in many districts. The scabbed areas of the tuber are inhabited by spore-balls which escape into the soil; these spores produce motile amœboid bodies, which form a plasmodium and pass to the newly planted tuber. Johnson warns growers of the serious nature of the disease and suggests remedies: clean seed, proper rotation of crops, dry soil and steeping the seed-tubers before planting in Bordeaux mixture.

Development of the Sporangia in Trichia and Arcyria.†—Helene Kränzlin has been applying new and improved methods of technique to the elucidation of problems connected with the Mycetozoa. In *Arcyria* the development of the sporangia takes place by a heaping up of the plasma, first in roundish then cylindrical masses; the plasma in the younger stages is thick externally with vacuoles in the interior. Large nuclei in process of division were to be seen at the first stage of sporangium formation. As the cylindrical form takes shape the nuclei of the outer layers become more closely associated and fuse in pairs; later the central nuclei fuse also. The author discusses the views about reduction of the chromosomes which number eight in the fused nucleus, and she also gives notes on the formation of the elaters.

* Econ. Proc. Roy. Dublin Soc., i. (1908) pp. 453–64 (1 pl.).

† Arch. Prot. Kunde, ix. (1907) pp. 176–94 (1 pl. and 7 figs.). See also Bot. Centralbl., cviii. (1908) pp. 180–1.

Schizophyta.

Schizomycetes.

Bacillus Pneumoniæ Tigris.*—E. Marx found in smears prepared from the lung of a tiger that had died with hæmorrhagic pneumonia of both lungs, a minute micro-organism that did not stain by Gram's method, but showed distinct polar staining, and morphologically resembled a bacterium rather than a coccus. Cultures made on blood-agar and on serum resembled those of the influenza bacillus; the morphology of the organism varied on different media. On agar and in broth they are ovoid rods about $0 \cdot 6$–$0 \cdot 8 \mu$ long, and occasionally longer forms: on blood-agar the long forms predominate, and the ovoid appearance is not so obvious; on Loeffler's serum the rods are slender like tubercle bacilli, and measure 2μ in length; they are non-motile. This bacillus is a strict aerobe; it does not produce indol; it is killed by heating to 60° C. for one hour. It causes fatal septicæmia in mice, guinea-pigs and rabbits, though the virulence for these last animals is not very great. It is not especially virulent for cats.

Bacillus metatyphosus.†—A. Nieter has examined the cultural properties of the species described by Mandelbaum as *B. metatyphosus*, and compared them with those of forty cultures of *B. typhosus*. There is only slight or no influence on the hæmoglobin of ordinary blood-agar, but if this contains 1–2 p.c. of glycerin there is a distinct effect, and with 6 p.c. glycerin-agar it is considerable; with a 6 p.c. glycerin-agar to which a few drops of rosol acid have been added, the growth of *B. typhosus* is yellow, and that of *B. metatyphosus* is red; the same differences being observed with rosol acid glycerin-pepton water.

Bacillus of Bang.‡—J. Nowak gives an account of the bacillus described by Bang as the cause of the specific abortion in cows, and isolated from the exudate of the internal surface of the uterus, from the fœtal membranes, and from the blood and viscera of the aborted calves. In liquid gelatin or blood-serum after a few days at 37° C. small colonies appear only in a narrow zone of the medium situated about 15 mm. from the surface; the organism belongs to a class of bacteria intermediate to the anaerobes and aerobes, and requires an atmosphere containing less than 10 p.c. of oxygen; to separate the bacillus from the other germs that are usually present in these cases, the establishing of this atmospheric condition is essential. To attain this the author has devised the following method: it consists in incubating tubes of sloped agar inoculated with the exudate to be examined, together with similar tubes of agar inoculated with *Bacillus subtilis*, under a sealed bell-jar, at 37° C.; when the *B. subtilis* has absorbed sufficient oxygen the bacillus of Bang commences to grow.

The organism is a minute non-motile rod resembling the cocco-bacillus of fowl cholera; it stains with anilin dyes, often more strongly at the poles, but does not stain with Gram's method; it does not form

* Centralbl. Bakt. 1te Abt. Orig., xlvii. (1908) p. 581.
† Op. cit., 1te Abt. Ref., xlii. (1908) p. 156.
‡ Ann. Inst. Pasteur, xxi. (1908) p. 541.

spores. Superficial colonies appear as round pink transparent drops with a faint green reflection; the deeper colonies are smaller and more compact, round or irregular; individual organisms present many polymorphic forms. Vitality is retained in cultures for at least two years. Cultures may be obtained on all nutrient media; the optimum temperature is 37° C.; growth appears on gelatin at room temperature after 6 weeks; there is no gas formation in media containing the various sugars.

By injecting pure culture into the veins, vagina, or uterus of an enceinte cow, Bang obtained abortion. The author found that inoculation of female guinea-pigs and rabbits produced abortion in almost every case.

Five New Species of Iron-bacteria.*—D. Ellis gives preliminary notes of five new species of iron-bacteria.

1. *Spirosoma ferrugineum* consists of regular wavy threads, with wave-lengths two to three times the amplitude, and varying in size from a few μ to 100 μ or more. Reproduction is effected by formation of conidia, and rarely by a splitting process. The organism is present in all Scottish iron-waters, excepting those of the extreme northern counties; it has not been found in English iron-waters.

2. *Nodofolium ferrugineum* consists of a flat band constricted at regular intervals, varying greatly in the sizes and in the number of the constrictions; reproduction occurs by conidia formation, which swells out the band to double its normal thickness. This organism occurs in the central and western parts of Scotland, but not in the north and south.

3. *Leptothrix Meyeri* resembles *L. ochracea*, but differs from it in the absence of shapely contoured walls, and in the appearance of the iron deposit, which is transparent at first and becomes opaque later. The threads vary in length from 40–70 μ, and in breadth from 2–3 μ. The transparent nature of the iron deposit is due to mucilage formed by the degeneration of the thread-walls; the iron slowly penetrates, and colouring the mucilage renders it visible. The method of reproduction has not been studied.

4. *Spirophyllum tenue* consists of a spirally twisted flat band, 1 μ in width and from 200–300 μ long, as many as 200 spirals occurring in one individual. It has a loose solenoid structure, and only a slight iron deposit, which is detected by ammonium sulphide and with potassium ferrocyanide. The complete life-history has not been established.

5. *Spirosoma solenoide* resembles the preceding. But the spirals are very close together, and made up of a thread, not a band; the average individual measures about 70 μ, the thread is 0·5 μ in diameter, and the distance between two turns is less than 1 μ. The complete life-history has not been established.

Lactic Acid Fermentation in Milk.†—M. W. Beijerink finds that in the various forms of lactic acid fermentation there is no formation of gas, or only of carbonic acid, and sometimes there is a vigorous slime

* Proc. Roy. Soc. Edinburgh, xxviii. (1907–8) p. 338.
† Konink. Akad. Wetensch., x. (1907) p. 17.

production. This form of milk fermentation is caused by many different bacteria, which are classed as lactococcus and lacto-bacillus; they are non-motile non-sporing organisms, that resist heating to 65° C. and 75° C.; they require nitrogen in the form of pepton, and carbon in various forms of sugar; they do not peptonise proteids, and do not liquefy gelatin; some forms are aerobic, others anaerobic. All active lactic acid ferments invert sugar, and more or less readily decompose esculin and indican, but not amygdalin; they reduce levulose to mannite. The slime-producing forms have an optimum temperature of 20° C. or lower.

Tetradiplococcus filiformans Lodzensis.* — St. Bartoszewicz and J. Schwarzwasser have isolated from well-water at Lodz a diplococcus which in hanging-drop appears as a tetrad, each corner of which represents a diplococcus of gonococcal form; usually three or more tetrads are grouped together and form an irregular membrane, in which the cocci are distributed as at the margin of a hanging-drop. In fresh culture the tetrads exhibit an active rotatory movement, but no flagella could be detected. The tetrads are 4–6 μ in size; growth occurs at room temperature, but more freely at 37° C.

In the depth of gelatin-plate culture, after a few days, they form round shining pin-head colonies, with a mother-of-pearl tint; the medium is not liquefied. In broth, growth appears as delicate white threads that grow upwards from the bottom of the tube, and which either reach to the surface and form a fine pellicle, or bend back again to the bottom; at room temperature this thread formation does not occur, but a slimy deposit collects at the bottom of the tube; the medium always remains clear. The threads appear to consist of tetrads bound together by flagella and slime.

Melitensis Septicæmia.†—J. W. H. Eyre in his Milroy Lectures before the Royal College of Physicians, London, gave an exhaustive account of this disease, commonly known as Malta Fever. The author, referring to the history of the subject, quotes Hippocrates and other ancient writers to show that this fever was recognised in olden times. Its distribution extends over the Mediterranean coasts and islands, and cases are reported from India, China, and South Africa.

The disease is described as a septicæmia due to the infection by the *Micrococcus melitensis*, having definitely recognised clinical signs, and readily diagnosed by the serum agglutination test. It has a maximum incidence in the hottest season of the year.

It is generally believed that the leisured classes are more prone to this disease than the labouring people, but the author discredits this, and considers that the cases among the peasants are frequently not attended or reported, though military statistics show that the officers are more liable than the men.

The author describes the bacteriological attributes of the organism, and the effects produced in lower animals by inoculation of living

* Centralbl. Bakt., 2te Abt., xxi. (1908) p. 614.
† Lancet (1908) i. pp. 1677–82, 1747–52, 1826–32.

cultures, and gives details of the clinical aspects and treatment of the disease in man, and an account of the morbid appearances of different organs.

The author then discusses the channels of infection, showing that direct contagion plays no part, though there is strong evidence in favour of its transmission by sexual congress, and that transmission by mosquitos acting as carriers is possible, though exceedingly rare. It was shown that of 2000 goats (one-tenth of the goat population of Malta), 40 p.c. yielded positive agglutination reactions, and 10 p.c. secreted milk that contained the *Micrococcus melitensis*; and further, that all evidence points to goats' milk as the source of infection, and that since this fact has been recognised and the necessary preventive precautions have been instituted, the disease has practically disappeared from the naval and military services stationed at Malta.

Lactic-acid Bacilli and Cancer of the Stomach.*—A. Rodella finds that aerobic and anaerobic mouth bacteria pass into the stomach, and that the duration of their stay there depends on the quantity and quality of the acid and unorganised ferments present. In general, inorganic acids hinder or prevent the fermentation of yeast, the growth of sarcina and the development of the higher micro-organisms. Carcinoma of the stomach establishes a most favourable condition for the production of lactic acid fermentation, viz. a lack of free acid, a stagnation of the stomach contents, the ready fermentation of carbohydrates by ptyalin, and the relation of the oxygen of the air to the ferment action of the lactic acid bacilli. The albumen that separates from the surface of the malignant growth acts in two ways on the development of lactic acid bacilli. Firstly, the microbes are able to ferment the keton group of the albumen and produce lactic acid; and secondly, the albumen acts as a reducing agent in a nutrient medium; the conditions are assisted by the immobility of the stomach wall.

Opsonins and Antiphagins in Pneumococcic Infection.†—N. Tschistowitsch and W. Jurewitsch find, on examining the opsonic property of dog's blood in pneumococcic infection, that strongly virulent diplococci cultivated after several passages through rabbits, on solidified blood-serum, and possessing well-marked capsules, were not phagocytosed when emulsified in salt solution and mixed with dogs' leucocytes. But if the same diplococci had been thoroughly washed with physiological salt solution they were phagocytosed, although they had not lost their capsules; and further, if these washed diplococci were mixed with the decentrifuged fluid from the original diplococcal emulsion, their capacity for being phagocytosed was again lost. From these observations the authors conclude that the failure of phagocytosis of the unwashed virulent diplococci is connected not with the amount of opsonin present in the blood, but on the action of some specific substance, "antiphagin," in the diplococcal culture. This diplococcal antiphagin is specific for the special strain of diplococcus. If the

* Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) p. 445.
† Op. cit., 1te Abt. Ref., xlii. (1908) p. 193.

diplococci lose their virulence, they lose also their antiphagin, but after passage through rabbits both virulence and antiphagin are regained. The antiphagin retains its action after being heated for an hour at 35–90° C., and after twenty minutes at 100° C. Antiphagin obtained from diplococci that have been fortified by passage through rabbits, is active against the leucocytes of both rabbits and dogs.

The authors regard these antiphagins as antiopsonins, and suggest that opsonins are anti-antiphagins.

Microbes of Intestinal Putrefaction.*—E. Metchnikoff shows that the filtrates of cultures of *Bacillus putrificus*, *B. aerogenes*, and *B. sporogenes*, are highly toxic, and argues that as these bacteria are almost constant habitants of the alimentary canal, their toxins must necessarily be harmful to the organism. He accentuates his position by pointing out that these three putrefaction bacteria are not the only microbes infesting the colon, and shows that cultivations made from fæcal matter produce even more lethal toxins than those already enumerated. Experiments are being made under the direction of the author to ascertain by what means the organism defends itself against the morbid action of this intestinal flora.

Bacterium isolated from the Nervous Centres of Rabid Animals.†
V. Busila has isolated from the nervous system and cerebro-spinal fluid a bacterium which when inoculated on animals produces symptoms of rabies. It is a motile sporogenous bacillus, Gram-positive, about the size of Anthrax, and though growing at first with some difficulty is afterwards easily cultivable on various media. It forms a thin scum on broth, slowly liquefies gelatin, grows freely on slices of brain, and is isolable only in inoculated animals before symptoms of rabies declare themselves. It has been found once in human cerebrospinal fluid.

In the nervous tissue of animals dead after injection of cultures of the bacillus Negri's corpuscles are found in abundance, especially in the cornu ammonis.

The bacillus is agglutinated by antirabic serum in dilutions of 1 : 125 to 1 : 150.

Animals immunised against rabies are resistant to this bacillus, while all the controls succumbed.

Chain-formation by Staphylococcus aureus.‡ — V. Babes claims that his researches show that there is a close relationship and also intermediate forms between Streptococcus and Staphylococcus. In fact the two species divide in the same way, i.e. by the formation of chains, but which in Staphylococcus are often double. The staphylococcic form arises partly from irregularity of division and partly from the presence of capsules, which bind the microbes in irregular clumps.

Bacillus pathogenic to Cats.§—Z. Skrzynski describes a microbe which caused an epidemic among cats. It belongs to the *coli* group,

* Comptes Rendus, cxlvii. (1908) pp. 579–82.
† C.R. Soc. Biol. Paris, lxv. (1908) pp. 269–70.
‡ Tom. cit., pp. 265–7 (1 fig.).
§ Ann. Inst. Pasteur, xxii. (1908) pp. 682–8.

but is distinguished from the normal *B. coli* in being non-motile, by the character of the growth on agar, by not fermenting saccharose, and by being pathogenic to cats. Morphologically it is a rodlet with rounded ends. It stains easily with the ordinary anilin dyes, but is Gram-negative. It is a potential anaerobe, and the cultures after two or three days' incubation exhale a fœtid odour similar to that of *B. coli*. Fluid media are rendered turbid ; it does not liquefy gelatin ; on agar the growth is copious and characteristic, and after a few days long phosphatic crystals appear on the under surface of the colonies. It grows well on potato. Milk is coagulated with an acid reaction. It forms indol and reduces nitrates to nitrites, and on sugar media forms gas. It is pathogenic to laboratory animals as well as to cats, but immunisation is easily effected in the usual way, and the serum of these animals possesses both preventive and curative properties.

MICROSCOPY.

A. Instruments, Accessories, etc.*

(1) Stands.

Ross' New Micrometric Mechanical Stage.†—This apparatus (fig. 159) is adapted for micrometric measurements, and enables the user to ascertain the exact size of an object with any power. In conjunction with a fine-adjustment of known rate, the depth, length and width of metal fractures are measured at one operation. The micrometer move-

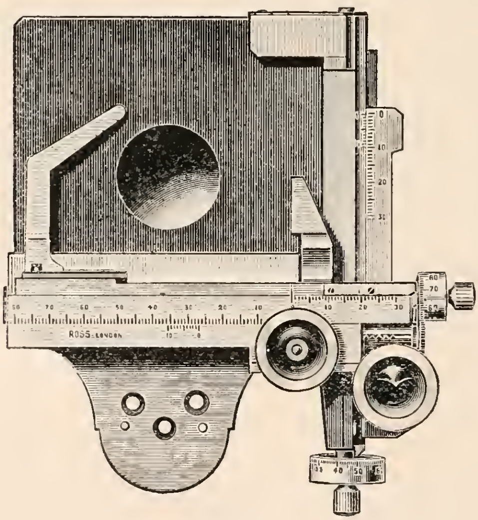

Fig. 159.

ments depend on slides built into the stage, actuated by milled heads attached to delicate micrometer screws with divided drums read against pointers or verniers. The bearing-points of the micrometer screws press against steel surfaces, and are kept up to contact by spiral springs.

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

† Ross' Catalogue, 1908, pp. 18–19 (1 fig.).

This movement has not only measuring capabilities, but also acts as a fine-adjustment to the mechanical stage, and this, when objectives with high magnification are used, is of great value. The quick movements by rack-and-pinion cover a range of 3 in. by 1 in. The stage-screws have threads $\frac{1}{3}$ mm., and the drum has 100 equal divisions, thus permitting measurements up to $\frac{1}{300}$ mm., or $\frac{1}{7620}$ in.

Ross' No. 2 "Standard" Metallurgical Microscope.* — The adjustments and construction of this stand (fig. 160) are on the same

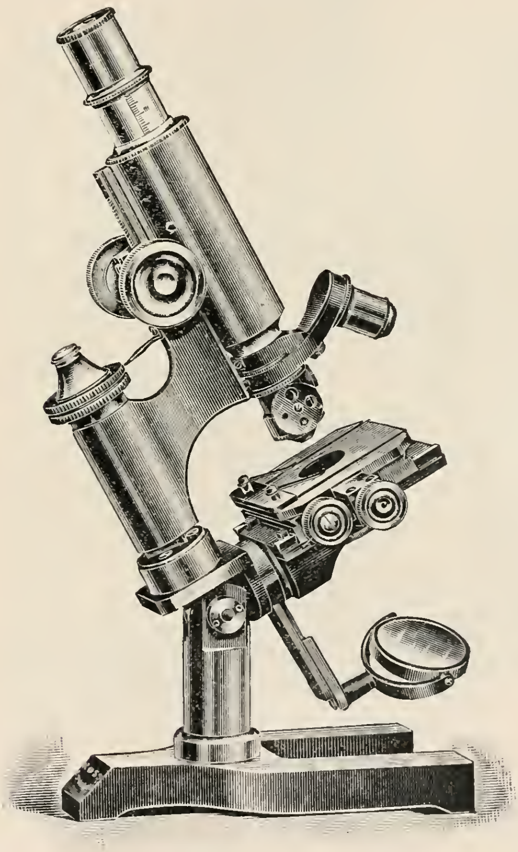

FIG. 160.

lines as those of the Ross' No. 2 Standard, but the instrument is specially adapted for metallurgical work. One revolution of the milled

* Ross' Catalogue, 1908, pp. 10–11 (1 fig.).

head of the fine-adjustment is equal to $\frac{1}{50}$ in., and the head has divisions to read to $\frac{1}{1000}$ in., for fracture measurements. The mirrors, in addition to their universal motion, swing over the stage upon a centre behind it, for the illumination of opaque objects. For high power-work an opaque illuminator is attached to the $\frac{1}{6}$-in. objective, mounted as short as possible to secure a maximum of light upon the specimen. There is

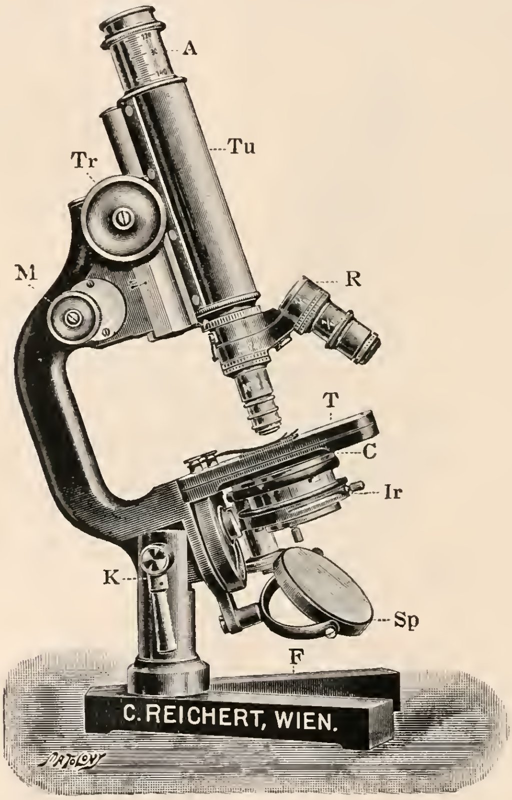

Fig. 161.

also a 1-in. objective, with parabolic illuminator and angle silver reflector combined, and a substage iris-diaphragm for observation of transparent objects.

Reichert's Travelling Microscope.*—This apparatus is shown in figs. 161 and 162. The stand (No. 52 in the Catalogue) is practically

* C. Reichert, Vien a, Catologue, Mikroscope, No. 26 (1908) p. 32, figs. 19-20.

the same as Stand A ii, which only differs from Stand A i (see October Journal) in being a little smaller. The prongs of the foot are hinged, and can be shut together, and the stage and mirror can be swung round, for packing in box. The size of the box is 9 × 19 × 29 cm., and the weight complete is 4·7 kilos.

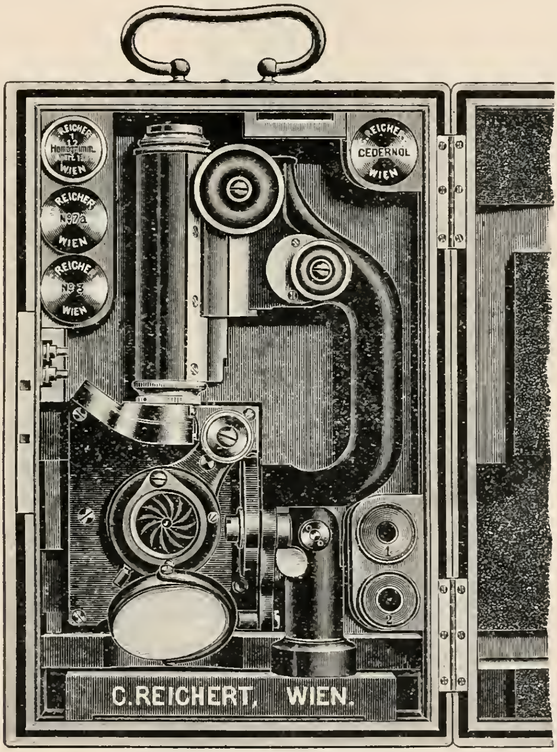

Fig. 162.

Reichert's New Steinach Stand C.*—This stand (fig. 163) is fitted with a large circular brass stage of about 105 mm. diameter. The projection of the inclinable upper part is considerable, and affords a convenient grip in carriage. The tilt of the inclination is regulated by a lever-clamp. The coarse-adjustment is by rack-and-pinion, and the fine by micrometer screw. The Abbe condenser has a screw for quick

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 22, fig. 9.

raising and lowering; the iris-diaphragm is fitted with a ring for the insertion of a blue glass. The mirror is plane and concave, and laterally adjustable.

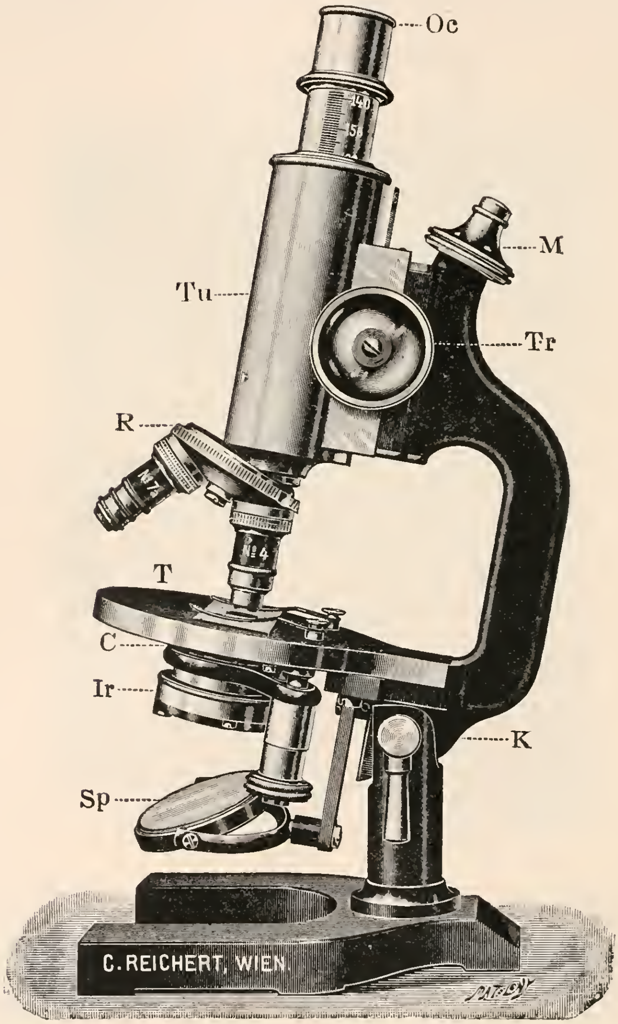

FIG. 163.

Reichert's New Stand vi.*—This stand (shown in fig. 164) is inclinable to 45°. It has a large circular brass stage of about 105 mm. diameter, and considerable upper stage projection. The coarse-adjust-

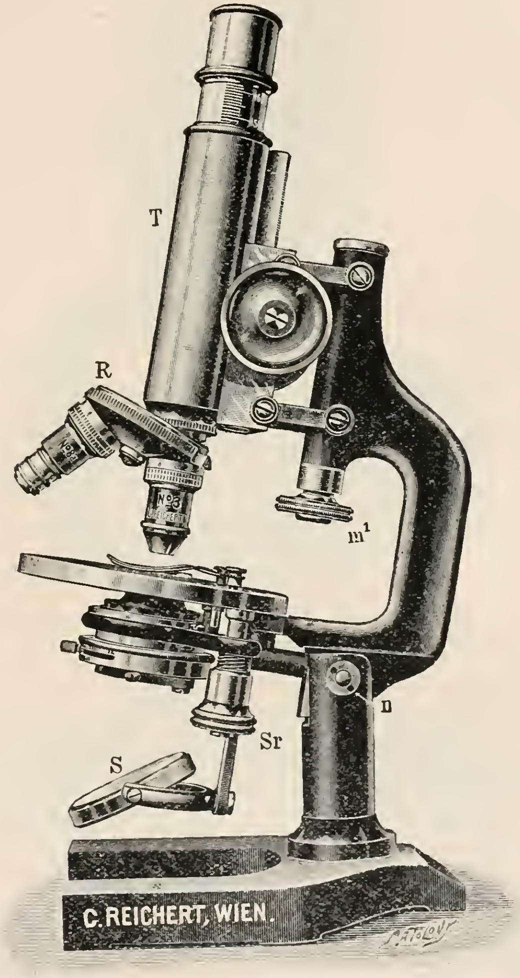

Fig. 164.

ment is by rack-and-pinion, and the fine by micrometer screw, which may, if desired, be placed under, as shown in figure. This under-screw

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 28, fig. 14.

is recommended for beginners, as it practically removes all risk of injury to objective and slide. Fig. 165 shows a non-inclinable form of the same instrument.

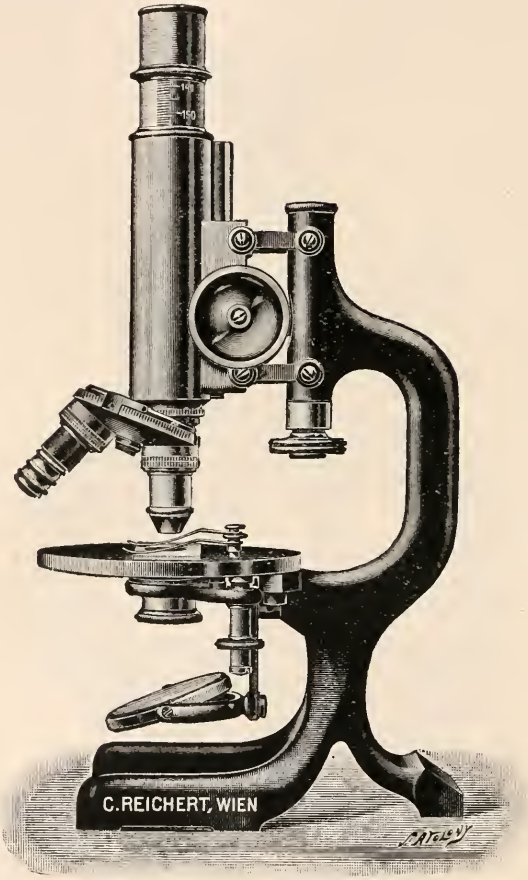

FIG. 165.

Heusner's Object-stage with Exchangeable Plates.*—H. L. Heusner has endeavoured to meet an inconvenience frequently experienced in working with the ordinary vulcanite stage when a weakly coloured preparation is apt to become invisible on the dark under-ground. Although the operator may cover his stage with blotting-paper, the result in many cases is unsatisfactory. The author has therefore arranged with Messrs. Leitz so that the vulcanite stage can be replaced by a

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 62–4 (1 fig.).

similar stage of ground opal glass of equal thickness (fig. 166). After four years' experience the arrangement is found to answer well.

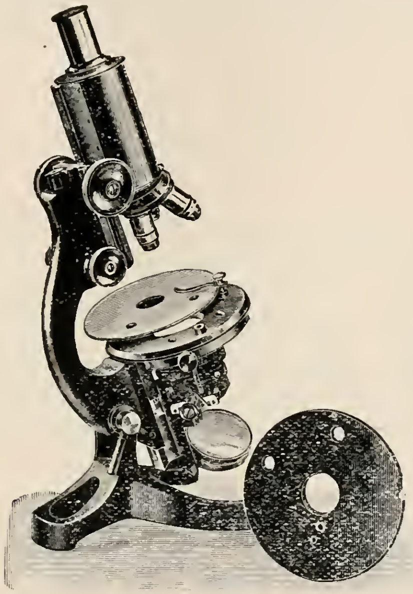

Fig. 166.

(3) Illuminating and other Apparatus.

Mercury Vapour Lamp for Microscopical Work.*—In this mercury vapour lamp (fig. 167) designed by J. E. Barnard, the illumination is obtained from an exhausted tube partially filled with mercury, the passage of the current through which renders the vapour luminous. The light emitted is confined to a few wave-lengths widely separated, which permits of the use of monochromatic light, by the aid of screens, in several regions of the spectrum, thus affording good contrast with different stains. Even without screens the light is more efficient than other forms of illumination giving a continuous spectrum, there being no red rays emitted. The size and shape of the tube permit of its use for critical illumination.

The tube A, with resistance B, which can be supplied to suit any voltage from 80 to 250, is inclosed in a metal cover C, $16 \times 7 \cdot 5 \times 12 \cdot 5$ cm. ($6\frac{1}{2}$ in. $\times$ 3 in. $\times$ 5 in.), mounted on a heavy base with square upright, adjustable for height and tilt for starting the lamp, which is simply effected by pressing up the lever E, thus cutting out a portion of the resistance and depressing the left side, until that portion of the tube is filled with mercury; on slowly bringing the tube back to the horizontal, still keeping the lever E pressed up, an arc will be formed,

* C. Baker's Special Catalogue, 1908.

and this will extend along the tube as the mercury retreats to the lower reservoir. As the lamp is somewhat sensitive to pole connections, the plug should be reversed should the surface of the mercury appear to boil as it retreats along the tube. This procedure usually has to be repeated two or three times before the lever E can be released.

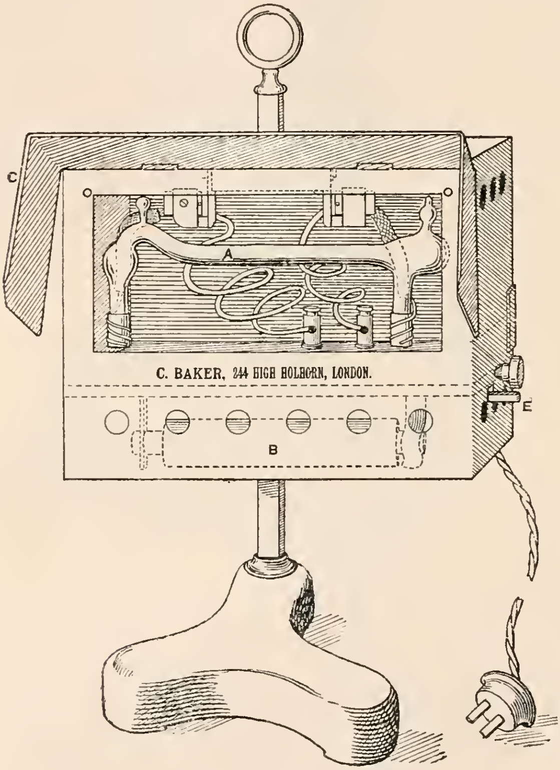

Fig. 167.

New Reflecting Condenser.*—W. von Ignatowsky describes a new reflecting condenser which has been made at the works of E. Leitz. The necessary data were supplied by the author, and the condenser has been in use since October 1907. The fundamental principle of the method of observation in a dark field is the modification of the incident pencil in such a way as to establish a marked contrast between vividly illuminated particles, e.g. bacteria, and a dark ground. As the details to be distinguished become finer, it is necessary to increase the intensity of the illumination so as to enable the particles to emit a sufficient amount of diffused light. Reflecting condensers and

* Zeitschr. wiss. Mikrosk., xxv. (1907) pp. 64–7 (2 figs.).

other appliances designed for the same purpose may be regarded as objectives which form an image of the source of light in the plane of the particles, but solely through the instrumentality of rays prevented from passing directly into the objective. The observer, therefore, sees diffused light only at those points which are occupied by particles

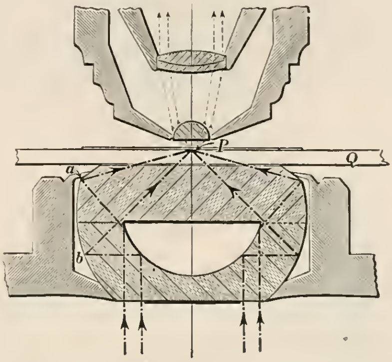

FIG. 168.

differing optically from the surrounding medium, whereas the rest of the field remains dark. Those rays which go to form an image of the source of light occupy within the condenser the space bounded by two cones having their apices and axes in common. The aperture of the inner cone is slightly greater than the angle subtended by the object

FIG. 169.

under observation, so as to make sure that no direct rays enter the objective. In order to secure an increased illumination when the magnitude of the particles is diminished, three conditions are necessary : (1) the difference between the apertures of the inner and outer pencils should be as great as possible ; (2) the image of the source formed at the apex of the pencil should be as well defined as possible ; (3) the image should be free from spherical difference of magnification, by satisfying the condition of sines, with respect to all the rays passing through the space bounded by the two cones. Chromatic errors are eliminated by the fact that the image is formed by reflection, not by refraction. As will be seen from fig. 168, the author's condenser has two reflecting surfaces, one internal, the other external. This tends towards a complete satisfaction of the second and third conditions, and the author claims that his condenser more fully satisfies these conditions than any other yet brought out. The illuminating rays have a numerical aperture of about 1·1 to 1·45. The reflecting condenser is contained

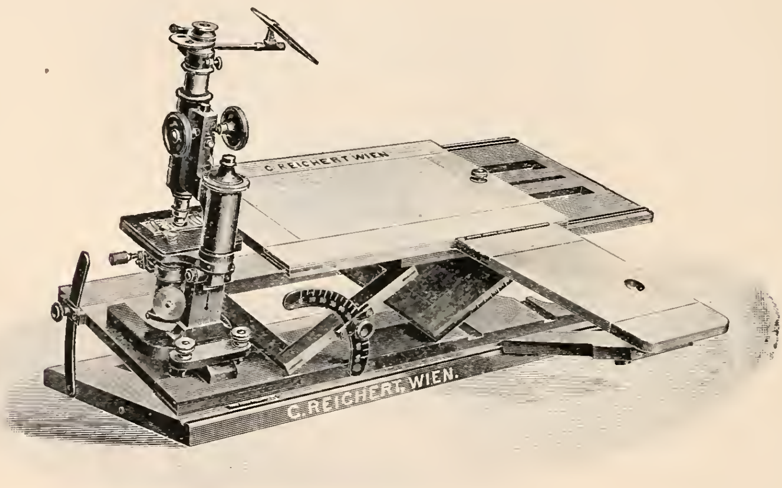

FIG 170.

in a centring mount, which slips into the sleeve of the Microscope substage in the place of the ordinary condenser.

There is another and simpler form of this condenser mounted within a plate, which is merely laid flat upon the stage of the Microscope (fig. 169). This arrangement dispenses with the necessity of specially adapting the reflecting condenser to the Microscope. By means of a lever the condenser may be raised and lowered within the limits necessitated by variations in the thickness of object slides. In conjunction with an arc lamp of 4 amperes the condenser is sufficiently intense to obtain an instantaneous photograph of living bacteria.

Reichert's Drawing Apparatus.*—This apparatus, designed by Bernhard, appears as in fig. 170. The drawing plane can be raised to

* C. Reichert, Vienna, Catalogue, Mikroscope, No. 26 (1908) p. 61, fig. 63.

a height of about 17 cm., and can be inclined at any angle up to 35° to the horizontal. The Microscope is screwed on to the ground-plate. Arm supports are provided to rest the draughtsman's hand.

Fig. 171.

Reichert's Marking Apparatus.*—This is constructed with a diamond point, and will be easily understood from the illustration (fig. 171).

6. Miscellaneous.

Paraffinum liquidum (B.P.) as an Immersion Oil.†—C. Rowntree, after alluding to the drawbacks of cedar-wood oil, points out that paraffinum liquidum (B.P.) is an efficient substitute. It is a colourless and transparent fluid, inexpensive, and keeps in any climate indefinitely. As it is non-volatile, it does not dry up, and is easily wiped off from cover-glasses and objectives. Its index of refraction is somewhat lower than that of cedar-wood oil, but for the ordinary purposes of histology and bacteriology the optical results are at least as good. Both with apochromatic and achromatic lenses the definition and illumination are excellent, even with a magnification of 1600 diameters. It is especially valuable for the examination of film preparations.

Quekett Microscopical Club.—The 450th Ordinary Meeting was held on October 2, the President, Professor E. A. Minchin, M.A., F.Z.S., in the chair. Mr. T. A. O'Donohoe exhibited and described some photo-micrographs of *Podura* scale × 2000, taken with condenser cones of aperture 0·35–0·65, and expressed the opinion that a small cone gave an altogether wrong impression. Mr. C. F. Rousselet, F.R.M.S., exhibited and described a new species of Rotifer, *Notholca bostoniensis* sp. n., he obtained in Boston, U.S.A., in August 1907. Mr. D. J. Scourfield, F.Z.S., F.R.M.S., made a few remarks on Entomostraca Mr. Rousselet had brought from Boston, mentioning points of similarity

* C. Reichert, Vienna, Catalogue, Mikroskope, No. 26 (1908) p. 62, fig. 66.
† Journ. Pathol. and Bacteriol., xiii. (1908) p. 28.

and differences in American and European forms. Mr. T. B. Rosseter, F.R.M.S., gave an historical account of the family Tæniidæ, and a sketch of his own work on *Hymenolepis*, and the methods he employed in obtaining and preparing specimens of these Platyhelminths for examination.

B. Technique.*

(1) Collecting Objects, including Culture Processes.

Influence of the Composition of the Medium on the Solvent Action of certain Soil Bacteria.†—C. W. Brown has studied the influence of the composition of the medium upon the solvent action of certain soil bacteria. The materials experimented upon were finely powdered rock phosphate, bone, tricalcium phosphate, dicalcium phosphate, and calcium carbonate. These were shaken up in water, and a little of the washed powder put into a flask of medium and sterilised for 15 minutes; after cooling to 60° C. the particles of powder are distributed through the medium by shaking, plates are poured, and inoculated by a stroke on the surface of the solidified medium, and incubated at 22° C. With ordinary nutrient agar there was no visible dissolution of any of the five minerals. With agar containing 2 p.c. dextrose, several germs showed an action upon calcium carbonate, dicalcium phosphate, and tricalcium phosphate, but there was no visible action on bone or rock phosphate.

A synthetic agar medium composed of 0·02 p.c. magnesium sulphate and ammonium sulphate and 2 p.c. agar, was then used both with and without sugars. The results showed that no germs had any action in the plates containing no sugar, but with 1, 2, and 4 p.c. dextrose, some germs acted on calcium carbonate, and on dicalcium and tricalcium phosphate; there was no action on bone or on rock phosphate.

The solvent action of some germs was greater in the presence of a large percentage of sugar; that of others being as great with 1 p.c. as with 4 p.c. If meat infusion was substituted for the water in the synthetic medium, the solvent action of the germs was less. On using a medium composed of soil leachings with 2 p.c. agar, no action was noticed, but on the addition of sugar to this medium, the results were similar to those obtained with the synthetic medium. It was found that those germs which in the presence of sugar were the most active acid producers, were those that showed the greatest solvent action.

Plate-cultivation of the Streptobacillus of Ducrey.‡—R. Stein finds that the streptobacillus of soft chancre will grow well on rabbits' blood agar plates if kept in a moist chamber to prevent drying. The waxy, shining, whitish-grey colonies have no growth in the depth of the medium, and can be easily removed from the surface of the plate.

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

† Mich. Acad. Sci. Rep., ix. (1907) p. 160.

‡ Centralbl. Bakt. 1te Abt. Orig., xlvi. (1908) p. 664.

Potato Broth for the Culture of Tubercle Bacilli.*—W. Jurewitsch recommends the following preparation of potato broth for the cultivation of tubercle bacilli. Potato is cut in slices and washed and pressed through a sieve; to 500 c.cm. of this potato mash is added about 500 c.cm. of tap water; on the following day the mixture is shaken and pressed through linen; after $\frac{1}{4}$ to $\frac{1}{2}$ hour the infusion is poured off from the deposit and an equal amount of ordinary "fleischwasser" is added, and also $\frac{1}{2}$ p.c. of pepton and $\frac{1}{4}$ p.c. of salt solution or calcium phosphate; the whole is warmed to make a complete solution, boiled for an hour in a Koch's steam apparatus, and filtered. To the filtrate is now added 3 p.c. glycerin and a requisite amount of carbonate of soda to attain the desired alkaline reaction, and the whole is then placed in an autoclave for $\frac{1}{4}$ to $\frac{1}{2}$ hour at 118–120° C., cooled, filtered, and finally sterilised for $\frac{1}{2}$ to 1 hour at 115° C. The broth thus prepared should have a dark brown colour; if it is dark red in tint, it is not sufficiently alkaline, and should be corrected.

Malachite-green Agar and the Bacilli of the Typhoid Group.†—L. Padlewsky recommends the following medium for isolating the bacilli of the typhoid group. Ordinary 3 p.c. nutrient agar is mixed with 2 p.c. pepton and 3 p.c. ox-gall and 1 p.c. chemically pure lactose; the sugar is previously dissolved in a small quantity of distilled water; the gall is steamed in a Koch's apparatus and filtered through wool; the reaction of the medium should be slightly alkaline; it is then divided into 200 or 100 c.cm. flasks and submitted to fractional sterilisation. To 100 c.cm. of the fluid agar, cooled to 60–65° C., is then added the following mixture:—0·5 c.cm. of 1 p.c. aqueous solution of malachite-green, 0·5 c.cm. of gall, and 1 c.cm. of a 10 p.c. aqueous solution of sulphate of soda. This mixture is not sterilised, but, after thorough mixing, it is poured into dishes and allowed to stand in the open until the agar is solidified, and is then dried in an incubator for 15 minutes. The agar must be transparent yellow in colour and without a trace of green. The fæcal matter is spread on the surface of the agar with a suitable glass spatula. The author claims for this medium that it is the most favourable for a quick and vigorous growth of the bacilli of the typhoid group; that it has an antiseptic action on many of the other fæcal microbes: and that the colour reaction, whereby the colonies of *B. coli* and other acid-producing organisms are stained an intense green, and the colonies of the typhoid group remain colourless, enables the organisms of this group to be readily differentiated; it is especially useful when large quantities of fæcal matter have to be dealt with; it is easy and inexpensive to prepare.

Culture in vitro of Avian Plague.‡—E. Marchoux has inclosed blood from a fowl dead of avian plague in a sealed capsule, and found that the virulence was retained for a longer time in an ice chamber at 7–10° C. than at the temperature of the laboratory or of an incubator, suggesting that in the virulent blood, the antibodies, whose activity is

* Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) p. 664.
† Tom. cit., p. 540. ‡ Comptes Rendus, cxlvii. (1908) p. 357.

suspended in the cold, can alter the germs and hinder the development at ordinary temperatures. In the ice chamber the blood remains virulent for a less time in an open tube than in a closed one; but though the virus maintained its strength for at least three months in a sealed capsule, it became inactive after three days in a vacuum. In colloidin capsules placed in the peritoneum of a rabbit, the virus perished within four days. The addition of glucose and pepton in varying proportions enables the virulence to be retained for a longer period. For purposes of culture, therefore, the author limits the quantity of blood, and uses glucose-pepton-agar as a medium.

Detection of Indol in Microbial Cultures.*—G. Buard has adopted the following method for the detection of indol: 10 c.cm. of culture are mixed in pepton water, and after 15 to 20 hours' incubation, 5–6 c.cm. of absolute alcohol are added, and after mixing there is added 1 c.cm. of alcoholic solution of vanilin and 3 c.cm. of pure hydrochloric acid. If indol is present it develops a pink coloration which becomes more intense, deepening to a red-magenta or violet-red, especially on the application of slight heat. The author experimented with several varieties of pepton. With the pepton of Defresne the pink colour changes to saffron. The author claims for this method great certainty of results and much saving of time.

Method of Fixing the Eggs of Ascaris megalocephala.†—C. Artom leaves uteri in salt solution until most of the eggs reach the desired stage of development. Little heaps about 0·5 cm. high are placed on a carbonic acid freezing-microtome, and when frozen the mass is sectioned. Though many eggs are of course irretrievably damaged by this procedure, yet a good few will be found with only a thin slice removed from the shell. The sections, which should be about 30 μ thick, are transferred while still frozen from the knife to the fixative, such as Flemming's strong solution, sublimate-acetic acid, formol-alcohol, picro-acetic acid. The blackening from osmic acid must be removed by immersion for several days in turpentine oil. Borax-carmin and dilute Delafield's hæmatoxylin give good results for preparations fixed in Flemming's solution. The fixed eggs were examined *in toto* or imbedded in paraffin and sections made.

Celloidin Decalcification and Desilication.‡—C. F. Bödecker gives the procedure for removing lime and silica from organic material in minute detail.§ After fixation the material is passed through the following fluids: alcohol 40 p.c. (1 hr.); alcohol 70 p.c. ($\frac{1}{2}$ hr.); alcohol 96 p.c. ($\frac{1}{2}$ hr.); absolute alcohol (12 hr.); ether and absolute alcohol (1 hr.); thin celloidin (12 hr.); acidulated celloidin (1 week to 2 months). (This mixture consists of celloidin solution, to which 10 p.c. nitric acid is added. The acid is mixed with ether and alcohol and gradually added to a celloidin solution, stirring the while.)

During decalcification it is necessary that evaporation should be

* C.R. Soc. Biol. Paris, lxv. (1908) p. 158.
† Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 3–7. ‡ Tom. cit., pp. 21–9 (1 pl.).
§ See this Journal, 1905, p. 764.

avoided by careful closure of the vessel. The author advises a special jar, the lid of which is kept taut by a spring.

When the lime or silica is removed, a block with sides 3 mm. broad is cut out, and having been coated with celloidin is submitted to the following procedure: alcohol 70 p.c. (6 hr.); alcohol 40 p.c. (2 hr.); aqueous alum solution 5 p.c. (12 hr.); running water (12 hr.); alcohol 40 p.c. (1 hr.); alcohol 70 p.c. ($\frac{1}{2}$ hr.); alcohol 96 p.c. ($\frac{1}{2}$ hr.); absolute alcohol (10 min.) Then follows a mixture of pure carbolic acid 1 part and chloroform 2 parts, or anilin oil (12–24 hr.). These must be frequently changed.

After this an equal bulk of chloroform is added (6 hr.), then pure chloroform (12 hr.); followed by chloroform and paraffin (6 hr.), soft paraffin m.p. 45° (6 hr.), hard paraffin m.p. 58° (12 hr.). The sections made in the usual way, are stuck on by the "Japanese method." The paraffin and celloidin are successively removed, and then the sections may be stained by any desired method, though iron-hæmatoxylin is advocated.

Examining Stylaria lacustris.*—G. Dalla Fior, when examining the asexual reproduction of *Stylaria lacustris*, first benumbed the animals with cocain and then fixed them in one of the three following fluids:—(1) sublimate-acetic acid 6 p.c.; (2) Perenyi's fluid; (3) Flemming's fluid. The first gave the best results. Transverse and longitudinal sections 4 μ thick were made. The preparations were stained with Delafield's hæmatoxylin, acid-fuchsin, orange, and Heidenhain's iron-alum.

Examining the Poison-glands of Salamandra maculosa.†—A. Nierenstein fixed the material, the poison-glands of *Salamandra maculosa* (adult animal and larvæ at various stages of development) in Zenker's fluid and 1 p.c. osmic acid. The latter gave better results when it contained 0·6 p.c. sodium chloride. Sections made by the freezing method from osmic-fixed preparations gave very good results. For staining purposes, Mayer's muci-carmin was superior to other dyes.

Combined Imbedding in Celloidin and Paraffin.‡—A. Breckner takes the pieces, which have been fixed, out of absolute alcohol and transfers them to 2–3 p.c. celloidin solution, wherein they remain, according to size, from a few hours to days. The pieces are then picked out and placed in chloroform for 5–10 hours, after which they are passed successively through benzol, a warm mixture of benzol and paraffin, and pure melted paraffin. In the latter they remain until completely saturated. Blocks are made in the usual way. The sections are treated as if made from paraffin blocks, and made to adhere to the slide by the albumen or water method. In the further treatment, absolute alcohol should be avoided, and dehydration effected by means of a mixture of 3 parts xylol and 1 part water-free carbolic acid, or by a mixture of equal parts of chloroform and absolute alcohol.

* Arb. Zool. Inst. Wien, xvii. (1908) pp. 109–38 (2 pls.).
† Arch. Mikr. Anat. u. Entwickl., lxxii. (1908) pp. 47–140 (3 pls.).
‡ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 29–32.

Examining the Oocyte of the Fowl.*—Sonnenbrodt obtained material from birds found dead in the fowl trains which come from Russia to Berlin. For the ovaries of young animals sublimate acetic acid was found to be the best fixative, but for ovaries with large follicles calcium bichromate 2 p.c., sublimate 2 p.c., and acetic acid (20 : 10 to 1) was superior. After having been passed through upgraded alcohols the pieces were immersed in water-free aceton ($\frac{1}{4}$ to 1 hour), then in xylol or chloroform (10 minutes to $\frac{1}{2}$ hour), followed by a mixture with paraffin ($\frac{1}{4}$ hour), and finally pure paraffin twice changed ($\frac{1}{2}$ to 3 hours). The sections according to the size of the follicles were cut from 2–10 μ thick. For sticking the thicker sections to the slide Olt's phenol-gelatin was used; the superfluous adhesive was removed by means of blotting paper, and then the slide placed on edge was allowed to dry at room temperature. When quite dry the preparations were treated with 10 p.c. formalin. Several staining methods were tried, but Heidenhain's iron-alum-hæmatoxylin was the only really successful one. Contrast-staining was effected with orcein, rubin, orange, picric acid, acid-fuchsin-picric-acid.

(4) Staining and Injecting.

Differential Staining Method for Acid-fast Bacilli.†—L. v. Betegh recommends the following method for staining acid-fast bacilli. Smears are made and dried and fixed in the flame; they are then treated with 2 to 3 drops of 15 p.c. nitric acid and heated over a flame until slight steam arises, and then washed with water; they are then treated with 2 to 3 drops of methylen-blue or methylen-violet and 2 to 3 drops of carbol-fuchsin, and again heated over a flame until the steam arises, after which they are thoroughly washed and decolorised with 60 p.c. alcohol, washed with water, dried, and mounted in balsam.

For tubercle bacilli, perlsucht bacilli, avian tubercle, and leprosy bacilli in sputum, the author recommends treating the specimen (after the last washing with water) with a thick layer of water into which a drop of malachite green solution has been added, and this to be followed again with a washing with water.

The bacilli stain red, the spores blue; the nuclei of the leucocytes are blue-violet or green-blue according to the duration of the action of the malachite-green; the cell plasma and other adventitious bacteria stain light green.

Silver Method for Differentiating the Bacilli of Leprosy and Tubercle.‡—J. Yamamoto recommends the following process. Cover-slip preparations of leprosy bacilli are made from nodules, after incision with a sharp knife, care being taken to disinfect the skin, and to avoid as much as possible the admixture of blood by pressure. Cover-slips of tubercle bacilli are prepared from sputum or from pure culture spread in egg-albumen. The preparations are dried and fixed in the flame; heated for 10 minutes in 5 p.c. nitrate of silver solution at 55–60° C. They are then placed for 5 minutes in the reducing solution, which is

* Arch. Mikr. Anat. u. Entwickl., lxxii. (1908) pp. 415–80 (4 pls.).
† Centralbl. Bakt., 1te Abt. Orig., xlvii. (1908) p. 654.
‡ Tom. cit., p. 570.

composed of pyrogallic acid 2 p.c., tannic acid 1 p.c., and distilled water to 100. The slips then become covered with a black deposit, which is carefully removed by several applications of filter paper moistened in water; they are then dried and mounted in balsam. Examined with an oil-immersion lens the tubercle bacilli are found to be stained black, whilst the leprosy bacilli remain transparent and clear, and may be subsequently stained by Ziehl-Nielsen's carbol-fuchsin method.

Studying the Sexual Organs of Cestoda.*—H. H. Balsz found that *Anoplocephala magna* was the best material, though he also used *A. perfoliata* and *Solenophorus* sp. The worms were fixed in sublimate, and paraffin sections made. The sections were stained with: 1. Iron-hæmatoxylin and eosin. 2. Methylen-blue safranin: the sections removed from water were first stained on the slide by means of Nissl's methylen-blue method, the stain being gently warmed for about $\frac{1}{2}$ minute. After a wash in water, the slides were quickly passed through 40 p.c. alcohol and then to safranin solution (200 c.cm. distilled water, 0·5 grm. safranin, 79 c.cm. absolute alcohol), wherein they remained for $\frac{1}{4}$–1 minute, according to the thickness of the section. They were rapidly passed through upgraded alcohols to xylol and balsam. 3. For demonstrating the basal membrane, Mallory's triple stain was used. The sections were first stained with acid-fuchsin, then washed, and afterwards mordanted for 1 or 2 minutes with $\frac{1}{2}$ p.c. solution of phosphomolybdic acid and then placed in the following solution:—anilin-blue, 0·5 grm.; orange, 2 grm.; oxalic acid, 2 grm.; distilled water, 100 grm. In this they remained for from 2–5 minutes, and after a wash in distilled water they were placed in 40 p.c. alcohol. This brings out the blue. If not sufficiently dyed, the sections may be re-stained. Next, upgraded alcohols to xylol. 4. Bleu-de-Lyon with ammonium-picrate and Hein's thionin methods were also used, but the results were not better.

Staining Spirochæta pallida.—M. Gottberg † fixed this material in Zenker's fluid and then stained the paraffin sections by Heidenhain's iron-hæmatoxylin method. The sections were mordanted for 24 hours in 2·5 p.c. iron-alum solution and immersed in Weigert's hæmatoxylin for one or two days. The differentiation in 0·75 p.c. iron-alum solution took a few minutes.

H. Ehrlich and J. T. Lenartowitz ‡ find that *Spirochæta pallida* stains in Ziehl-Nielsen and in carbol-gentian-violet in from $\frac{1}{2}$ to 2 minutes; in carbol-methylen-blue or carbol-dahlia in 5 to 10 minutes; in Loeffler's methylen-blue and carbol-thionin in 25 to 30 minutes; in saturated aqueous solution of safranin, Bismarck-brown and vesuvin in 1 hour or more.

Gradle § recommends as a clinical stain:—(1) methylen-blue 0·5,

* Zeitschr. wiss. Zool., xci. (1908) pp. 266–96 (2 pls.).
† Archiv f. Hygiene, lxv. (1908) pp. 243–51.
‡ Wiener Med. Wochenschr., 1908, p. 1018.
§ Journ. Amer. Med. Assoc., l. (1908) No. 16. See also Centralbl. Bakt. Ref., xlii. (1908) pp. 290–2.

potassium carbonate 0·5, water 50 ; (2) cyanide of potassium 1, water 50 ; (3) potassium iodide 1 p.c. Mix equal parts before staining.

Alizarin, a Vital and Specific Stain for Nervous Tissue.*—H. Fischel has found in alizarin a pigment which will stain *intra-vitam* the nerves of *Cladocera*. The simplest method is to drop some of the powder into the water in which the animals live, and in a few hours to a few days the nervous system of some of the animals will be found stained a dark violet. Better results are obtainable by means of a solution of alizarin made by dropping the powder into boiling water and continuing the boiling for some time. The clear filtrate is used and an equal quantity added to the water in which the animals are. When successful the staining results are said to be excellent. The method, however, has certain disadvantages :—(1) the action of the stain is somewhat uncertain, thus under similar conditions some animals will be found well stained, others not at all ; (2) the stain seems to be specific for *Cladocera* only, other animals having failed to be affected by its action.

Vital Staining of Fresh-water Animals.—The same author gives an interesting account of the results of his researches on the vital staining of fresh-water animals, with especial reference to *Cladocera*. The dyes were used in extremely dilute solution. The principal pigments used were neutral-red, neutral-violet, Nile-blue, Bismarck-brown, methylen-blue, and toluidin-blue. Combinations of these stains were also used. Coloured illustrations show the effect of the pigments, and special attention may be drawn to the action of alizarin on the nervous system. The author also alludes to the influence of light. He found that rays of long wave-length intensified the action of the stain, and quotes the result of lithium-carmin in combination with ruby glass as a light-filter. In the last section he discusses the theory of vital staining.

Flemming's Triple Staining Method.‡—H. v. Winiwarter and G. Sainmont allude to the unfavourable criticisms of this method, and then state that unsatisfactory results are due to the insufficient directions given in the original. They have adopted the procedure for twelve years, and have found that, with the following slight modifications, it gives excellent results.

Though the triple staining is specially adapted for material fixed with Flemming's solution, it may be used after other fixatives provided that the sections are immersed in Flemming's solution for 24 hours, and afterwards washed for about 20 minutes in running water.

After fixation for 24 hours in Flemming's solution, it is indispensable that the pieces should be thoroughly washed in running water for 24 hours. After this they may be passed through up-graded alcohols to paraffin. The paraffin should be removed by means of xylol unaided by heat. The sections are next treated with a mixture of xylol and absolute alcohol, then twice with absolute alcohol, followed by 95 p.c. and 65 p.c. alcohols. The slides are placed for 24 hours in safranin

* Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 154–7.
† Internat. Revue ges. Hydrobiol. u. Hydrograph., i. (1908) pp. 73–141 (2 pls.).
‡ Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 157–62.

solution (1 p.c. safranin in absolute alcohol to which a few drops of anilin-water have been added), diluted with an equal bulk of distilled water. After frequent washings in distilled water, the sections are placed in 1 p.c. aqueous solution of gentian-violet for 24 hours; then, after more washings in water, immersion in an aqueous solution of orange G for about one minute. The strength of this solution varies with the object to be stained, and the result must be controlled under the Microscope. The sections are next immersed in absolute alcohol to which 6 to 8 drops of a mixture of equal parts of absolute alcohol and pure hydrochloric acid have been added; they are removed directly violet clouds are given off. Then absolute alcohol again to remove the acid. The special differentiation is effected in oil of cloves, which may be thinned down with a little absolute alcohol. This is a slow process, and should be controlled under the Microscope, and is usually ended when the nuclear portions are blue and the non-nuclear yellow. Then pure oil of cloves; then drain in vertical position on blotting-paper; xylol, xylol-balsam.

The authors end their remarks by pointing out the importance of using the best safranin, for if this pigment does not work well the violet and orange also produce useless pictures.

Localising Purin Bodies in Animal Tissues.*—C. Ciaccio demonstrates the presence of purin bodies in the organs of Vertebrates under normal and pathological conditions by the following method, the technique of which depends on two principal facts, viz. the formation of urate of silver, and the property possessed by purin bodies of reducing ammoniacal solution of silver nitrate. Three forms of procedure are given.

1. To a $1\frac{1}{2}$–2 p.c. solution of silver nitrate is added ammonia drop by drop, until the precipitate formed is dissolved. After filtration ammonia is again added until the odour is clearly perceptible. The filtrate, placed in a perfectly clean vessel, is kept in the dark. In this solution small pieces (4 or 5–100 c.cm.) are placed for from 1 to 5 days, according to the temperature, the optimum being 37–40°. On removal the pieces are placed in 1 p.c. ammonia for 24 hours, the fluid being changed every 2 or 3 hours. They are next washed, and then passed through upgraded alcohols to xylol and paraffin in the usual way. The sections are stained with thionin, toluidin-blue, methylen-blue, or polychrome blue, or with the author's eosin-orange-toluidin stain. Acids and hæmatoxylin must be avoided.

2. The material may be fixed in 96 p.c. or absolute alcohol, or in Carnoy's fluid. If in alcohol the pieces must be small, and after fixation soaked in water; if in Carnoy's fluid, they must be treated afterwards with alcohol and then water. In both cases the subsequent treatment is the same as in procedure (1).

3. Fixation in alcohol or in Carnoy's fluid; imbedding in paraffin. The sections having been freed from paraffin are passed through downgraded alcohols to distilled water (a few seconds). They are then

* Anat. Anzeig., xxiii. (1908) pp. 298–320 (18 figs.).

immersed in the ammoniacal silver nitrate solution at 37–40° in the dark for 24 hours. On removal they are washed in 1 p.c. ammonia for 10 to 15 minutes, followed by distilled water and staining as before.

Though the results are the same in all three procedures, the author recommends fixing in Carnoy's fluid, and treating the pieces *in toto* with the ammoniacal silver reagent. The purin bodies are seen in the cells or within the tubules as black granules, which vary much in size.

HANSEN, F. C. C.—**Ueber die Ursachen der metachromatischen Färbung bei gewissen basischen Farbstoffen.**
Zeitschr. wiss. Mikrosk., xxv. (1908) pp. 145–53.

„ „ **Ueber Eisenhämatein, Chromalumhämatein, Tonerdealaunhämatein, Hämateinlösungen und einige Cochenillefarblösungen.** *Op. cit.*, xxii. (1905) pp. 45–90.

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

Farrants' Medium.*—Farrants' medium, says H. S. Ogilvie, is very apt to give trouble by the formation of air-bells in the mounts. These often originate in the making of the medium, through stirring it too vigorously. Before use, filter it through a fine linen or spun glass-cloth, previously washed in distilled water. This process takes some time, therefore protection from dust and undue evaporation should be provided. The secret in mounting with this medium is to use a very liberal supply; it is also advantageous to use a rod for transferring it instead of a pipette. The specimen, having previously lain two or three days in some of the mountant, is placed on a slide, carefully arranged, and then a comparatively large quantity of the medium is placed upon it. Air-bells may then be removed either to the edge with needles, or by bursting them with a hot needle. Apply the cover-glass very gently, and do not press it down for two or three days, and even at the end of that period do so very gradually. After a week or two the excess of medium may be cleaned away, and the slide allowed to dry. If the edges refuse to dry, use less glycerin in the preparation of the mixture. The same remarks apply to Dean's medium, and glycerin-jelly; excepting that, in the case of the last-mentioned, the cover-glass should be pressed home at once, the superfluous jelly cleaned away when cold, and the slide ringed. The advantages derived from any of the foregoing are chiefly: 1. Their low refractive index, which renders delicate unstained tissue more easily seen than would be the case were balsam used. 2. By their use, previous dehydration, which sometimes causes contraction, is avoided. In either of these respects one medium is practically as good as the other. 3. In many cases such media are as useful as a liquid, with the advantages that they are easier to use, and the risk of subsequent leakage is avoided. In the preparation of any of these mixtures, be careful to avoid glycerin that has been diluted with water.

* English Mechanic, lxxxviii. (1908) p. 240.

(6) Miscellaneous.

Pipette for Microscope Work.*—M. Wolff describes a pipette (fig. 172) which he has found useful in Microscopical work. It is made on the lines of the Stroschein syringe, and consists of a glass tube of 4 mm. bore which is provided with a point in the usual way, whilst at its upper end it has two welts by means of which it may more conveniently be held between two fingers. The aspirator consists of a small cylinder of a bore of 5·5 mm. and 40 mm. long, and is hermetically sealed at its upper end.

The open end of the cylinder has a piece of rubber tubing 1 cm.

Fig. 172.

long, 4 mm. bore, and 8 mm. external diameter slipped over it. The tubing is acccrdingly narrower than the body of the pipette. A length of 7 mm. of the rubber tube is slipped over the cylinder and the remainder embraces the pipette so that an airtight joint is insured.

The pipette is charged by drawing the cylinder up. The pipette should be held between the thumb and the middle finger, and by slowly pressing upon the cylinder with the index finger the fluid is very easily ejected in single drops. The apparatus has been placed on the market by E. Leitz, of Berlin.

Mesophotography and its Application to Delicate Unfixed Embryos.†—C. J. Patten defines mesophotography as the photography of objects of natural size, or but slightly enlarged or reduced. The apparatus used consists of a camera with an ordinary front, but arranged to take different sized lenses by a series of adapter flanges. The lens used was a Zeiss microplanar of 75 mm. focal length. Most of the photographs which the author took were of embryos which five minutes before were within the uterus of the living parent. Having detached the embryo from the uterus of a freshly killed animal, all that has to be done is to fill a glass capsule with cold distilled or boiled water, drop in the embryo, place the capsule on the stand in a position under the lens, bring the embryo into the field with a touch of a soft camel hair brush, focus it, cap the lens, draw the dark slide, wait a few seconds until all objects seen reflected in the water appear perfectly motionless, remove the cap gently, and expose the plate.

The advantages claimed for this procedure are its simplicity, rapidity, and usefulness for making illustrations of the external form of the embryo for plate reproductions.

* Centralbl. Bakt., 1te Abt. Orig., xlvi. (1908) p. 648 (1 fig.).
† Brit. Med. Journ. (1908) ii. pp. 593–4.

Metallography, etc.

Cohesion of Steel.*—Assuming that resistance to deformation is due to simple friction, and that the coefficient of friction is independent of the load, G. H. Gulliver calculates the ratio of the yield-point in tension to the yield-point in compression, for mild steel, as 0·705 to 1. Experimental results give a ratio nearer to unity. Assuming, further, that a cohesive force acting between the metallic particles gives rise to a frictional resistance which may be added to that due to the effect of the external load, the author deduces the value of this cohesive force to be 3·384 times the stress which corresponds with the tension yield-point.

Function of Chromium and Tungsten in High-speed Tool-steel.† C. A. Edwards has made hardness tests, cutting tests, determinations of thermal critical ranges, examinations of microstructure, and tempering experiments on two series of iron-carbon-chromium-tungsten alloys (sixteen samples). The composition of one series was approximately C 0·65, Cr 6·0, W 3 to 19 p.c., that of the other series C 0·65, W 19, Cr 1 to 8 p.c. The author concludes that the critical point at about 380° C., existing in steels with more than 3 p.c. chromium and 6 p.c. tungsten, is a change occurring in a carbide of tungsten which is slowly formed at about 1200° C. At 1320° C. or above, a double carbide of chromium and tungsten is formed, and no low critical point is found. The function of the chromium is the formation of the double carbide.

Test of Plates from an Old Boiler.‡—M. Longridge gives details of tests of material cut from a boiler which had been in continuous use for 72 years. The iron plates were found to be extraordinarily brittle, and could be broken up with a hammer.

Copper-aluminium Alloys. — After briefly reviewing the earlier work, including his own, L. Guillet § discusses the equilibrium diagrams obtained by Carpenter and Edwards, ‖ and by Gwyer.¶ The author questions the assumption, almost universally made, that a maximum in the curve always corresponds to a definite compound. He supports Gwyer in asserting the existence of CuAl and denying that of Cu_4Al. The position of the transformation points, and the constitution of the quenched alloys, are still undecided.

Hardness of Constituents of Alloys.**— Ziegler describes an optical method for measuring relative hardness. When a section is polished on a soft body such as thick cloth, the harder constituents are left more in relief, and the relative hardness is indicated by the

* Proc. Roy. Soc. Edin., xxviii. (1908) pp. 374–81 (2 figs.).
† Journ. Iron and Steel Inst., lxxvii. (1908) pp. 104–32 (37 figs.).
‡ Mechanical Engineer, xxii. (1908) p. 305 (2 figs.).
§ Rev. Métallurgie, v. (1908) pp. 413–24 (3 figs.).
‖ See this Journal, 1907, pp. 755–6. ¶ Op. cit. 1908, pp. 260–1.
** Rev. Métallurgie, v. (1908) pp. 565–70 (2 figs.).

differences in level, which can be measured. Applying this method to alloys produced by heating iron in boiling sulphur, the author obtains further evidence that FeS is first formed, then FeS_2. Sulphur appears to form solid solutions with both compounds FeS and FeS_2.

Troostite.—H. le Chatelier * remarks that in his article on the constituents of steel † troostite was purposely described vaguely as constituent X in order to avoid controversial matter. The author agrees with Charpy, Grenet, and Benedicks in regarding troostite as pearlite of extremely fine structure. But this has not yet been proved, and is only the most probable hypothesis. The fineness of structure, introducing effects due to surface tension, is the cause of the difference in properties between troostite and pearlite. The thickness of the cementite lamellæ in pearlite is of the order of $0 \cdot 01 \mu$, while the dimensions of the cementite particles in troostite probably do not exceed $0 \cdot 001 \mu$. The description of troostite as a colloidal solution is unsatisfactory. The term is applied to widely differing mixtures which have the common characteristic of not separating under the action of gravity, while they lack the properties of true solutions. It is difficult to see how a solid body, such as steel, can be correctly described as a colloidal solution.

Corrosion Tests of Iron and Steel.‡—C. Frémont describes the methods of etching for developing the macrostructure of iron and steel, and gives numerous examples of their application. He employs pure hydrochloric acid for rapid etching and dilute sulphuric acid for slow etching. For rendering visible effects due to piping and segregation, the author prefers iodine solution. Examination of macrostructure should be supplemented by shock tests on small notched bars taken from segregated parts. The employment of segregated steel, which has caused many serious accidents through fracture, might be avoided by submitting the metal before use to testing by corrosion.

Metallography of Quenched Steels.§—Kourbatoff has studied the transformations of austenite at temperatures up to 445° C. He did not succeed in obtaining pure austenite, but austenitic steels were produced by rapid quenching from high temperatures of samples containing 1·1, 1·6, and 1·9 p.c. carbon. Austenite appears to contain about 2 p.c. carbon. The samples used in the tempering experiments were small bars, one end of which had been heated to fusion in the oxyhydrogen flame, and quenched. Treated in this way, each piece contained several constituents. No change resulted at temperatures below 100° C., even when the heating was continued for two or three months. At 137° C. a change of structure quickly occurs. At 218° C. austenite is completely transformed in 12 to 18 hours, and at 248° C. in a few minutes. Austenite appears to change directly into troostite, not passing through the intermediate stage, martensite. The author's reagents A and C were used for etching.

* Rev. Métallurgie, v. (1908) p. 639. † See this Journal, 1908, p. 523.
‡ Rev. Métallurgie, v. (1908) pp. 649–703 (41 figs.).
§ Tom. cit., pp. 704–10 (13 figs.).

Quenching and Tempering of Iron and Steel.* — E. Maurer has quenched a number of steels of varying carbon content, at temperatures 800–1100° C., and reheated each sample successively at temperatures rising from 100–750° C. After each heating, the structure, physical properties, and chemical condition of the sample were studied. Some physical measurements were also made on pure iron. The author inclines to the view that in an etched section, whatever the reagent used, martensite normally appears white. Only when the transformation to troostite has commenced does martensite assume a darker colour than austenite. Among the author's conclusions are the following : (1) the effect of quenching on the physical properties of pure iron is due to deformation of α-iron ; (2) homogeneous austenite may be obtained by rapidly quenching high carbon steel containing sufficient manganese ; † (3) austenite changes directly to troostite between 150° and 250° C., or at higher temperatures when much manganese is present. In mixtures of austenite and martensite, the change first begins in the martensite, but proceeds more slowly than in the austenite. Cooling (as in liquid air) causes austenite to be transformed into martensite.

H. le Chatelier ‡ remarks that Maurer's work on the constitution of quenched steels is possibly the most important since Osmond's first investigations. The changes which take place when a quenched steel is heated are :—1. Mechanical (removal of elastic strain). 2. Physical (change in size of grain, change of troostite into pearlite, removal of cold work effects). 3. Chemical (transformation of austenite and of martensite into troostite). A mathematical treatment of the problem of rate of change of physical properties with temperature, is attempted.

Alumina for Polishing.§—Aluminium alloyed with a little mercury is readily oxidised in air or water. Robin utilises this property in the preparation of powder for polishing. Strips of pure aluminium foil are shaken up with mercury and are then exposed to moist air. White tufts of alumina form on the surface and may be observed to grow. After about four hours no further oxidation takes place. The alumina thus produced may be used for final polishing without further preparation. It does not appear to be better than that obtained by lengthy and laborious levigation methods, but is speedily and easily prepared in quantity at a small fraction of the cost.

Heat-treatment of Muntz Metal.‖—G. D. Bengough and O. F. Hudson supplement their former paper ¶ by the results of impact and other tests. The Izod test is not considered to be sufficiently discriminating to give useful information about this alloy. Four types of structure are distinguished :—(1) the rolled ; (2) the island ; (3) the network ; (4) the cast type. The effects of cold work appear to persist even after long annealing at a high temperature.

* Rev. Métallurgie, v. (1908) pp. 711–50 (65 figs.).
† See this Journal, 1908, p. 394.
‡ Rev. Métallurgie, v. (1908) pp. 643–7. § Tom. cit., pp. 751–7 (8 figs.).
‖ Journ. Soc. Chem. Ind., xxvii. (1908) pp. 654–8 (11 figs.).
¶ See this Journal, 1908, p. 262.

Carbon-iron Diagram.*—H. M. Howe explains and supports at considerable length the double diagram of the iron-carbon system, indicating metastable equilibrium between iron and cementite, and stable equilibrium between iron and graphite. The evidence for and against this diagram is fully considered. The constituents austenite, cementite and ferrite are subdivided, and new terms are defined and employed by the author to indicate the genesis of each subdivision. For instance, cementite is classed as primary, eutectic, pro-eutectoid, or eutectoid cementite. Though graphite usually results from the decomposition of cementite, the author considers that eutectic graphite is sometimes formed directly from the molten state. In solidification the habitual order is through the metastable to the stable system. While cementite often changes directly into graphite and iron, graphite can only change into cementite through an intermediate state of solution in iron as austenite.

Vanadium-iron Alloys.†—R. Vogel and G. Tammann found that alloys with more than 30 p.c. vanadium could not be prepared by melting the metals together. High vanadium alloys were accordingly made by reduction of mixtures of the oxides with aluminium. Silicon was also reduced in the reaction from the crucible. A diagram is therefore given for a series of vanadium-iron alloys containing 7·5 p.c. silicon. By using magnesia-lined crucibles for the alumino-thermic reduction, the authors obtained alloys nearly free from silicon. Iron and vanadium form a continuous series of mixed crystals. The solidification point of the vanadium used was found by the Wanner pyrometer to be $1750 \pm 30°$ C.; probably pure vanadium solidifies at a somewhat higher temperature.

Silicon-aluminium Alloys.‡—W. Fraenkel has determined the equilibrium diagram. No compounds are formed. Silicon and aluminium are completely miscible in the liquid state; in the solid the limits of solubility appear to be not greater than 0·5 p.c. silicon in aluminium and 2 p.c. aluminium in silicon. The eutectic contains 10 p.c. Si, and melts at 578° C. Microscopic verification of the composition of the mixed crystals was difficult.

Composition of Saturated Mixed Crystals.§—W. v. Lepkowski has investigated, in two series of alloys, the production of supersaturated mixed crystals by rapid cooling. The microstructure of samples cooled in the furnace was compared with that of samples cast in iron moulds standing in ice. While in the tin-bismuth series the concentration of tin in solid solution in bismuth could be raised from 0 to between 1·1 and 1·5 p.c. by rapid cooling, no effect of this kind could be produced at either end of the copper-silver series. The equilibrium diagram of the tin-bismuth series was re-determined.

* Bull. Amer. Inst. Mining Engineers, xxii. (1908) pp. 461–529 (10 figs.).
† Zeitschr. Anorg. Chem., lviii. (1908) pp. 73–82 (2 figs.).
‡ Tom. cit., pp. 154–8 (1 fig.).
§ Op. cit., lix. (1908) pp. 285–92 (8 figs.).

Binary Alloys of Cobalt.* — K. Lewkonja has determined the equilibrium diagrams and studied the magnetic properties and structure of the alloys of cobalt with the nine elements named below. Cobalt is miscible with tin and also with antimony, in all proportions in the liquid state. The compounds are Co_2Sn, CoSn, CoSb, and $CoSb_2$. With lead, bismuth, and thallium, cobalt is miscible in the liquid state only to a small extent, the molten alloys separating into two layers except for short ranges at both ends of each system. The cobalt-zinc system was studied only in the range 0–18·5 p.c. cobalt. The existence of $CoZn_4$ is probable. Cobalt and chromium are mutually soluble in all proportions in the liquid and solid states. Cobalt and silicon are miscible in all proportions in the liquid state, and form five compounds. The diagram for the cobalt-cadmium system is incomplete. The results now available concerning the binary alloys of iron, of nickel, and of cobalt are carefully analysed and summarised in tabular form.

Manganese and Carbon.†—A. Stadeler has made a thermal and microscopic study of manganese and its alloys with carbon. The melting-point of the purest commercial manganese obtainable (96 p.c.) was found to be 1207° C. No evidence of allotropic modifications was obtained. The saturation point of carbon in manganese is 6·72 p.c., corresponding to Mn_3C. The solidification point curve rises to 1271° C. at 3·32 p.c. carbon, then falls to 1217° C. at 6·72 p.c. From 0·72–3·60 p.c. a critical point at 817–855° C. was found. Manganese probably forms with Mn_3C a series of mixed crystals which is continuous above 855° C. At lower temperatures, in the range 0–3·6 p.c. carbon, two series of solid solutions exist. Cementation of manganese with carbon does not appear to be possible.

Alloys of Zinc, Copper, and Nickel.‡—V. E. Tafel has determined the equilibrium diagrams for the three binary systems and partially for the ternary system zinc-copper-nickel. The microstructure of the alloys was also studied. The diagrams given by Guertler and Tammann for the copper-nickel system, and by Shepherd for the copper-zinc system, are, on the whole, confirmed. In the zinc-nickel system the compound $NiZn_3$ (melting-point 876° C.), and two series of mixed crystals containing respectively 12·2–23·0 p.c. and 39·7–49·0 p.c. nickel were found. The constitution of other phases is uncertain. The range 0–50 p.c. nickel only was studied, as zinc-nickel alloys with more nickel could not be prepared. The ternary system is very complex. No ternary compound or ternary eutectic was found.

Copper-arsenic System.§ — Considerable differences between the diagram given by Hiorns and that determined by K. Friedrich, have led the latter to carry out a further investigation. The author's results were confirmed in essential points. The compounds are Cu_5As_2 and Cu_3As. Evidence for Cu_2As was not obtained. Copper may contain

* Zeitschr. Anorg. Chem., lix. (1908) pp. 293–345 (41 figs.).
† Metallurgie, v. (1908) pp. 260-7, 281–8 (52 figs.).
‡ Tom. cit., pp. 343–52, 375–83, 413–30 (100 figs.).
§ Tom. cit., pp. 529–35 (16 figs.).

up to 4 p.c. arsenic in solid solution at 700° C. The curve showing the relation between composition and electrical resistance has an inflection at 4 p.c. arsenic.

BELLOC, G.—**Occluded Gases in Steel.**

„ „ **Occluded Gases in a Special Nickel-steel.**

[More complete accounts of work previously summarised. See this Journal, 1908, pp. 124 and 661.]

Rev. Métallurgie, v. (1908) pp. 469–88 (5 figs.); and pp. 571–4 (2 figs.).

FRIEDRICH, K.—**Contribution to the History of Metallography.**

Metallurgie, v. (1908) pp. 408–10.

FRIEDRICH, K., & A. LEROUX—**Binary Systems Cu–Cu_2Se, Ag–Ag_2Se, Pb–PbSe.**

Tom. cit., pp. 355–8 (11 figs.).

GUERTLER, W.—**Electrical Resistance of Alloys.**

[The bearing of recent researches on technical applications of alloys is indicated.] *Tom. cit.*, pp. 292–6.

PORTEVIN, A.—**Alloys of Aluminium.**

„ „ **Alloys of Copper.**

„ „ **Alloys of Iron.**

„ „ **Alloys of Manganese and Alloys of Magnesium.**

[Further instalments of Portevin's account of the Göttingen researches. See this Journal, 1908, pp. 522–23.

Rev. Métallurgie, v. (1908) pp. 274–94 (25 figs.); 361–95 (40 figs.); 535–60 (28 figs.); and 762–90 (38 figs.).

PROCEEDINGS OF THE SOCIETY.

MEETING

HELD ON THE 21ST OF OCTOBER, 1908, AT 20 HANOVER SQUARE, W., DR. J. W. H. EYRE, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of June 17, 1908, were read and confirmed, and were signed by the Chairman.

Dr. J. W. Judd, F.R.S., etc., was proposed by the Council as an Honorary Fellow of the Society, the election to take place at the next Ordinary Meeting.

The List of Donations (exclusive of exchanges and reprints) received since the last Meeting, was read as follows :—

	From
Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1907–8. Vol. 52, Part III. (Manchester, 1908)	*The President.*
Behrens, Wilhelm, Tabellen zum Gebrauch bei Mikroskopischen Arbeiten. 4th Ed. (8vo, Leipzig, S. Hirzel, 1908)	*The Publisher.*
Hauswaldt, Hans, Interferenz-Erscheinungen im polarisirten Licht. 3rd Series. (4to, Magdeburg, Joh. Gottl. Hauswaldt, 1907	*The Author, per Mr. Rheinberg.*
Stead, David G., The Edible Fishes of New South Wales. (16mo, Sydney, 1908)	*The Board of Fisheries for New South Wales.*

The thanks of the Society were voted to the Donors, and specially to Mr. Rheinberg, through whose kind intervention the Society was enabled to secure the copy of Dr. Hauswaldt's valuable work for the library of the Society.

Mr. T. H. Powell exhibited in the room a new apochromatic homogeneous-immersion $\frac{1}{40}$ in. objective which was slightly different in construction from those he had previously made, but which he considered was the best he had yet produced.

Mr. C. L. Curties (C. Baker) also exhibited a $\frac{1}{12}$ in. achromatic objective made on a new formula, which gave a very flat field and had an aperture of 1·30.

Mr. W. Wesché's paper on "The Mouth-parts of the Nemocera, and their Relation to the other Families in Diptera—with Corrections and Additions to the paper published in 1904," was read to the Meeting by Dr. Hebb, who explained that the portion now submitted was a résumé of the entire communication, and that he had been asked to communicate it to the Meeting, as Mr. Wesché's health did not permit him to read it himself.

The Chairman said this was a very important paper, which would be printed *in extenso* in the Journal, but it was, of course, difficult to judge of its full value from the abstract which had been read that evening. It would, no doubt, be read with considerable interest when they had it before them.

The thanks of the Society were unanimously voted to Mr. Wesché.

Mr. Wesché said that most of the points mentioned in the paper were illustrated by specimens exhibited under Microscopes on the table. The subject was one which required a considerable knowledge of the mouth-parts of Diptera to be able to appreciate thoroughly, although he thought that anyone who had a Topping slide of the proboscis of the blow-fly would be able at all events to understand one aspect of it; but instead of looking for minute hairs as test objects, workers with the Microscope would find it a more profitable and delightful study if they would give their attention to a comparison of the remarkable differences in the mouth-parts of this very large order of Insects.

Mr. E. M. Nelson's paper "On the Resolution of Periodic Structures" was read by Dr. Hebb.

A further paper by the same author on "An Auxiliary Illuminating Lens" was also read.

Mr. J. W. Gordon said that the first paper struck him as being a very suggestive one, and he thought the observations which Mr. Nelson had carried out were of very particular interest, because they reduced to a specific form what had hitherto been propounded only in a conjectural way. The verification of these conjectures was therefore a matter of very peculiar interest. One thing, however, he should like to suggest in this connection for further consideration, because Mr. Nelson's observations appeared to refer only to the half of the diffraction fringe which overlaid the dark field. There is a complementary dark half which overlies the edge of the bright field, and has much to do with the obscuration of line structures. This was never investigated, so far as he was aware, by any writer of authority, until it was taken up by Lord Rayleigh, and dealt with in his supplementary paper published in the Journal of this Society in 1903. When the bright field was narrowed sufficiently, this dark fringe extended right across it and prevented the illumination of this field from attaining to full intensity. This point, although it had no direct bearing on the paper, was so closely connected with the subject under discussion, and of so much importance that he hoped it would not be regarded as an impertinence on his part to mention it in this connection.

Mr. Curties said that he was showing in the room a lamp fitted with a lens as described by Mr. Nelson.

A short paper on "*Micrococcus melitensis*," by Messrs. A. A. C. E. Merlin and E. M. Nelson, was read by Dr. Hebb, as follows :—

"While we were employed in testing the auxiliary lens described, a stained preparation of this organism was placed on the stage, and the instant the object was brought into focus, flagella were readily seen. At that time the authors had no knowledge either of the existence of the flagella or of the motility of the organism, but have since learned that these flagella had been already discovered by Mr. Gordon : a second description was therefore unnecessary. Flagella were plainly observed on most of the cocci scattered over the field, which proved that a full field of illumination obtained by this auxiliary lens is no bar to the detection of minute objects such as flagella, whatever its influence on the resolution of periodic structures might be."

The Chairman remarked that the authors of this paper said they had no knowledge of the existence of flagella or of the motility of this organism before using this lens, and he thought he might say that they had no knowledge of their existence afterwards. Although Mr. Gordon (not the Society's Hon. Secretary) had stated that both the *Micrococcus melitensis* and *Bacillus pestis* possessed flagella, he would probably not now insist too much upon that statement, as his observation was made upon a very old cultivation stained by a complicated silver process, and in the speaker's opinion what Mr. Gordon took to be flagella were undoubtedly the results of preparation. The fact was that this organism had no motile property, and the supposed flagella had no existence. It would not be well therefore to place too much importance upon this notice of the observation by the authors of the paper.

The Chairman said they had received a letter from a Fellow of the Society living in Glasgow who had visited their library, but although he found there was a very good card-index of the books, it was not one that could be carried away, and he considered it would be well to have a new catalogue printed, and further, that this catalogue should contain not only a list of the books, but also of instruments, apparatus and slides possessed by the Society ; and that if the Council thought well to carry out his suggestion, he would be very pleased to subscribe three guineas towards the expense. The Council had for some time had the proposal for a new catalogue under consideration, but the expense of bringing one out had hitherto been the difficulty. This suggestion of Mr. Baird brought the matter up again, and it was thought if it was put before the Society some of the Fellows might also be willing to subscribe towards the cost, and, with such a good offer to start with, he thought it well to let the Fellows know, so that any who were interested in the project might offer donations towards it.

The Chairman said there was one other matter which he wished to refer to, and that was as to the sectional meetings which it was proposed to hold during the session. A circular would soon be in the hands of the Fellows in which the scheme was outlined, the proposal being to form two or three sections, one for Pond Life, another for Microscopical Optics, and a third for Bacteriology and Histology. These sections would meet on Wednesday evenings other than those already allocated to the Ordinary Meetings of the Society, the idea being that Fellows interested in either of these subjects could get into touch with each other, and would find opportunities for bringing forward new work which might afterwards be communicated to the Society. He asked all those present who took any interest in either of these matters, and would like to join either of the sections mentioned, to signify their desire to the Secretary. They wanted to start as soon as possible, because there were a large number of Fellows who took an interest in one branch of Microscopical Science only, and who consequently had small opportunity of discussing that at an Ordinary Meeting, where perhaps only one of the other subjects was brought forward.

The following Instruments, Objects, etc., were exhibited:—

Mr. C. L. Curties (C. Baker):—*Trypanosoma Brucei* under a new $\frac{1}{12}$-in. achromatic oil-immersion objective. Auxiliary Illuminating Lens in illustration of Mr. Nelson's paper.

Mr. T. H. Powell:—$\frac{1}{40}$-in. apochromatic homogeneous-immersion objective of 1·35 N.A.

Mr. W. Wesché:—The following slides in illustration of his paper—Trophi of Asilus from Pegu. The Labium has been separated, at the base of the hypopharynx and maxillæ is the pharyngeal pump; Proboscis of Blow-fly, *Calliphora erythrocephala*, dissected and separated, the labrum, hypopharynx, stipites and cardines of the maxilla and the submentum adhere together; Trophi of *Culex annulipes*, the pharyngeal pump is seen in the interior of the head; *Culex pipiens*, the pharyngeal pump is seen in the interior of the head; Dissected trophi of *Empis livida*, the pharyngeal pump is seen immediately behind the hypopharynx; Dissected trophi of *Hæmatopota italica* ♀, blood-sucking fly; Labium of *Hybos femoratus*, to show the "taste-cups," rare on the trophi of Diptera; Dissection of trophi of *Leptis conspicua*, to show the imbedded mandibles and the character of the tracheæ, occasionally a blood-sucking insect; Proboscis of *Phora concinna*; Proboscis of *Prosena sybarita*, one of the specialised forms in the Muscidæ, the trophi are specialised for flower-feeding; Proboscis of *Siphonia geniculata*, trophi specialised for flower-feeding; *Tipula oleracea*, the labella and maxillary palpi, at the base is the pharyngeal pump; Proboscis of *Zodion cinereum*, one of the Conopodæ, with trophi modified for sucking the nectary of flowers.

MEETING

Held on the 18th of November, 1908, at 20 Hanover Square, W., Conrad Beck, Esq., Vice-President, in the Chair.

The Minutes of the Meeting of October 21st, 1908, were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last Meeting, was read as follows:—

	From
Gage, Simon Hy., The Microscope: An Introduction to Microscopic Methods and Histology. 10th Ed. (Ithaca, New York, 1908)	*The Author.*
Herzog, Alois, Mikrophotographischer Atlas der technisch wichtigen Faserstoffe. (4to, T. B. Obernetter, Munich, 1908)	*The Author.*
Nuttall, G. F. H., Cecil Warburton, W. F. Cooper, and L. E. Robinson, Ticks: A Monograph of the Idoidea, Part I. (8vo, Cambridge, 1908)	*The Syndics of the Cambridge University Press.*
Vejdovsky, F., Neue untersuchungen über die Reifung und Befruchtung. (4to, Prag, 1907)	*Königl. Böhmische Gesellschaft der Wissenschaften in Prag.*
Slide of "Red Snow," *Protococcus nivalis*, from Cape York	*The Peary Arctic Club.*

The thanks of the Society were voted to the Donors.

The Secretary said that the Fellows of the Society were aware that arrangements had been made for holding Sectional Meetings, the rules for which would be available very shortly, and would be at the service of any Fellows who would apply for them to the Secretaries. In accordance with these rules, any ten or more Fellows might combine, if interested in a particular subject, to form a section to pursue the study of it. At present it was proposed to form three sections, one for the study of Medical Bacteriology, another for Biology other than Medical Biology, and a third for Brass and Glass. These sections to meet on the first, second and fourth Wednesdays in each month. The first meeting would take place that day week (November 25th) of the Brass and Glass Section, for the purpose of arranging itself and appointing a committee and a Sectional Secretary. A *réchauffé* would then be given of the Society's exhibit at the Franco-British Exhibition, the instruments shown there being set out in the Library for the purpose. He had received the names of a number of Fellows desirous of joining, and hoped to receive others; and though anyone who came next Wednesday would be heartily welcomed, those who sent in their names beforehand would have a postcard sent to them as a reminder of the engagement. On the succeeding Wednesdays the other sections would meet, that for Medical Biology under the direction of Dr. Eyre, and that for Pond Life under Mr. Scourfield; and Fellows intending to join either of these sections should send in their names to either of these gentlemen, and postcards would be sent in due course.

The Chairman intimated that they would be pleased to answer any questions as to these Meetings, should any Fellow present desire further information.

The Chairman asked Mr. J. I. Pigg to give a description of two specimens of Coccidæ he was exhibiting.

In reply, Mr. Pigg said, that one specimen of the Coccids (*Lecanium hemisphæricum*) was a living gravid female, the other was a dead female after parturition, the chitine shell containing the usual large number of eggs characteristic of their species.

Mr. C. F. Rousselet shortly described a number of mounted specimens of pond life, shown under Microscopes in the room. These were Infusoria, *Hydra*, *Volvox* with yellow stellate oospheres from Germany, apparently exceedingly rare in this country, and some fresh-water Medusæ and their Hydroid stage, namely: *Limnocodium Sowerbyi* from the Royal Botanic Gardens, Regent's Park (collected about 1890, since disappeared); *Mœrisia Lyonsi* from Lake Qurun in Egypt; and an undescribed Medusa lately received by him from Rhodesia. Mr. Rousselet remarked that it would be very desirable that some of the younger Fellows should devote their energies to the study of the Infusoria and the methods of their preservation; many forms could be readily killed, extended with osmic acid and mounted in formalin, but the more retractile species presented greater difficulties, and a suitable narcotic for these had still to be discovered by experiment.

The Chairman thought it would be a great advantage if some microscopists, who were not devoting themselves to any particular subject, would take up the study of the Protozoa, as there was still a great deal to be learned as to their life-history: such simple matters as the method of ingesting food in some of the common forms was little understood, and much yet remained to be discovered.

Mr. A. A. C. E. Merlin's paper "On a New Growing Cell for Critical Observations under the Highest Powers," was read by Dr. Hebb; an example being exhibited in the room by Mr. C. L. Curties.

Mr. Curties mentioned that if the space provided by this cell was not sufficient to accommodate a large specimen, its depth could be easily increased by building up additional thickness with pieces of linen or blotting paper.

Mr. Rousselet said he noticed that there was no provision made for regulating the thickness of the film, which he thought was a matter of importance. It was necessary first to know how thick the organism was and to regulate the cell accordingly, otherwise it was very likely to be crushed. Rotifera would not live very long in a cell of this kind, as they would soon die of starvation, but he understood that the cell was primarily intended for much smaller and lower organisms, such as Bacteria, Rhizopods and flagellate Infusoria, for which purpose it would no doubt answer very well.

The Chairman thought that if the cell was to be used with an oil-immersion objective, a means of varying the thickness of the film was not of much importance.

Mr. Rousselet considered it was a matter of great importance to the animal.

The Chairman said one great advantage of this cell seemed to be that it was quite easy to change from a dry to an oil-immersion objective without disturbing the object, as the water was supplied from below, and contrasted it favourably in this respect with the Dallinger life slide.

Professor J. A. Thomson's paper on "Studeria, a Remarkable New Genus of Alcyonarians," was read by Dr. Hebb, and was illustrated by three diagrams, and a specimen shown under the Microscope.

Dr. Marshall D. Ewell's paper on "The Present Status of Micrometry," was read by Mr. J. W. Gordon.

Mr. A. E. Conrady * regarded the paper as of great importance, but thought that the absolute values of the spaces of a stage-micrometer were of the greatest importance, for if these differed from the nominal values, all measurements of focal length of objective and of magnifying power by the usual methods were vitiated. He thought the Society ought to take steps to obtain a standardised Stage-Micrometer, and suggested that the National Physical Laboratory should be approached, as he had recently seen in the last volume of the "Travaux et Mémoires" of the International Bureau at Breteuil that there was at Teddington a standard metre sub-divided into millimetres, all errors of which were determined to a few tenths of a micron.

Mr. F. Shillington Scales said Dr. Ewell had done them a distinct service in bringing this matter before them. Most workers were aware that there was a considerable variation in the rulings of Micrometers in common use, and were accustomed to take the mean of a series of measurements, but it had taken him by surprise to find there was so much variation as was shown by this paper. It was also new to him that glass micrometers deteriorated so much by age, and this was rather a disturbing matter, since he possessed one of Grayson's rulings in glass which was priced at four guineas, and he would be very sorry to find

* With reference to the extremely interesting communications of the Chairman *re* work projected at the Standards office, Mr. Conrady begs leave to suggest that, even if this calibration were carried on so as to include the metre as well as the yard, and if the results should disagree with Michelson's, the result could only affect the relation of the yard to the metre and possibly also the value to be assigned to wave-lengths of light. The metre has been defined by international agreement as the length of a certain Iridio-Platinum bar at the Bureau International, and could not possibly be affected by this work at Westminster.

that it was deteriorating after a few years' time. He indorsed Mr. Conrady's suggestion that the Society might with advantage consider the advisability of standardising Micrometers.

Mr. F. J. Cheshire said that he had carefully read Dr. Ewell's interesting paper, but scarcely thought that the results had been given in the form most readily appreciable by an audience of microscopists who had not already read the paper. He had therefore taken the liberty of extracting those results from the author's paper most likely to be of interest to English microscopists, and had calculated from them certain comparative percentage figures, shown in tabular form on the blackboard.

No. of Micrometer in Author's Paper.	Maker.	Percentage Difference of Lengths of Longest and Shortest Divisions.	Average Percentage Difference from the Mean Length of the Divisions.
2	Zeiss	2·2	1·1
4	Do.	1·1	0·35
7	Leitz	0·32	0·11
8	Powell and Lealand	1·9	0·66
10	Beck	0·93	0·25
11	Do.	1·6	0·50
11A	Do.	1·6	0·46
16 (10 divs.)	Watson	4·8	1·2
16 (1st 5 divs.)	Do.	4·4	1·3
24	Grayson	0·63	0·22

The speaker then went on to point out that the important question to decide as a preliminary to the acceptance of Dr. Ewell's results was, of course, the order of reliability of those results. The method adopted and the figures obtained were not, unfortunately, set out in sufficient detail to allow of a conclusive answer; but as regards one important matter, it appeared from the fact that (1) only low and medium powers had been employed, and (2) that "the mean of from five to ten readings of each end of each space," that no attempt had been made to utilise the same part of the micrometer screw, as far as possible, for the different measurements. The author would thus appear to have taken it for granted that the various screws employed in the eye-piece micrometers had been cut and mounted so as to realise an order of accuracy greater than that claimed for the results. Let us see what this means. In the first micrometer tested (No. 1 Bausch and Lomb) a tenth of a millimetre is divided into about 4000 parts, so that if accuracy is claimed for the last significant figure a screw with a maximum error of $\frac{1}{4000}$ part of the space measured in the length of screw used, is postulated. Assuming even that the correctness only of the third significant figure is claimed, this works out as equivalent to the assumption that the screw employed had for the length used an error not exceeding the $\frac{1}{100000}$ part of an inch, the accuracy obtained by Rutherford in a screw which took three years to make, and the most exquisite workmanship! It is to be regretted that information on such a vital matter has not been given by the author. Finally, the speaker pointed out that, although the author states that from five to ten readings were taken of the position of each line, these readings had apparently in no single case been given, with the result that the calculation of the mathematical probable error of the result was impossible. Results claiming such a high order of accuracy should have been accompanied by the numerical result of control determinations. Nothing, for instance, would have been easier than to determine independently, and place side by side, the different comparative measurements for five given spaces, say, obtained by using different micrometers and different powers.

Mr. Hopkinson said that it was well known to meteorologists that thermometer tubes should not be graduated until they had been made for several years, otherwise they would alter, mercurial thermometers requiring in course of time a minus correction owing to the contraction of the glass, and he thought that if the errors in some of the micrometers tested were generally in the same direction they might be due to this cause.

The Chairman thought the great advantage of this paper was not so much the value of the results obtained, as that the writer had brought the subject forward for consideration. There were many matters which made it doubtful if they could accept the results as being entirely correct; also it seemed hardly fair in considering the subject to take as micrometers for comparison standard rulings which had no doubt been carefully selected from a large number, and to compare these with unselected specimens of commercial articles. All who were accustomed to this work knew how very difficult it was to make these comparisons. The whole difficulty was much greater than appeared at first sight, and it began with that of fixing a unit of measurement, the standard hitherto adopted being based upon the accepted standard English yard or French metre. He had, however, been authorised to bring before their notice a machine which was being made for Major Macmahon and Dr. Tutton on behalf of the Standards Department of the Board of Trade in order to calibrate in terms of the wave-length of light the standard yard deposited at Westminster. For this machine a large concrete bed had been sunk in the ground, and a brick foundation raised upon it to carry a heavy metal bed on which carriages would run containing a pair of very high power Microscopes. For the purpose of making an index they had obtained from Mr. Grayson, of Melbourne, a series of five lines ruled $\frac{1}{40000}$ of an inch apart on speculum metal, and some plates were supplied which had a number of such sets of five lines ruled at intervals upon them. A double cobweb micrometer in the eyepiece of the Microscope could be set so that one web was placed on either side of the central of the five lines. This formed the settling device; the Microscopes could then be travelled from one to another of a series of such rulings, and the method adopted to ascertain the amount of such travel did not depend on any screw or other mechanical method of measuring distances which were always open to sources of error. It depended on a direct measurement by means of an interferometer of the distance expressed in wave-lengths of light. One interferometer mirror was fixed to the base of the machine and the second interferometer mirror on the travelling Microscope itself. By an ingenious step-by-step method with two sets of plates and two travelling Microscopes, long lengths could be measured without the necessity of counting all the wave-lengths, and when the standard yard had been calibrated it would be interesting to compare the results obtained with those now accepted as correct. When the determination of the standard yard was completed he would suggest that the Royal Microscopical Society should submit a micrometer to the Board of Trade to be calibrated, and provided that the temperature could be maintained at the same degree, it would remove all sources of error, and would provide them with a reliable standard of measurement. If the statements in the paper before them could be trusted, the value of their present rulings was far from being satisfactory, but if they had a standard to refer to, all uncertainty would be removed. Mr. Conrady's suggestion that the Society should procure such a standard was an excellent one, but he would suggest that no action be taken until they were in a position to have one calibrated in terms of a fixed unit, such as a wave-length of light. Two other questions had been raised in the course of this discussion—one as to the deterioration of the glass by keeping, and this was a point of importance because almost all glass used for fine ruling was polished, by which the harder outer surface was removed, and he should think that many of the micrometers made a long time ago would be found to have been affected by lapse of time. The other point was as to the shrinkage of glass by age, he thought there was very little doubt that such did take place, and as micrometers made thirty years ago were not made of specially aged glass, he thought it probable that some of them might have suffered from this cause. Mr. Grayson's rulings were mounted in realgar, which would certainly protect the surface from deterioration so long as the realgar did not crystallise.

Mr. J. W. Gordon did not think he was in a position to give any general answer to the questions raised, and he should shrink from doing so in the name of Dr. Ewell, from whom he held no authority to speak on his behalf. Referring to the question asked by Mr. Hopkinson whether the error was all in one direction or not, as in the case of thermometer tubes, he observed that this was a point not covered by Dr. Ewell's paper. The writer had only in a few cases gone into the question of total error, his examination being for the most part limited to the uniformity of the divisions, whether right or wrong, so that total error did enter into his purview. He (Mr. Gordon) had been greatly interested in the paper and the questions it had raised, and especially so by the suggestion of Mr. Conrady, as it seemed a very desirable thing that the Society should possess a standard micrometer for reference and comparison. He thought anything in the way of appreciation of the paper would perhaps be out of place as coming from him as the reader of the paper on behalf of Dr. Ewell ; he would therefore content himself by making those few observations.

The Secretary read a requisition, signed by eleven Fellows of the Society for a Special Meeting of the Society to be called for the purpose of altering the By-laws in such a way as to remove the present prohibition of the attendance of Women at the Meetings of the Society. He gave notice that part of the next Ordinary Meeting would be made special for the consideration of this proposal.

The Chairman reminded the Fellows that at their last meeting a suggestion was received from Mr. Baird as to the desirability of printing a Catalogue of the Society's books and instruments, and offering a donation of three guineas towards the cost. Since then they had received promise of a further donation of two guineas from Colonel Tupman in furtherance of the same object; the Council would be very pleased to receive further contributions so as to help the matter to a more rapid conclusion.

It was announced that at the next Ordinary Meeting of the Society (on December 16th), nominations for Council and Officers for the ensuing year would be made, and Auditors of the Society's Accounts would be appointed.

The following Instruments, Objects, etc., were exhibited:—

The Society:—Slide of "Red Snow," presented by the Peary Arctic Club.

Mr. C. L. Curties:—Mr. Merlin's New Growing Cell.

Dr. R. G. Hebb:—Slide of Spicules from *Studeria* and 3 diagrams in illustration of Professor Thomson's paper.

Mr. J. I. Pigg:—*Lecanium hemisphæricum.*

Mr. C. F. Rousselet:—Exhibition of the following mounted specimens of Pond life—*Bursaria truncatella; Didinium nasutum; Epistylis galea; E. plicatilis*; *Noctiluca miliaris; Trichodina pediculus; Volvox globator; Hydra fusca; Hydra viridis*, with eggs and testes; Medusa of Marine Hydroid; Fresh-water Medusa; *Mœrisia Lyonsi* from Lake Qurun, in Egypt; Hydroid polyp of ditto; Hydroid polyp of *Limnocodium Sowerbyi*; New Fresh-water Medusa from Hunyani River, Rhodesia.

New Fellows:—Professor John Wesley Judd was elected an Honorary Fellow and the following were elected *Ordinary* Fellows: Messrs. Alfred Dillon Bell, James F. Carruthers Bell, John Gibson Connell, Albert George Parrott, James Alexander Robertson.

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