# 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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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY, 1914.

## TRANSACTIONS OF THE SOCIETY.

### I.—*The Binocular Microscope.*

By Felix Jentzsch, Ph.D.

(*Read December* 17, 1913.)

Figs. 1–3.

#### 1. The Employment of Binocular Microscopes in the Past.

Ever since optical instruments were known, people have tried to make them suitable for use with both eyes. There was no special reason for this, nor had they any very clear idea of the requirements which such an instrument should fulfil, but one was quite contented with the somewhat obvious experience of daily life, that a man with both eyes intact is better than one who is blind on one side. Thus, for instance, in the beginning of the seventeenth century the Dutch spectacle-lens maker, Lippershey, was granted a patent for a double telescope. This instrument was provided with all sorts of improvements during the ensuing decades; as, for instance, an arrangement for placing the two objectives in a convergent position. In 1677 Cherubin d'Orleans hit on the idea of fitting up the Microscope as a binocular instrument. Whether his arrangement was ever carried out or not we do not know. At all events, and in spite of further experiments by Zahn in 1701, the whole question was lost sight of, and we have to place on record that for the next 150 years not the slightest interest was taken in binocular Microscopes.

It only came up again when C. H. Wheatstone developed his epoch-making ideas on stereoscopic vision. This gave the lead for an extended period in the development of binocular microscopy, for now every maker aimed at the construction of a stereoscopic Microscope. In fact, at that period a plethora of new types appeared simultaneously, some of which produced pseudoscopic, while some attained orthoscopic effects. These effects were obtained in some cases by means of double Microscopes, in others by the use of a single objective, in which case a geometrical or physical division of the pencils of rays was produced. The history of these different types, numbering about twenty altogether, which appeared in the course of a very few decades, is admirably compiled by M. von Rohr * in his work of reference, "The Binocular Instruments."

While the Continental workers did not take very kindly to these types, the stands of English instruments were for a long time regularly provided with binocular fittings. The type most widely used was the one permitting the binocular arrangement to be thrown out of use in order to change to the ordinary monocular method of observation. This device could, however, be used only for quite low-power systems, otherwise two images were obtained differing widely in their coefficient of light intensity. With all forms of this construction the quality of the image suffered more or less deterioration, so that after the purely æsthetic pleasure of seeing stereoscopic views had passed by, it was realized even in England that for scientific investigations the monocular Microscope was always superior to these types. Later on, in Germany, E. Abbe † devised an arrangement with his stereoscopic eye-piece, which threw all previous types into the shade. Nevertheless, this eye-piece appears even to this day to enjoy a very restricted use. It is well known there has been in existence since 1897 a perfect type of instrument for low magnifications, namely, Greenough's Microscope.

As a matter of fact, in view of optical law, the importance of viewing stereoscopically diminishes in the same ratio as the magnifications and apertures in use are increased. Already, with medium magnifications and apertures, the penetrating power reaches values, so far as they can be calculated from purely dioptric data, which approach the limits of resolution of the Microscope, so that no further information of any importance bearing on the spatial structure of the specimen can be obtained. Taking physiological and psychological effects into consideration, the foregoing results will differ widely, which will be explained later. Many microscopists, especially in England, retained the binocular construction even with higher magnifications, in order to be able to use both eyes, as this was said to be less tiring. In spite of this,

* The Binocular Instruments. Berlin, 1907.

† Description of a New Stereoscopic Eye-piece, with general remarks on the conditions governing Micro-stereoscopic Observation. Kais. Zeit. f. Mikr., ii. (1880) pp. 207–34; see also Ges. Abhand., i. pp. 244–62.

during all this period, no one seems to have recognized clearly the great importance an instrument would have which, while being constructed for binocular use, should be definitely non-parallactic, but whose function should be to present to the eyes two identical or congruent images, and not two pictures which differ in their perspective. On the contrary, one reads frequent complaints * that a particular stereoscopic instrument is no good, or is even harmful, because it only produces simple binocular images. In recent years interest in this question, which had died out, seems to be reviving: thus, J. Amann† expressed quite definite requirements three years ago with regard to a purely binocular Microscope. The instrument which is to be described here was constructed, as far as the chief features are concerned, in the winter of 1909–10. In the year 1912 it was entirely reconstructed.

## 2. Geometrical and Physical Division of the Rays.

The designs hitherto adopted are unsuitable for meeting the conditions required. It may be noted that the chief advantage of observation by the binocular method only becomes specially apparent with very high magnifying powers and arduous examinations, such as are required for dark-ground illumination and ultra-microscopy. It is just in these cases that the earlier types fail. The Greenough Binocular is known to be suitable only for very low apertures, up to about 0·15. For higher magnifications larger apertures are necessary: these require, however, very short focal distances only obtainable by using one objective, therefore the division of the pencils of rays must be carried out above the objective. This can be done geometrically or physically, either by conducting certain groups of the rays, which leave the objective towards one eye and the remaining groups to the other eye; or by splitting each single ray into two parts, thus reproducing two images.

The geometrical division can be performed in very different ways. The most obvious method is to divide the circle of the objective into two semicircles by using reflecting prisms (45° prism, J. L. Riddell, 1852; 60° prism, Nachet, 1853) or by refraction (Wenham, 1860). Moreover, it has also been attempted (many years ago by the firm of Leitz) to divide the opening into one or more annular circles or into several rectilinear zones. With all these methods of construction, that is in every kind of geometrical division, a reduction of the aperture takes place, and consequently there must be a diminution in the resolving power of the instrument. Moreover, all the spherical and chromatic defects of the objective become much more marked with these diaphragms. (It

* Proc. R.M.S., No. 1 (1878) p. 149.
† Das Binokulare Mikroskop. Zeit. f. wiss. Mikr., xxvii. (1910) pp. 488–93.

may be noted here that this disability obtains with all ordinary opaque illuminators whenever prisms are employed.) Further, it may be pointed out that the division must take place in the upper focal plane of the objective, if a uniform illumination of the field of vision is desired. This, however, becomes an impossibility with dry lens systems of higher magnifying power, as in all systems known to me the upper focal plane is situated within the lens, where no mirrors or reflectors can be located, even if, as was done in several English types, the objective mounts were made very short.

All these objections disappear with the physical method of splitting up the pencils of rays, so that generally speaking this method is considered the more advantageous one. The aperture is not reduced, the field of vision is equally illuminated. There are several types which make use of this method of division, viz. (1) The binocular arrangement of Powell and Lealand,* where the partial reflection from a thick glass plate is employed; (2) The so-called Wenham †-Schröder objective-prism, made by Ross and Co., of London; and (3) the previously mentioned stereoscopic eye-piece of Abbe. The last two named types divide the rays at a thin film of air which transmits and reflects at the same time, and this arrangement, just as with Powell and Lealand's type, unavoidably causes a marked difference in the light intensity of the two fields of vision. This difference, which amounts to a ratio of about 1 : 2·5, with Abbe, and which is higher still with Powell and Lealand, is under some circumstances even a desirable factor for a stereoscopic effect such as is sought for in those types, while for purely binocular examinations it is undesirable. In addition to this it follows, at least with Abbe's arrangement, that two eye-pieces of different construction have to be used, one a Huyghenian and the other a Ramsden, and that only one degree of magnification in the eye-piece is available. A further disadvantage of Abbe's eye-piece is, that the two tubes are placed in a converging position (see pp. 6, 7).

### 3. The New Binocular Microscope.

The problem before us, therefore, was to construct a binocular Microscope which can be used with any desired pair of eye-pieces, in which the two fields of vision shall have equal intensity of

* Described by L. Dippel, Das Mikroskop und seine Anwendung. [2nd ed., 1882, p. 556.

† F. Wenham, On a Binocular Microscope for High Powers. Trans. London Micr. Soc., No. 14 (1866) pp. 103–6. Wenham himself does not appear to have carried out this type of construction. In mentioning the Wenham-prism, with English Microscopes, a different type, employing geometric division, is always alluded to.

light, and with which the employment of all objectives, including the most powerful oil-immersion lenses, shall be possible; so that

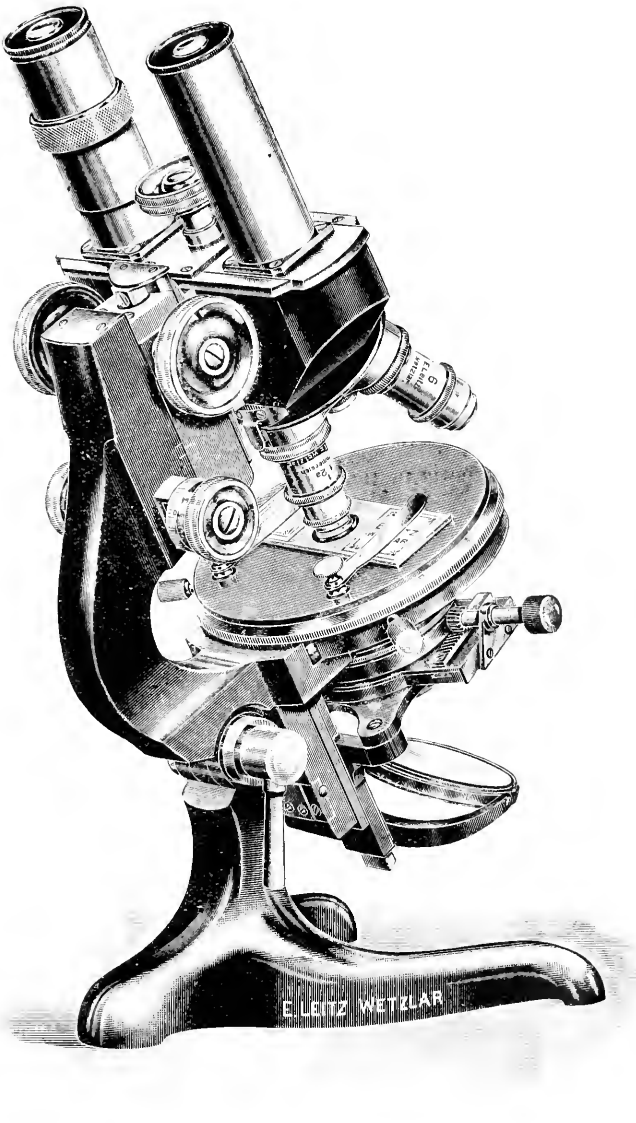



Fig. 1.

it would also include normal binocular ultra-microscopy. This problem has been solved, and it should be observed, that a noticeable deterioration of the image, which was to be feared owing to the large bodies of glass necessary, has not taken place

Fig. 1 shows the external appearance of the instrument. The tube has become a flat box containing the system of prisms. At the upper end are situated the two eye-pieces, whose distance apart can be regulated to suit the eyes of the observer by means of a milled head which actuates two toggle levers inside the box. The distance apart can be varied between 54 and 74 mm. The eye-pieces slide in guides so constructed that no dust can enter the prism-box owing to this movement. On the left-hand side is a millimetre scale, permitting the correct setting to be made for observation.

As the two eyes are generally of unequal strength, it was found necessary to fit an independent adjustment on one of the eye-pieces. This can be placed in the right- or left-hand eye-piece. The usual way is to focus by coarse and slow adjustment, using the fixed eye-piece only, then the proper setting apart is given to the two eye-pieces, and finally, if necessary, a further adjustment by the movable eye-piece is made. All kinds of eye-pieces may be used. The eye-piece corresponding to the eye which is more shortsighted is of course set a little lower than the other.

The simple internal arrangement is shown in fig. 2. In the cemented prism nearest to the objective will be found a semi-transparent coating of silver, which effects the above-mentioned physical division of the pencils of rays. There is nothing novel about the arrangement of the prisms; on the contrary, it has been variously applied to optical apparatus in this and other modifications. It is derived from the so-called "Swan cube." The semi-transparent film of silver also finds application in physical instruments. It is technically possible to adjust the film of silver so exactly that the transmitted and reflected light are practically of equal intensity. The thickness of the glasses is chosen so that the length of the optical paths are equal both to the right and to the left, thus securing equal magnification.

The new Microscope has another peculiarity, namely, that the two eye-pieces are parallel. We know that in the human eye the actions of accommodation and adjustment for convergence are coupled so as to work together. A convergent action generally calls for an effort of accommodation corresponding to an approach of the object under observation nearer to the eyes, and vice versa. If, therefore, the eyes are forced to convergent action a certain accommodating effort is forced upon them, and this one would prefer to avoid because the eye-pieces of Microscopes are designed for the emergence of parallel rays, that is for an unstrained eye. Such observational work is very tiring when continued for any length of time, principally owing to the fatigue of the muscles of the eye. Nevertheless, this method of construction for stereoscopic purposes is defensible at least in one respect, inasmuch as the purpose is to assist the purely optical effect by adding auxiliary psychological perceptions, in this case by convergence. For a purely binocular instrument, on the other hand, convergence of the optical axes of the eyes loses all its importance. We would rather require each eye to work as far as possible without effort of accommodation, that is without strain, and that the point of convergence

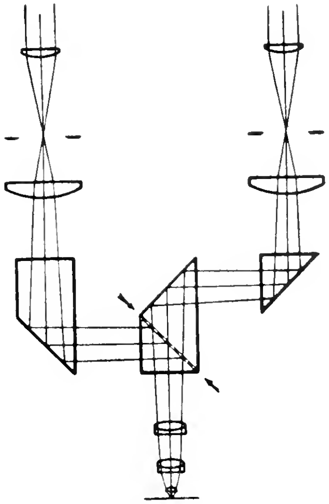


FIG. 2.

of the axes of the two eyes should be as distant as possible: in other words we prefer to place the two eye-pieces parallel.

With this arrangement everyone * can succeed in making the two images coincide, and this is accomplished the sooner the more effectually one avoids any sort of strain in working. If the coincidence of the images takes place under conditions of complete relaxation, the tranquillity and steadiness of the image is surprising. The distance at which the image is located varies in individual cases as with the ordinary Microscope.

* It is a fact that anyone, who can see at all with both eyes, can use any properly designed and well-constructed binocular Microscope without previous practice.

## 4. The Hygienic Importance of Binocular Observation.

We know that in most "Introductions" on the use of the Microscope one is advised when working to change about from one eye to the other, and we likewise know that it is the custom not to follow this good advice! On the contrary, most microscopists have accustomed themselves to such an extent to the use of the one eye, that if they have to use the other eye for any length of time they experience acute discomfort. Very often they cannot use it at all. When stopping work after hours of tiring observation, everyone has probably noticed that it is not the eye which one has been using which is most tired, but the one which has been out of service and which was apparently idle. Some observers have even assured me that after working for a long period with the right eye they have noticed a disturbance in the sight of the left eye which has for some time hindered them when reading.

An explanation of this fatigue of the unused eye, which, by the way, is noticeable with any form of continuous observation with one eye, might be sought in the fact that the unemployed eye, in seeking a suitable point to focus on, causes the muscles or accommodation to be continually on the move, backwards and forwards so to speak, thus sustaining much more fatigue than the other eye, whose accommodation remains practically unchanged during the whole period of observation. It may, however, be just as likely that the seat of fatigue is more central, i.e. in the brain, for while we are working with the Microscope we have to ignore entirely the images received by one eye while concentrating our attention on the images received by the other. The idle eye has to be continually "called to order," i.e. it has to be forced into inactivity, a process which absorbs a good deal of "energy." However, this last-named discomfort only affects the beginner. With continued practice the impressions received by the one eye are suppressed unconsciously and without difficulty. It is no concern of the science of optics to decide which of these or perhaps other explanations is the correct one.

Owing to this fatigue not only is the period of observation reduced, but perhaps its value is diminished. At any rate Amann * considers that it is not improbable that, owing to the constant brain-effort which is required, the power and the discriminating efficiency of the working eye might be injuriously affected.

As a matter of fact I found it possible to carry on observations with the new binocular Microscope for a much longer period. It is astonishing how comfortable and how little fatiguing it is. Especially with dark-ground illumination the difference between monocular and binocular observation is remarkably great.

* Das Binokulare Mikroskop. Zeit. f. wiss. Mikr., xxvii. (1910) p. 492.

## 5. The Superiority of Binocular Observation.

The appearance of the microscopic image differs qualitatively from that with the monocular type of instrument. The first consideration is that in binocular observation one generally sees better than otherwise, and moreover one is able to detect more detail. It must, however, be admitted that there are marked differences in this respect in individual cases. The fact that more detailed examination is possible leads one to think that possibly an actual increase in visual power takes place in binocular work. Certain experiments tend to support this theory, but I have tried to explain the effect in the following manner.

According to the Duplex vision theory of von Kries, we possess two entirely different methods of vision, i.e. "daylight vision" and "twilight vision." Now the sensitive surface of the retina consists of two different sets of organs, the rods and cones, of which the former receive principally colour impressions while the latter are acted on by differences of light intensity. According to the above mentioned Duplex vision theory the cones are the organs for daylight vision and the rods for seeing in the semi-darkness.

Now it is often pointed out that the rods are missing from the *macula lutea*, therefore with direct vision only the colour-discriminating cones are employed and the rods only play a part in indirect vision or possibly only in the twilight. This is not stating the case quite correctly. The rods do not disappear entirely in the region of direct vision. They are not absent from the whole *area centralis*,* but only from the innermost spot, the *fovea centralis*, that is a region which externally only covers a field of vision of about 1° to 1·5°. Round about this region the rods make their appearance without any marked boundary line and varying greatly in individual cases. They increase in number farther away from the centre while the number of cones decreases. Besides these there are certain qualitative differences to be noted. At the points where the rods commence to diminish the cones gradually assume the shape of the former. This similarity is most marked in the *fovea centralis* itself.

During normal vision (excepting perhaps with very high light-intensities) the cones and rods act at the same time; only that the rods have a greater capacity for adapting themselves to darkness, so that a weak intensity of light suffices to excite the action of the rods but is insufficient to affect the cones. In the same way when one is using the Microscope both these organs are generally active.

In addition to the differences in intensity of light we have

* This expression is considered to be more suitable than the synonymous *macula lutea*, as according to Gullstrand the yellow colour of the so-called yellow region only refers to a post-mortem effect.

above all things to observe fine colour differences or shades. Now as both eyes are rarely equally efficient, it may happen that one eye is more fitted for the one, while the other eye is particularly well equipped to do the other kind of work. Thus if we are in a position to use both eyes we can also utilize their respective strongest points.

Everyone who makes much use of binocular instruments is aware that the two eyes assist each other to a much greater extent than would be expected from general consideration. With this method of observation there is not only a continual movement of accommodation, as is the case in monocular instrument working, in virtue of which as is known the penetrative efficiency of the instrument is increased, but the attention, the perceptive organs of the main cerebral centres, turn from one eye to the other as it were, thus combining the delicate shades of colour as seen by one eye with the fine contour lines of the image as seen by the other.

The process as described need not take place actually in such a simple manner. The capacity of our sense of sight is not exhausted by the mere perceptions of colour and light intensity. In analysing the sense of sight one would rather bracket the light- and colour-sense together as one factor and would then add the optical sense of space and position-perceptions, and finally the capacity for optical resolution and the sense of form. Although with the ordinary phenomena of sight all these senses come into action simultaneously, there will, nevertheless, generally speaking, always be differences between the two eyes of any individual with respect to these different phases. There may also be differences in the degree of sensitiveness of corresponding points on the retina. It may here be mentioned that the unpractised eye is generally less sharpsighted than the practised eye, while having greater sensitiveness to light.

All these differences are naturally less noticeable with the binocular method of observation than with the monocular, so that we can now more easily realize how it is that one can make better observations with a binocular than with the ordinary Microscope. Moreover, this conclusion holds not only for the Microscope but also for many measurements made by the aid of optical instruments, especially in photometric work. Observations in all these cases are directly comparable with normal binocular observations on far distances.

It is common experience that long distance observations made from an isolated mountain peak or from a balloon are rendered much more effective by using both eyes. It will also be necessary to take into consideration the binocular summation of stimuli and the so-called "vividity" of perception.

## 6. The Summation of Stimuli in Binocular Vision.

Although one generally has rather too much than too little light in the Microscope, it is necessary that we should be quite clear about the conditions of light intensity in the new instrument, as one might easily expect a certain amount of obscuration. First of all only about half the light transmitted by the objective reaches each eye-piece.* Further, a certain percentage is absorbed in its passage through the prisms and lost by reflection.

Experience teaches us that if there be any obscuration at all in the new binocular Microscope as compared with the ordinary Microscope, this does not appear to be as great as calculation would lead one to expect. This question of light intensity has to be handled with a certain amount of caution. For when we have arrived objectively at the determination of a certain degree of illumination, we have still to deal, in the case of an optical instrument, with its use considered subjectively, for here the sensibility to light impressions has to be taken into account.

It is known that in ordinary vision the same impression of light intensity is obtained with two eyes as with one. One can easily convince oneself of this by closing one eye when observing an illuminated surface. If the proper precautions are taken no obscuration will be observed. We know that in an experiment of this kind the pupil of the open eye becomes dilated. It is not possible, however, that this should simply make up for the loss of light. For, owing to the comparative slowness of this reflex action, a slight shadow should appear to cover the image during the first moment. This, however, is not the case. The experiment, moreover, only succeeds in a good light, and only then if the object is so far distant that it can be observed easily and well by both eyes, and provided that the person making the test is not accustomed to observe with one eye only, which happens rather often.

The opposite result, namely that the apparent illumination of a surface is greater when observed with two eyes than with one, is generally arrived at if a diaphragm be interposed in such a way that one eye sees only part of the test surface. On making the fields of vision coincide, the part seen by both eyes appears brighter than the other. According to this, therefore, binocular summation of light stimuli obtains in everyday life. I do not, however, consider this experiment to be decisive, for a fusion with the

* The light absorbed by the silver coating may be entirely neglected. No colouring of the images can be observed, although from theoretical considerations this might be expected owing to dispersion from the silver.

usually less bright image of the diaphragm itself takes place on the apparently darkened portion of the field of vision.

According to modern physiology, the binocular summation of stimuli only takes place with the eye adapted to obscurity, and in the case of vision in full light it is entirely absent. It appears to me, however, that there are certain transition stages, and that a very high degree of full light adaptation must indeed be necessary to entirely eliminate any summation of stimuli. It may even be discovered that the conditions of "twilight vision" are already entered upon at much higher intensities than has hitherto been supposed. I do not wish to go any further into this question in all its bearings, but only wish to emphasize that, according to my personal experience, this is actually the state of the case with the new binocular Microscope.

We know that a summation of stimuli takes place within one eye when the object is very small, and when the image approaches the size of an optical sensory element. In this case the intensity of light is proportional in the first instance to the number of sensory elements covered, but it will not increase as soon as the stimulated surface has reached a certain size. I suppose, therefore, that also in binocular vision an analogous summation of stimuli takes place (even with adaptation to bright light), as the objects to be examined are very small. This would explain the fact that on using both eyes in the new binocular Microscope a marked increase in the impression of light intensity is noticeable. However, it is also possible that this feature is greatly due to another phenomenon generally experienced, the so-called "vividity."

## 7. Vividity.

In using the new instrument, one has another observation to make which is not so easy to put into words. Perhaps the best way of giving expression to it is to say that everything appears more alive, more life-like than otherwise, so that the term "vividity" is perhaps the most suitable.

The expression "vividity" was introduced in psychological terminology by Richard Semon in order to characterize the vivacity of perception. Vividity is a quality of perception clearly different from "intensity" but not completely independent from it. For we are able to perceive an object of very small intensity, such as a distant light on a dark night, with great vividness (vividity), and on the other hand the effect which a brilliant arc lamp has may be one of very slight penetration. We hear, for instance, the steps of a person carefully coming nearer on tiptoes with great vivacity and distinctness though as something quite noiseless. On the other hand, the fortissimo of a noisy open-air concert to which we listen only inattentively is the example of an intense but not vivid perception.

The difference seems to be related to the difference between attentive and inattentive observation, although it is not identical with it. For the greater impressiveness of a perception under equal objective intensity may, apart from the question of attentiveness, be conditioned by a multiplication of the areas susceptible to stimuli. The orchestra does not become less loud if we hear it through only one ear, nevertheless we feel the desire to increase its vividity by listening with both ears. Also, we do not always see more intently with two eyes than with one, but more vividly.

I am convinced that this holds good for all kinds of binocular instruments: thus the advantage of prismatic binocular field-glasses over the so-called "prismatic monoculars" lies not merely in their stereoscopic effect, which is in any case only apparent with comparatively near objects, but especially in the vividity, that is, the general increase in the "lifelikeness" of the impression, which is brought about by binocular as against monocular vision. In the new Microscope this advantage is similarly noticeable.

Now I will go a little further, and should like to make the suggestion that in the impression of vividity is included also a part of the sense of depth, that is, those psychological factors which occur only in binocular vision. For the sense of depth (spatial effect) is known to be not only a function of the impressions on the senses, but is composed of actual optical factors and of physiological and psychological effects. If you remove by any method the immediate perception of depth by submitting to the two eyes two identical images, the remaining physiological and psychological factors can still produce a conception of depth (spatial effect).

The estimation of the distance of a thing takes place according to the size of objects of a known extension: one judges from the appearance of the perspectives (covering, cast-shadows, intensity of colours, so called "air-perspectives") and many other incidental facts. Further physiological features may be mentioned, such as, the straining of accommodation and the convergence of the two visual axes.

In the new instrument not only are the purely optical conditions for depth-effect absent (the two images are identical) but the physiological factors are also eliminated (both eyes are parallel and are accommodated to infinity). The psychological effects which accompany an impression of depth may, however, be produced by some conditions and so give rise to a certain depth-effect. The majority of these accessory impulses in connexion with the sense of depth are also to be considered in connexion with monocular vision: some, however, only appear with binocular vision. Thus, for many observers, the stimulus for the conception of depth lies in the fact that they are observing with both eyes. The certain expectation that "Now I shall see objects stereoscopically," suffices to induce the apparent effect. This suggestion, with the impression of greater vividity, produces, by the binocular Microscope, the impression of stereoscopic effect and life-like appearance.

### 8. Parallactic Effects.

Although parallactic perception of depth is out of the question with the new instrument, and the effect which sometimes astounds the observer is only psychological with higher magnifications, nevertheless conditions may be obtained with the binocular Microscope resulting in proper parallactic vision, and what is more both orthoscopic and pseudoscopic. This takes place when the eyes of the observer are not centred with the eye-pieces. One has only to take care that the half of the rays emanating from the object should reach each eye, and, moreover, on account of inversion in the Microscope, the rays from the left half of the object must be led to the right eye, and from the right half to the left eye if you desire an orthoscopic effect. In the reverse case we have pseudoscopic effect, i.e. parts which stand in relief appear to be depressed, and so on. These conditions were first made clear by Professor Abbe in 1882.*

As is shown in fig. 3,† this screening has to be done in the upper focal plane of the objective. It could, however, be moved to an image of this focal plane—the only one available in the ordinary Microscope being the Ramsden disk. There one would have to apply to the "exit pupil" as has been done by Abbe,

* On the Conditions of Orthoscopic and Pseudoscopic effects in the Binocular Microscope. Journ. R.M.S., 1881, pp. 203–11.

† Figure 3 shows the path of the rays in the Microscope from the image of an object P Q to an eye which looks into the Microscope from a position out of the direct line of the principal axis. The rays from P are indicated by dotted lines, those from Q by continuous lines. Both points are represented on the retina, hence the field of vision will not be limited. Of the eight rays proceeding from the object, pairs may be taken together which are parallel in front of the objective and therefore intersect in the upper focal plane of the objective. This focal plane is represented by means of the eye-piece in the Ramsden disk of the whole Microscope. If the eye of the observer is out of the line of the principal axis, some of the rays are prevented by the iris from reaching the inner eye. This is the case with all those rays in the figure which pass through one half of the focal plane of the objective, that is to say, only such rays contribute to form the image of the object P Q as run in a certain direction. In the example given in the figure only the shaded part of the path of the rays reaches the eye. If the other eye of the observer is so placed that it receives the other half of the path of the rays, then the two eyes receive two images of different perspective, and all the conditions of a stereoscopic perception of depth are fulfilled. If on this assumption the eye in the figure is a right eye, the observer will receive a pseudoscopic image; if, on the other hand, it is a left eye, the observer will receive an orthoscopic one. (We suppose ourselves to be opposite the observer.)

a semicircular diaphragm* in order to obtain all the desired effects. With normal microscopic observation, however, this is the spot where the "entrance-pupil" of the observer's eye should be placed so that inconvenience with the eye would be unavoidable; this would

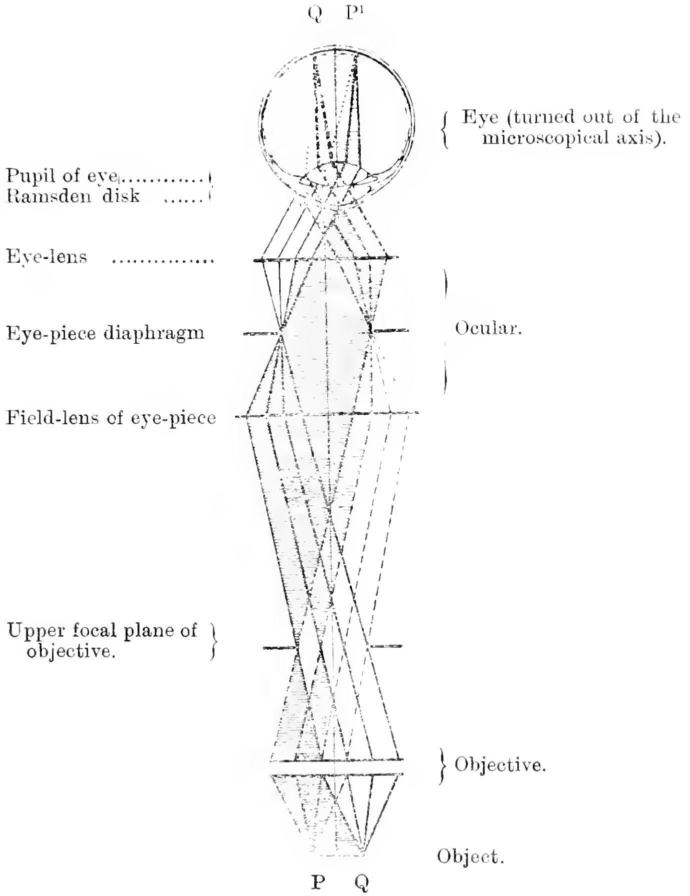



FIG. 3.

also be the case, for instance, with Abbe's stereoscopic eye-pieces. For a stereoscopic Microscope it would therefore be better to produce another image of the Ramsden disk between the objective and eye-lens of the ocular, and to do the screening there. This neces-

* It may be interesting to note that F. H. Wenham already in 1854 made a proposal of this kind. Quart. Journ. Micr. Sci., ii., pp. 132–4.

sary screening can, however, be done more conveniently in another way, by placing the pupil of the eye in a special way in the path of the rays. For example, if we make the space between the oculars somewhat less than the distance between the observer's eyes would be for parallel vision; but if, nevertheless, his eyes remain parallel and wholly without strain, then he must necessarily perceive an orthoscopic effect; on the other hand, pseudoscopic effects must be expected if the oculars are farther apart than the mean distance between the observer's eyes.

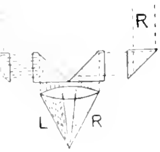
This consideration, which is a direct result of Abbe's theories, was proposed by A. C. Mercer.* Observation confirms its truth entirely for low power magnifications. With higher powers the Ramsden disk becomes so small that, probably owing to the movements of the eye, it cannot be observed in part but can only be taken in entirely or not at all.

This phenomenon can, however, best be observed with incident light, as the production of cast shadows is most conducive to an increase of stereoscopic effect. Besides all granular preparations, for instance, somewhat thicker test preparations of *Macroglossa stellatarum* are most suitable for observing this effect. The oblique illumination is best obtained in this case by fitting a concave Microscope mirror with spindle into one of the holes for the specimen clamps; the light may then be directed obliquely on to the preparation, the individual scales throwing shadows on each other and even at times on themselves. Coins are also very suitable with low-power magnifications. For this case with a suitable adjustment of the distance between the eye-pieces, one sees the lettering stand out with remarkable parallactic effect.

In conclusion, it may again be remarked that with medium and still more high power magnifications there can be no question of an actual parallactic effect. The advantage of the binocular Microscope lies in such cases in the qualitatively enhanced impression produced in different ways, and above all in its hygienic importance.

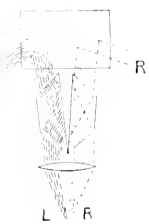
* Stereoscopic Vision with non-stereoscopic Binocular arrangements. Journ. R.M.S., 1882, p. 271.

## TYPE 1




1 RIDDELL


2 WENHAM-RIDDELL

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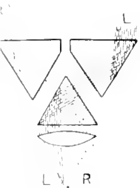
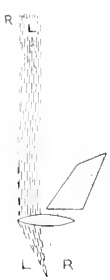
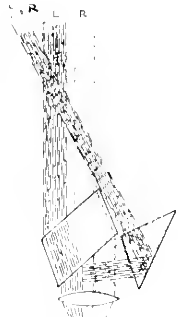



4 NACHET

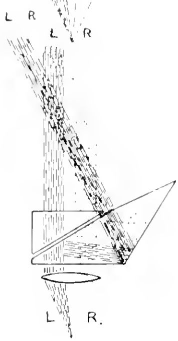



5 WENHAM

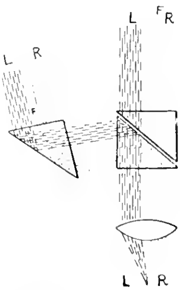
## TYPE 2



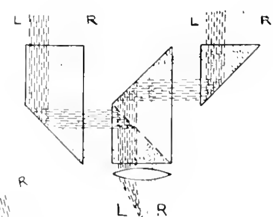
6 POWELL & LEALAND



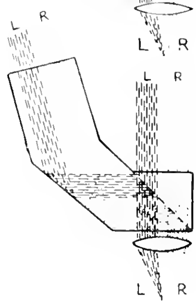

7 WENHAM-POWELL




8 ABBE




9 LEITZ




10 BECK

London Etching Co., Ltd., Eng.

## II.—*The Binocular Microscope of the Past, and a New Form of Instrument.*

By Conrad Beck.

(*Read December* 17, 1913.)

Plates I, II.

The paper by Dr. Jentzsch has suggested that an exhibition of the chief types of binocular Microscopes of the past and present might be interesting. To illustrate the construction I show on Plate I diagrams of the optical arrangement of the various forms. Dr. Jentzsch has made a happy classification of binocular Microscopes into two kinds, and, adopting this classification, I would add a third.

I. The first type of binocular Microscope is that in which the light from a single object-glass is geometrically divided and half directed into each eye. The beam of light is bisected. This type includes in order of priority:

1. *The Riddell* (Plate I, fig. 1).—My example of this is a small dissecting compound Microscope, made by Smith and Beck.

2. *The Achromatic Prism of Wenham and Riddell* (Plate I, fig. 2).—I can only obtain one of the prisms of this type, but I have a simple achromatic Microscope on this principle made by Smith and Beck.

3. *The Stephenson Prism* (Plate I, fig. 3).—An example of this has kindly been lent by Mr. Rousselet, and another by Mr. Curties.

4. *The Nachet* (Plate I, fig. 4).—Sir Frank Crisp has kindly lent us a sample of this form.

5. *The Wenham Binocular* (Plate I, fig. 5).—I have two examples of this, one in use with a low power and the other in use with a high power mounted very close to the prism. I have also an old experimental one, in which the prism is actually mounted in the back cell of a $\frac{1}{6}$ object-glass so as to be practically in contact with the back lens, and another prism only mounted on an arm which projects down into the interior of a high-power object-glass. The Wenham form of binocular Microscope has been sold in thousands and is the only binocular Microscope that has had very great popularity.

II. The second type of binocular Microscope is that in which the light from a single object-glass is divided into two beams in a manner described by Dr. Jentzsch as "physically." The beam of light is not bisected, but is as it were sifted into two so that some light from each portion of the beam goes to each eye.

6. *Powell and Lealand* (Plate I. fig. 6).—The earliest type will demonstrate this. The whole of the light impinges on the first surface of the thick plate No. 1, and while some enters the plate and passes through to form the direct image some is reflected at the first surface, and is caught by prism No. 2 and reflected at an angle up the second tube of the Microscope. I have one of these instruments, kindly lent by Mr. Muiron.

7. *The Wenham Modification of Powell and Lealand* (Plate I, fig. 7) cuts off the top of prism 1 and places it below between prisms 1 and 2, leaving an air space between prisms 1 and 2, and slightly alters the angle of these prisms to get a larger proportion of the light reflected. I have been unable to obtain a specimen of one of these, and it is doubtful if any but experimental instruments were made.

8. *The Abbe Binocular Eye-piece* (Plate I. fig. 8) is optically exactly the same as the Wenham-Powell, except that he divided prism 2 and altered its angle so as not to cross the right- and left-hand beams over. By his construction the length of path of the two beams of light had been much altered. He used a Huyghenian eye-piece on the left-hand body and a Ramsden eye-piece on the right-hand body to correct this, as a Ramsden eye-piece has its focus (F) at a much lower position than that of a Huyghenian. Abbe, instead of using this instrument nearly over the object-glass, placed it near the eye-piece.

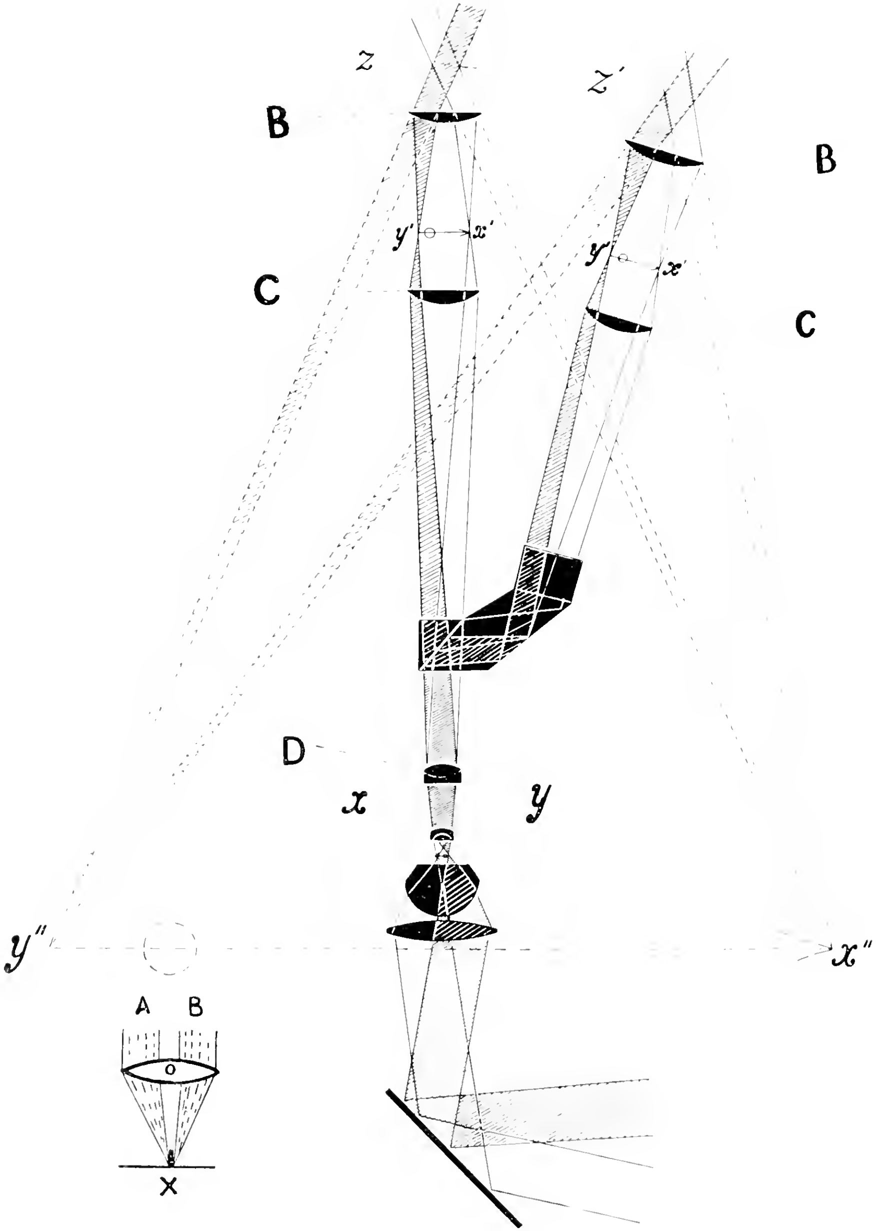
9. Dr. Jentzsch now describes the *New Leitz Binocular* (Plate I, fig. 9), which makes use of a half-silvered film cemented between two glass prisms to divide the beam.

10. I have devised a still further form (Plate I, fig. 10), which I am exhibiting here to-night, which is somewhat on the lines of the Wenham-Powell No. 6, but I am making use of the half-silvered film for dividing the light, and am not crossing over the beams for certain important mechanical reasons, and I also use a parallel block of glass on one of the prisms for equalizing the optical path of the two rays, so that both come to a focus at the same position in the eye-piece.

III. The third type of binocular Microscope consists of two complete Microscopes pointed obliquely at the same object, and is only useful for low powers.

*The Greenough Microscope,* as made by Mr. C. Baker, has kindly been lent me by Mr. Curties to illustrate this form.

The paper by Dr. Jentzsch is a most admirable and interesting comment on most of these instruments, and the qualities may thus be summarized.

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*Properties of the First Type of Binocular Microscope, which has a geometrically bisected beam, one half going to each eye.*

1. *Resolution.*—As compared to monocular vision this type is not equal to a monocular, because the diffraction image of a point is increased in consequence of the aperture of the light forming each individual image being half that of the object-glass, and each image has less detail in it on this account. The fact that the two images are combined in the brain does not fill in the detail when it has once been lost in the images in consequence of the half-size bundles of light.

2. The geometrical bisection of the beam must take place near the back nodal or equivalent plane. Dr. Jentzsch says it should take place at the back focal plane of the object-glass, but this is a mistake. It is even worse, as it should be at the back equivalent plane in order to ensure a proper sub-division of the rays, which come from the right-hand and left-hand sides of an object-point respectively, otherwise these rays have become mixed up and cannot be sub-divided except at the Ramsden disc outside the eye-pieces, which will be referred to later. For this reason this first type of instrument can only be used with low-power lenses, unless the high powers are specially mounted exceedingly close to the bisecting prism; even when this is done great care must be taken with the illumination to ensure equal lighting to both halves of the object-glass. I am exhibiting to-night a binocular form of the well-known Wenham make, with a $\frac{1}{12}$ oil-immersion mounted specially short showing tubercle bacilli, and you will notice that the performance is extremely satisfactory and the stereoscopic relief very marked, but the resolution is not equal to that of a monocular instrument. The change from binocular to monocular vision in this form by simply pushing the prism out of place is so quick and simple that I do not think the lack of resolution has been the only reason why this form has not more generally been used for high-power work.

3. *The illumination in each tube* in this type is similar in brilliance if the illumination is such that the two halves of the object glass receive equal amounts of light.

4. *Stereoscopic Relief.*—This type of instrument, excepting forms 1 and 2 which give pseudoscopic images, gives a stereoscopic relief of a very marked kind, indeed, of what is strictly a somewhat exaggerated character. This fact has at times been disputed, it has been stated that the stereoscopic effect is purely an illusion. The small diagram (Plate II) renders the reason for the stereoscopic relief clear. Suppose that O represents the objective, and that an object at X consists of a fine blade of material placed on end, all the light from the left hand of this blade which enters the object glass

at all reaches the left hand of the lens only and from the right hand side of X reaches the right hand side only. If the light from the lens O is geometrically divided and passed to one eye at A and the other at B, a perfect stereoscopic picture will result, as though the eyes were looking on both sides of a card held in front of them in the well known experiment on binocular vision. It must, however, be remembered that a Microscope inverts the image, and consequently to pass the correct image to the eyes to obtain the stereoscopic relief the two beams must be crossed over as in Form 4 the Nachet, and Form 5 the Wenham, or else the images must be re-erected as in Form 3.

5. The images are viewed in Form 1, Type I, with the two eyes parallel, in the other forms of this type with the eyes converging to a greater or less degree.

*Properties of the Second Type of Binocular Microscope, which has a Physically Divided Beam.*

1. *The resolution* of this type is in all cases equal to that of a monocular provided the surfaces of the prism are perfect, because each eye receives a full size beam of light.

2. The prisms may be placed in any position in the beam of light between the object glass and eye-piece, and need not be placed close to the back lens.

3. *The relative illumination* in the two eyes in No. 6 Powell and Lealand, No. 7 Wenham Powell, No. 8 Abbe, is very unequal. In the Leitz and my own form it is equal in the two eyes, and no special care is required as to the equal illumination of the two halves of the object glass Even if a single beam of oblique light be used for resolving a diatom, which enters the object glass from only one side, the second type of binocular is as efficient as the monocular. In type 6, Powell and Lealand, the light when it reaches the first face of prism 1 is divided into a reflected beam and a transmitted beam, the latter being about five times as brilliant of that of the other. Wenham, in his modification of the above, by placing his reflecting surface at a greater angle to the incident light, increased the brilliance of the reflected light, but even then the relative intensity differed from about 1 to 3. Abbe adopted Wenham's modification in this respect; he claims that an unequal illumination is advantageous for those microscopists who, before taking to the use of a binocular Microscope, have already reduced the sensitiveness of one eye with a monocular instrument. This argument is one that is difficult to follow, for if the binocular Microscope should come into general use, which, now that the correct type of instrument is being designed is extremely probable, it is important that it should be constructed for the normal

observer whose eyes have not been previously damaged by the use of a monocular instrument. It is possible to suit special cases, in either the Leitz or my own new model, by constructing instruments in which the brilliance of the respective eyes is varied by varying the amount of the reflecting silver deposit, but it is probably not desirable.

4. *Stereoscopic Relief.*—Dr. Jentzsch says that the Abbe binocular eye-piece threw all previous models into the shade, though he states also that it had a very restricted use. Probably in Germany, where the Wenham Binocular was not popular, this is accurate, but in this country and also in America no instrument has yet thrown the Wenham binocular into the shade, and it may be said to be the only binocular instrument that has hitherto been made in large quantities. The Abbe eye-piece is a difficult instrument to keep in adjustment, and has various disadvantages, but it was of great interest from a scientific point of view on account of the controversy that it occasioned as to whether it gave a stereoscopic picture. To elucidate this problem, Abbe pointed out that the Ramsden circle of a Microscope is the conjugate image of the aperture of the object glass, and that if the beam of light entering the eye were divided at the Ramsden circle instead of at the aperture of the object glass, exactly the same rays would be excluded from each eye, and the optical effect would be the same. Suppose in Plate II *d* represents the object glass and *b c* the eye-piece of the Microscope, *z* the Ramsden disk, which is the conjugate image, i.e. a small picture of the lens *d*, a shutter cutting off half the lens D or a smaller shutter cutting half its image at *z* allows just the same rays to enter the eye. Thus Abbe proved that a stereoscopic effect can also be obtained with any of the second type instruments, provided a diaphragm be placed in the Ramsden circle of each eye-piece which cuts out half the rays. It could be turned into a pseudoscopic effect by cutting out the wrong half of the rays or no stereoscopic effect at all by making use of the whole aperture. If by means of a lens held above the eye-pieces the Ramsden disks of a Wenham binocular Microscope be examined, they will be found to be half discs in each eye, small pictures of the back of the bisected object glass, whereas in binocular Microscopes of the second and third type the Ramsden circle is a complete disk. Abbe pointed out that if in these Microscopes that give a complete disk, a D-shaped diaphragm be placed over the Ramsden circle, the same stereoscopic result would be obtained as in the so-called stereoscopic binoculars, except that half the light would be wasted. Theoretically this is quite correct, but there is a serious practical drawback. The proper use of the Microscope necessitates that the observer's eye should be placed so that the Ramsden disk is inside the eye very close to the pupil, and the diaphragm made by Abbe cannot therefore be placed in the right position. In consequence of the

observer's eyelashes it cannot be placed nearly at the correct position, and consequently many observers denied that any stereoscopic relief was obtained with his binocular eye-piece. The use of his eye-piece diaphragms with any but very low power eye-pieces is unsatisfactory, because the Ramsden disk is very close to the Microscope, except in the case of eye-pieces of either very low power or of special construction. But there is another way of stopping out the portions required to give a stereoscopic picture, and that is by placing the eye-pieces slightly too near or too far apart, so that the pupils of the observer's eyes form the necessary diaphragms to cut down the Ramsden disk; and as the stereoscopic effect with a high power object glass is generally exaggerated, a very slight movement of the eye-pieces is often sufficient to cause the necessary stereoscopic effect, and very little loss of light is occasioned.

5. In Types (5), (7), (8), and (10) the two eyes are converged to a point generally about 12 or 15 in. from the observer. Dr. Jentzsch states that to ensure comfort the eye should be looking out parallel. This is not borne out by experience, as the Wenham binocular of the ordinary form gives perfect rest to the eyes when used for hours at a time, and I am inclined to expect it will always be found more comfortable to use an instrument with the eyes converging at an angle of about 10° to 15°. One thing is certain, that the convergence must not be more than 18° and probably not so great, as this is an angle to which the observer is not accustomed. It will be noticed that with the Wenham binocular (Form 5), and the Powell and Lealand (Form 6), if the angle of convergence of the bodies is not to exceed the above convenient amount, the tubes must be long in order that the eye-pieces may be at the required distance apart. It is this fact, together with the trouble of illumination and loss of resolution, which has prevented the Wenham and Powell and Lealand (Forms Nos. 5 and 6) from being even more extensively used than has been the case. It is since the time of short tube-lengths that the popularity of binocular Microscopes has ceased to advance. Any binocular Microscope that is to be universal must have all the advantages of the monocular. In my design of binocular Microscope which I am showing for the first time to-night, I have been able to retain the small convergent angle of about 14° for the two tubes and yet use a tube-length so short that even with a triple nose-piece attached it does not exceed the 160 mm. standard short tube-length. You will notice that the apex of the triangle at which the optic axes of the tubes meet is 3½ in. below the prisms (see Plate II). This advantage is gained by altering the construction of the Wenham Powell model so that the rays do not cross over when deflected from the prisms into the tubes. It will also be noticed that if for certain purposes monocular vision is required, the prism may be pushed out of position with

a touch and either binocular vision with half light in each eye or monocular vision with full light in one can be employed as desired.

The question of slightly convergent versus parallel tubes for a binocular Microscope is one which depends on whether the observer who uses the Microscope uses his accommodation or not. It is, of course, well known to oculists that convergence and accommodation act together, not that they are actually interconnected, but that by long habit when the accommodation is used the eyes converge, and vice versa, and if when the accommodation is used the eyes are obliged to look out parallel, considerable eye-strain and fatigue are occasioned. For telescopes, which are used when the observer is viewing objects at a distance, the eyes are naturally looking out parallel, and parallel tubes should be used, but where the Microscope is employed, alternately with the examination of objects on the table along side it, at a distance of say 12 or 15 in. the observer's eyes are converged to this distance, and it would appear reasonable that such would be the angle at which the Microscope tubes should be set.

A further advantage of this method of constructing the tubes is that by a slight movement of the head backwards or forwards the observer can obtain stereoscopic, flat, or pseudoscopic vision. The distance apart of the eye-pieces of the Microscope is varied by rotating one tube with the finger and thumb. They should be set at such a distance apart that the complete Ramsden disk of each eye-piece is central with the pupil of each eye. Under these circumstances the full resolution and no stereoscopic relief is obtained. Now if the eyes be placed a little closer to the eye-piece the observer's pupils cut off the margins of the Ramsden disks and the stereoscopic effect is obtained; on the other hand, if the eyes are drawn back a pseudoscopic image is seen. Under the Microscope which is on exhibition will be seen a number of *Coscinodiscus* showing the spines whose composition created discussion some time back in the Society. When the observer examines these, moving his eyes towards or from the Microscope, a pair of individual specimens, which are on different planes will completely change over their relative positions, at one time a specimen being behind, at another time in front of its neighbour. Thus an observer using this instrument for resolution under the most perfect conditions can instantly obtain the perception of the relative depth of the parts by a slight movement of the head.

In working with this Microscope so far I have found no disadvantage as compared with a monocular instrument, but even if such should sometimes exist, a touch slides the prism out of position and it is then exactly the same in every respect as the ordinary monocular Microscope.

## III.—*Development of an Embiid.**

By J. C. Kershaw, F.Z.S.

(*Read November* 19*th*, 1913.)

Plates III, IV, and Fig. 4.

These insects feed chiefly on the inner but dead part of the bark of the trees where they live and spin their webs, but they sometimes eat remains of insects and other dead animal matter. The male, except when breeding, seems to live under a separate web, and the proportion of males to females is only about one to fifty. The males fly fairly well, chiefly at night it would appear, since I have had two or three come to light.

The egg-batch is laid on the surface of the bark, or beneath a loose piece or crevice thereof. When the webs and tunnels are near the ground they are usually carried down between the bark and the earth and grass, and the eggs are often laid on the bark

* This Embiid is *E. uhrichi* de Saussure. See Note sur la Tribu des Embiens, par Henri de Saussure, Bull. Soc. Ent. Suisse, ix. (1896) p. 8. It is a very common insect in Trinidad, B.W.I.

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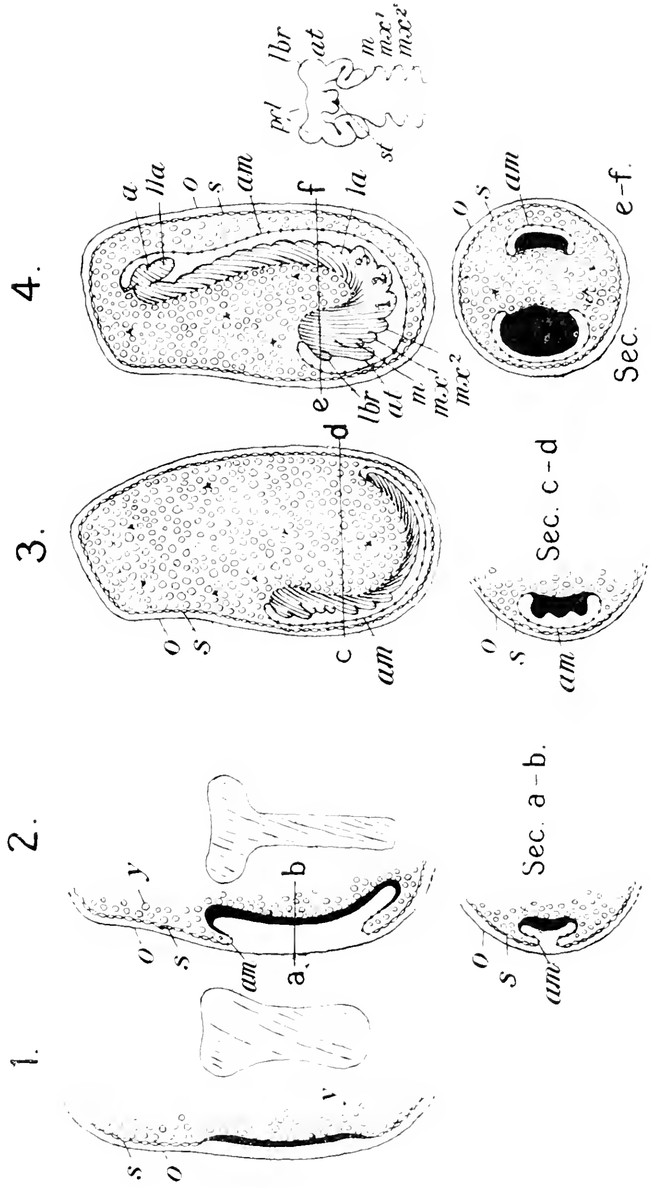
EXPLANATION OF PLATES III and IV.

Fig. 1.—Longitudinal section through primitive band, and front view thereof.
,, 2.—Longitudinal section; band sinking into yolk, and amnion and serosa growing over it; front view thereof; beneath, a transverse section.
,, 3.—Longitudinal section through egg (embryo itself not in section), appendages budded; below, a transverse section.
,, 4.—The same, tail just recurved; to the right, anterior end of embryo unrolled, showing bi-lobed labrum; below, a transverse section.
,, 5.—The same, more advanced (embryo in section); to right, view of a maxilla; below, a transverse section. Section *i–j* is through an embryo of still later date, when the ventral part of the amnion has disintegrated, and it is growing around the yolk laterally and dorsally.
,, 6.—Longitudinal section, embryo revolved; below, a transverse section.
,, 7.—Embryo in egg; only egg-shell (chorion) and embryonic membranes in section; below, transverse section showing appendages embedded in the disintegrated material.
,, 7*a*.—Longitudinal section of anterior part of embryo at a later date, showing absorption of serosa and amnion.

N.B.—In all but fig. 7 the chorion, or egg-shell, is not shown.

Lettering of Figures:—*am*, amnion: *at*, antenna; *ch*, chorion; *cu*, cuticle; *ec*, ectoderm; *l*, leg; *lbr*, labrum; *m*, mandible; *mi*, mid-intestine; $mx^1$, first maxilla; $mx^2$, second maxilla; *o*, oolemma; *pcl*, procephalic lobe; *pr*, proctodæum; *rs*, remains of serosa; *s*, serosa; *ss*, membrane secreted by serosa; *st*, stomodæum; *y*, yolk; *ys* + *as*, substance formed by remains of part of the yolk and amnion; 1*a*, 10*a*, and 11*a*, first, tenth, and eleventh abdominal segments.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in this position. Before oviposition the female gnaws the chosen spot fairly smooth. The eggs are laid with their posterior poles touching the bark, but the interstices between the eggs are filled up with excrement to the level of the lids. The female searches for the dry pellets of excrement which are plentiful beneath the Embiid webs. She chews it up and probably salivates it, and plasters the material around the eggs as they are laid with her jaws and palpi. now and again intermingling a little silk with a rapid scratching action of the front tarsi. The eggs are not all

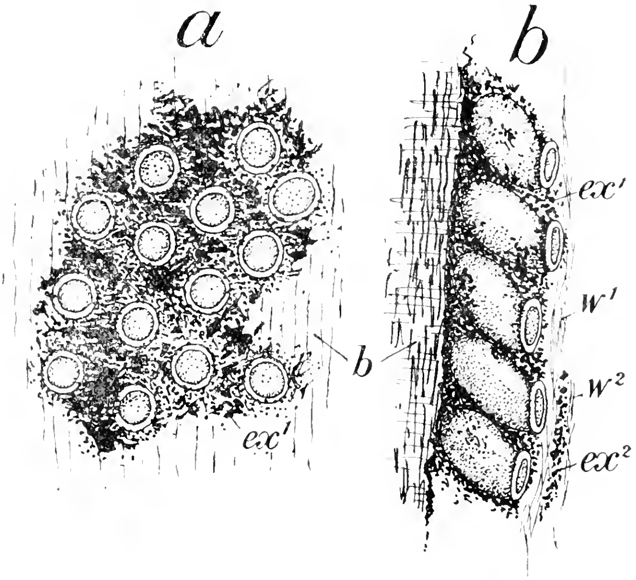


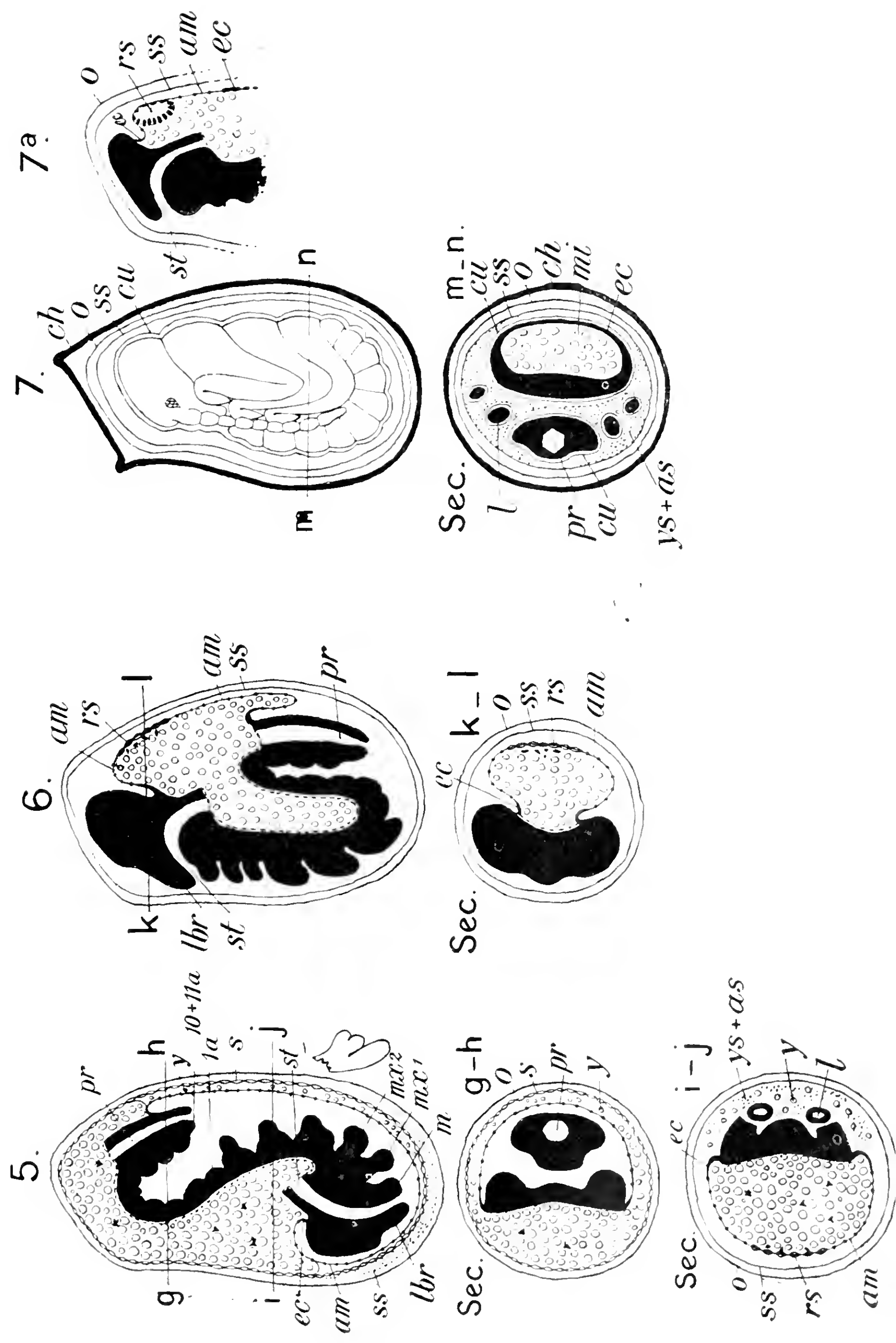

FIG. 4.

Eggs.—A. View looking on top of part of egg-batch, the blanket of webs and excrement removed

B. Longitudinal section (eggs not in section) through part of egg-batch. *b*, bark; $ex^1$, excrement between the eggs; $ex^2$, blanket of excrement over the eggs; $w^1$, first silk web; $w^2$, second silk web (only a small piece of second web and blanket shown).

laid the same day, though the excrement, etc., is added as they are laid. When all are laid, a thin web is spun over the top of the batch, a layer of excrement spread over this, and another web spun over the blanket of excrement. The whole affair is included under some part of the owner's large general web and tunnels. The female watches over her egg-batch like an earwig, but, of course, cannot shift the eggs about as the latter insect often does. The number of eggs in a batch varies greatly—from forty to eighty—and any number between these figures is common; below and above these numbers is less frequent. One female in confinement laid three or four eggs on June 16, but the batch was not completed till the 25th, when it consisted of forty-five eggs. Thus, on an average five eggs per diem were laid. The first nymphs hatched out on July 25, the last on August 8, or, roughly speaking, the nymphs hatch out in about 40 days. The number of antennal joints in the just-hatched female nymph is nine: the number of adult joints appears to be twenty-two. I have not run the nymphs through from hatching to adult, but they must take a long time maturing, since a batch which hatched on April 26 are still (September 10) not yet adult. I have not noted the moults, but believe they devour the shed skins, as they certainly eat away some of the eggs soon after hatching.

There is no revolution of the embryo, the head throughout development remaining on the ventral side of the egg, although the embryo changes its position. The primitive band at first forms about the middle of the ventral side of the egg (Plate III, fig. 1), but later the head moves towards the posterior pole, and the band grows around the pole and up the dorsal side of the egg. It soon reaches nearly to the anterior pole, and the posterior end of the band recurves (Plate III, fig. 4), whilst the head is in its lowest position at the posterior pole of the egg. At this time the appendages have already budded out, the antennæ and labrum being first distinct, afterwards the mandibles and maxillæ, and finally the legs. The labrum is at first very markedly lobed (Plate III, fig. 4). The amnion and serosa around the head region of the embryo are in close contact, but early in the recurved stage the posterior part of the embryo sinks somewhat back into the yolk, so that — except around the head region — there is yolk between the amnion and serosa. At a later recurved stage the serosa secretes a complete outer membrane (Plate IV, fig. 5, section *i–j*) which separates from the serosa. The amnion tears or disintegrates down the median ventral line of the embryo and commences growing afresh laterally and dorsally, fusing to the dorsal remnant of the serosa (the ventral part of which disintegrates as well as the ventral part of the amnion, the remains—together with some yolk which was enclosed between the amnion and serosa—forming the secretion in which the appendages of the embryo are embedded up to the time of hatching). The dorsal remnant of the serosa thus serves to surround the yolk whilst the amnion grows around and encloses it, which it quickly does, and the amnion itself is soon followed up by the ectoderm, which quickly encloses the whole yolk: the remains of the serosa and amnion gather dorsally near the head (Plate IV, fig. 7*a*), and are absorbed into the gut with the remnant of yolk as the ectoderm closes over and completes the back of the embryo. But the total absorption of the amnion and closure of the ectoderm over the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whole dorsal region does not take place until just after the embryo has assumed its final position in the egg, as it appears just previous to hatching. This final movement of the embryo must take place within a very short time, since out of many sections made of batches of eggs consisting wholly of late recurved and final position embryos, only two or three were in the intermediate position. Probably the movement is effected within an hour or two. After this semi-revolution the insect remains some 16 days in the egg whilst the musculature, etc., develops, and then hatches out in the early morning.*

The nymphs appear to remain with the female under the same web for weeks.

As all the eggs are not laid the same day, but with an interval of about ten days from first to last, it is difficult to fix exactly the length of the various embryonic stages, but the following dates compiled from a number of egg-batches are approximately correct :—

| | |
|---|---|
| Egg laid ... ... ... ... ... ... | day |
| Primitive band discernible... ... ... | 6th ,, |
| Tail just recurved ... ... ... ... | 12th ,, |
| Ready to revolve ... ... ... ... | 24th ,, |
| In position as at hatching ... ... ... | 24th ,, |
| Hatches ... ... ... ... ... | 40th ,, |

There is, properly speaking, no real revolution of the embryo, since the head from start to finish is always on the ventral side of the egg, though right at its posterior pole. But, as may be seen from the figures, there is a considerable movement of the embryo.

In, conclusion, from what we have observed of the habits, anatomy and embryology of this Embiid, we have no doubt whatever that it is really an Orthopterous insect (probably near the Earwigs) and should not be included in the Neuroptera.

* The nymph, just at hatching, is thus enveloped in three membranes :—the oolemma; the membrane secreted by the serosa; a cuticle moulted by the nymph. These three membranes are left within the egg-shell on hatching-out.

## IV.—*Notes on Shell-structure in the Genus Lingula, Recent and Fossil.*

By Frederick Chapman, A.L.S. F.R.M.S.
(Palæontologist to the National Museum, Melbourne.)

(*Read November 19th*, 1913.)

Plate V.

In a recently published paper on fossil (Silurian) species of *Lingula*, one of which showed well-preserved shell-structure,* I commented on the apparent discrepancies between Carpenter's and Gratiolet's descriptions of shell-structure in this genus of Brachiopods, and promised some further remarks on the question. By the courtesy of Mr. C. J. Gabriel, who enabled me to examine microscopically the shells of some recent *Lingulæ* in his collection, I have studied the minute structure of these shells by means of flakes and vertical sections, and submit the results herewith as being of some scientific interest. Two recent species of *Lingula* were examined, namely, *L. albida* Hinds and *L. anatina* Lamarck.

*Carpenter's Description of Lingula Shell-structure.*—This author states † that "The structure of the shells of *Lingula* and *Orbicula*‡ is equally peculiar, but very different from that which has been now described. These shells are almost entirely composed of laminæ of horny matter, which are perforated by minute tubuli, closely resembling those of ivory in size and arrangement, and passing obliquely through the laminæ. Near the margin of the shell, these tubuli may be seen lying nearly parallel to the surface."

In this description Dr. Carpenter did not say which species of

* Proc. Roy. Soc. Victoria, n.s., xxiv. (1911) pt. 1, pp. 181–3, pl. xlv, figs. 3–5.

† On the Microscopic Structure of Shells. Rep. British Assoc. 1844 (1845) p. 18. See pl. ix, fig. 22, of that paper.

‡ *Orbicula* Sowerby, 1830 = *Discina* Lamarck, 1819.

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EXPLANATION OF PLATE V.

Fig. 1.—Vertical section of shell of *Lingula* (*Glottidia*) *albida* Hinds. Showing predominant corneous structure. × 150.

„ 2.—Vertical section of shell of *L. anatina* Lamarck. Showing predominance of calcitic layers. × 150.

„ 3.—Vertical section of fossil *Lingula* (*L. lewisii* Sowerby var. *flemingtonensis* Chapman) of Silurian age. Showing dark calcitic layers and fibrous corneous layers. × 190.

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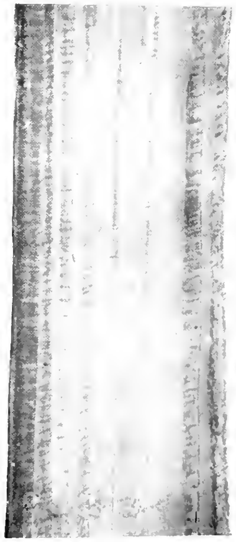

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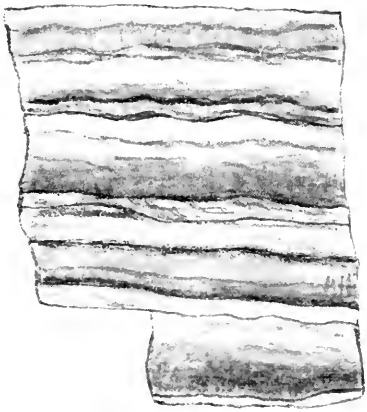

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SHELL STRUCTURE IN RECENT AND FOSSIL LINGULAE.

*Lingula* was examined, but, judging from the present study, it was probably a species closely related in structure to *L. albida.** He did not differentiate the horny from the calcareous layers, although the two structures are presumably apparent in all species of the genus.

*Gratiolet's Description of Lingula Shell-structure.*—In his exhaustive and classical paper on *Lingula anatina*,† Gratiolet states ‡ that the shell is composed of alternate layers of corneous or horny, and shelly or calcareous laminæ, the thickness of each varying in the different parts of the shell. He notes that the horny layers prevail towards the external surface, and the shelly layers towards the internal surface. The structure of the horny layers is simple, transparent, and varying from yellow to green in the species examined. Gratiolet further states that he found no traces of the canaliculi in the horny layer, even after the action of caustic potash, and that it is composed entirely of parallel fibres. The shelly layer is described as recalling the shell of the Terebratulidæ, being traversed by a multitude of microscopic canals, and covered besides with striæ of extreme fineness. The mean diameter of the canaliculi in the shelly layer in *L. anatina* as given by Gratiolet is 0·0008 mm. Gratiolet takes exception to Carpenter's statement that the corneous layers in *Lingula* and *Discina* ("*Orbicula*") predominate over the shelly layers.

*Correlative Evidence in regard to the Observations of the above Authors.*—A vertical section of the shell of *Lingula albida* Hinds, from Long Beach, California, taken from the central region of the valve, shows the corneous layers to greatly predominate over the shelly or testaceous layers in thickness; and this is in accordance with the evidence of Dr. Carpenter, who, it is assumed, must have examined a closely-allied, if not the identical species, when he made the above-quoted observation. In the section before me, the horny layers are from four to eight times the thickness of the shelly layers. The horny layer is, as Carpenter stated, perforated with very fine canaliculi, obliquely set to the laminæ, and closely resembling those of ivory. These canaliculi are much finer than those seen in the same section traversing the shelly layer, which are comparable to the coarser tubules found in the Terebratulidæ. In this section of *L. albida* the tubules of the shelly layer measure 0·00132 mm. in maximum diameter, and the

* This species is now placed by Dr. Dall in a new genus, *Glottidia*, in which the pedicle valve bears two diverging parietal ridges, and the brachial valve a median ridge of about the same length. It appears to represent the genus *Lingula* in American seas. (See Hall and Clarke, Pal. New York, viii. (1892), Pal. Brach. pt. 1. p. 14.

† Études anatomiques sur la *Lingule anatina* (*L. anatina* Lam.) Journ. de Conch, sér. 2, iv. (1860) pp. 49–172, pls. vi.–ix.

‡ Études anatomiques sur la *Lingule anatina* (*L. anatina* Lam.) Journ. de Conch, sér. 2, iv. (1860) pp. 59–60.

average measurement is much the same as in *L. anatina*, for which Gratiolet gives 0·0008 mm.

On the other hand, a marked difference of detailed structure is seen in *L. anatina*: firstly, in the general predominance, as Gratiolet points out, of the shelly layer; and, secondly, in the non-structureless appearance of the horny layers, which are in this section composed of parallel fibres of a transparent character.

*The Nature of the Shell structure in a Fossil (Silurian) example of Lingula.*—Considering the immense age of this fossil,* it is surprising to find the shell retaining so much of its original structure, not only physical but chemical. In regard to the latter point, the shell, when tested, gave a decided reaction for phosphoric acid.† The structural details of this fossil shell shows the calcitic and horny layers to be in about equal proportional thickness. It is therefore about as corneous as in *L. anatina*, and decidedly more shelly than in *L. albida*. The layers are slightly flexuose, and tend to separate between the horny layers. Occasionally the vertical tubes passing through the calcitic layers have been preserved, and they are seen to be rather larger than those of either recent species quoted, measuring 0·0026 mm. in diameter. This entirely bears out the statement by Hall and Clark,‡ who remark on the comparatively large pores in the shell of a *Lingula* from the Waverly Sandstone (Lower Carboniferous) of Ohio, and suggest therefrom, "That these vertical canals have sometimes attained a greater development in the extinct than in the living species." In the present examples of *L. lewisii* var. *flemingtonensis*, the shells are of a purplish-brown colour, and still show a dull horny texture like that of polished cow-horn, and under a tolerably high power is seen to be finely-punctate. This Australian Silurian example of the genus appears to be the oldest known *Lingula*, which still retains much of its original structure. Flakes taken from the horny layers show a vermiculated tubulated structure nearly identical with Carpenter's figure, but of a more irregular character. As in Carpenter's example, these canaliculi are set obliquely to the laminæ and tend to branch.

## Summary.

1. The shell-structure of the living *Lingulæ*, as shown by the two species examined, are very diverse in their detailed characters, the horny layers being predominant in one, the calcareous in the other.

2. In *Lingula* (*Glottidia*) *albida* the horny laminæ are canali-

* *Lingula lewisii* J. de Sowerby, var. *flemingtonensis* Chapman, from the Silurian (Melbournian stage) of Flemington, near Melbourne.

† Chapman, loc. cit., p. 183.

‡ Pal. New York, viii. (1892) Pal. Brach., pt. 1, p. 17.

culate, whilst in *L. anatina* they are fibrillate and otherwise structureless.

3. In the recent species of *Lingula*, as far as seen, the tubules are finer in the living than in the Palæozoic species, as previously pointed out by Hall and Clarke.

4. It is obvious from the foregoing observations on *L. albida*, that Dr. Carpenter had examined either that or an allied species, when remarking on the predominant horny structure in the genus, and on the canaliculate character of the horny layers.

# SUMMARY OF CURRENT RESEARCHES

RELATING TO

# ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

# MICROSCOPY, ETC.*

## ZOOLOGY.

### VERTEBRATA.

#### a. Embryology.†

**Electrical Conductivity of Ova.‡**—J. Gray has tested the electrical conductivity of fertilized and unfertilized ova of starfish and sea-urchin. He finds that the entrance of the sperm into the egg causes an increase in the electrical conductivity of the egg. This condition usually attains its maximum within ten minutes of adding sperm to ripe eggs. The increase in conductivity is followed by a process which returns the conductivity of the fertilized egg to or towards that of the unfertilized egg.

The changes may be purely physical or purely chemical, or both. The egg in the unfertilized state is remarkably impermeable to electrolytes, and can almost certainly be regarded as being enclosed within a semi-permeable membrane. In its unstimulated condition this surface must necessarily be polarized. If now this polarization be destroyed, the membrane must become more permeable to ions than before. On this view the entrance of the sperm effects the depolarization of the plasma-membrane. After about fifteen minutes this membrane must become polarized again, but the mechanism whereby this is effected is not at present clear. On the other hand, if the sperm carries an enzyme into the egg, which acts on some constituent of the egg-cytoplasm, then a rise in conductivity may occur as the result of the liberations of ions from un-ionized substances, while a reversal of this reaction will have an opposite effect.

**Effect of Radium-rayed Sperms on Trout Ova.§**—K. Oppermann gets results similar to those obtained in regard to frog's ova by O. and G. Hertwig. The spermatozoa exposed to radiations produce abnor-

* 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.

‡ Journ. Marine Biol. Assoc., x. (1913) pp. 50–59.

§ Arch. Mikr. Anat., lxxxiii. (1913) 2te Abt., pp. 141–89 (3 pls. and 10 figs.).

malities in development, such as spina bifida in various degrees. Deteriorative effects are also predominantly seen in the spinal cord, the eyes, and the muscle-plates. These vary greatly in amount. There may be slight displacements in the brain, or there may be general disruption of the tissues.

**Oogenesis of Zoogonus mirus.*** —F. Wassermann gives a detailed account of the oogenesis in this Trematode. He especially discusses the origin of the reduced chromatin elements, the early displacements of the chromatin, and the maturation divisions. His results neither prove nor disprove the theory of the continuity of the chromosomes. Nor is he able to convince himself of the applicability of the "hetero-homœotypic reduction-scheme" to the maturation divisions in this type. It does not seem probable that the first maturation division is a reduction division, and the second is certainly an equation division.

**Development of Ear Ossicles in Fœtal Perameles.**†—R. W. Palmer finds evidence that the manubrium of the malleus is a secondary and later developed process of the malleus, that the tympanic is a triradiate bone, that the quadrate and incus are homologous, and that the Mammalian tympanic bone is the modified angular of the Reptiles.

**Early Development of Scale and Feather.**‡—Joseph Schleidt finds that the scales on the chick's feet have primordia like those of Reptilian scales. On the trunk of the grass snake and of the chick, and on the feet of the chick, there are very similar structures, small bilaterally symmetrical papillæ, passing without definite limits into one another, and forming what Ficalbi described as an "ondulazione in toto." They consist of a proliferation of epidermis and dermis. When feathers are going to develop there is on the second day a proliferation of epidermis at the apex and steep side of the papillæ, and the feather primordia become circumscript as if the "ondulazione in toto" was smoothed out.

The foot of the chick and the fore limb of the blackbird show embryonic down-feathers on scales. At a very early stage the down-primodia are seen as special differentiations on the scale primordia. The author inclines to the conclusion that there is not an homology between scales, embryonic down-feathers, and definitive feathers.

**Development of Pharyngeal Bursa in Ferret.**§—Marion Radford concludes from her observations that the anterior end of the notochord, i.e., Sessel's pocket, loses connexion in the ferret embryo with the main chorda, which at this stage ends blindly close to the pharyngeal wall; and that this anterior portion develops characteristics which would point to its identity with the pharyngeal bursa as described in human and pig embryos.

* Arch. Mikr. Anat., lxxxiii. (1913) 2te Abt., pp. 1–140 (4 pls. and 43 figs.).
† Anat. Anzeig., xliii. (1913) pp. 510–15 (4 figs.).
‡ Arch. Mikr. Anat., lxxxiii. (1913) 1te Abt., pp. 118–29 (1 pl.).
§ Anat. Anzeig., xliv. (1913) pp. 371–7 (6 figs.).

**Artificial Insemination in Birds.***—E. Ivanow has effected artificial insemination of hens and pheasants, and reports that a small percentage of the hens laid fertile eggs which developed.

### *b.* Histology.

**Fine Structure of Cuticle.**†—Paul Schulze has made a study of the various types of structure in the cuticle of beetles, and distinguishes the limiting lamella, the upper or main plate, the pillars and the lower plate, which may bear spinules. Between the limiting lamella and the main plate there may be (1) an alveolar seam of rods at right angles to the surface; and (2) a lac-layer. The last named layer has typically an hexagonal areolation, corresponding to the shape of the formative cells. When chitinization occurs a more or less distinct fibrillar structure is often to be seen. The surface relief of the elytra of Cicindelids—consisting of papillæ, hexagons, etc.—dissolves away in caustic potash, and cannot therefore consist of chitin.

**Histology of Cold Spots in Human Skin.**‡—Gösta Häggqvist finds beneath a cold spot (fifteen cases) a thick bundle of smooth muscle-fibres, occurring at about the level of the rete cutaneum of the skin-vessels. The muscle is not connected with a hair-follicle or with the corpus papillare; it lies always at the same level. It is very unlikely that it is an arrector pili, as is shown in detail. It seems to be a muscle not previously recognized. The author did not find the muscle in pieces of skin without cold spots. It perhaps contracts reflexly when a cold object is placed on the skin, and constricts the local blood flow.

**Peculiar Cells in Lingual Epithelium of Guinea-pig.**§—Christian Ditlevsen describes the occurrence of peculiar elongated spindle-shaped cells with long nuclei, sometimes arranged in narrow bands or in bows. They end in extremely fine prolongations to both sides, and these may branch. They have a strong affinity for basic stains. They are probably peculiar epithelial cells, and there are some intermediate forms which link them to the typical epithelial cells.

**Mitochondria and Mitochondrial Strands in Epidermis Cells of Tadpoles.**‖—Sakae Saguchi finds that the chondriosomes of the epidermic cells, before the appearance of the so-called Eberth's intracellular structure, are usually threads, the chondriokonts of Meves, which, though intricately twisted, are on the whole vertically disposed. There are not often granules or rows of granules or chrondriomites. What look like granules turn out to be twisted chondriokonts.

Up to a certain stage in the larval development, the chondriokonts or mitochondria persist, representing Flemming filar mass. At a certain point the zig-zag chondriokonts dispose themselves vertically and horizontally. They become coalescent, and primary mitochondrial

* C.R. Soc. Biol Paris, lxxv. (1913) pp. 371–4.
† Ver. Deutsch. Zool. Gesell., 1913, pp. 165–95 (37 figs.).
‡ Anat. Anzeig., xlv. (1913) pp. 46–63 (12 figs).
§ Anat. Anzeig., xliii. (1913) pp. 481–500 (5 figs.).
‖ Arch. Mikr. Anat., lxxxiii. (1913) pp. 177–246 (5 pls. and 5 figs.).

strands unite into secondary strands. They are disposed passively in cell-division. It seems probable that the homogeneous basal layer of the pyramidal cells is due to the horizontally disposed mitochondrial strands, and becomes the connective-tissue of the cutis. It is probable that some of the vertical strands become tonofibrils in the adult, which are in direct connexion with the cutis.

**Chromatophores of Mullus.***—E. Ballowitz has studied the changes in these pigment-cells, and finds reason to believe that the cytoplasm is traversed by very numerous, very delicate, radial canaliculi with thin contractile plasmic walls. The streaming of the pigment-granules is due to the contraction of the protoplasm forming the walls. The pigment may be concentrated in the central disk or spread out to the very periphery. When the granules do not reach the periphery they exhibit a remarkable "dance."

**Chromatophores of Gobies.**†—E. Ballowitz continues his study of the chromatophores of *Gobius minutus* and *G. pictus*, and gives a finely illustrated account of combinations of pigment-cells that occur. There are melanophores (of two types), xanthophores, erythrophores (derived from xanthophores), and iridocytes. Their cytoplasm is "canalized," and the pigment-granules and guanin-crystals move about according to the contraction or relaxation of the plasmic walls of the canaliculi. The chromatophores are generally united in organ-like complexes—black-red and stellate combinations, which are minutely described.

**"Mast"-cells of the Blood.**‡—Alexander Maximow distinguishes two kinds of "mast"-cells, those of the tissues and those of the blood. They agree in showing characteristic metachromatic basophilous granules in the cytoplasm, but they are quite distinct. Those of the blood show a certain specificity in different types. They represent a specialized kind of granulocyte, and are never to be regarded as degenerate elements. They arise from "mast"-myelocytes in the marrow, and they do not multiply in the blood.

**Pecten of Bird's Eye.**§—Ebba von Husen has made a careful study of the structure and development and function of the pecten. The tissue is a reticular syncytium of neuroglia. There is a superficial epithelium with the bases of the cells turned to the outer surface, and a network of anastomosing cells with fluid in the intercellular spaces. There are blood-vessels with an endothelium and a homogeneous envelope. The pigment is inside the glia-cells and their processes. The fibres in the pecten are glia-fibres, not nerve-fibres. They are best developed at the bridge, and end on the surface of the pecten and on the vessels in knob-like thickenings, which are not sensory. The cells of the bridge have papilla-like elevations on their outer surface, from which fibrils of the vitreous humour take their origin. This explains

* Arch. Mikr. Anat., lxxxiii. (1913) 1te Abt., pp. 290–304 (2 pls.).
† Zeitschr. wiss. Zool., cvi. (1913) pp. 527–93 (5 pls. and 25 figs.).
‡ Arch. Mikr. Anat., lxxxiii. (1913) 1te Abt., pp. 247–89 (2 pls.).
§ Zool. Jahrb., xxxvi. (1913) pp. 214–70 (4 pls.).

the adherence of the vitreous humour to the pecten. The pecten is thus concerned in the production of the vitreous humour in the adult eye.

In development the pecten starts, as Bernd has shown, from a mesodermic keel and an ectodermic primodium, which are intimately associated. Both form fibrils, which go to the making of the embryonic vitreous humour. The neuroglia of the pecten arises from proliferations of both layers of the secondary optic vesicle. The vascular supply of the pecten is very carefully described. The author's results go to show that the pecten helps to form the vitreous humour and is also nutritive. It probably assists in regulating pressure, and may have other functions.

**Eye of Toad.*** — D. Tretjakoff gives an account of the minute structure of the front part of the eye of *Bufo cinereus*, with especial reference to the margin of the pupil and the associated structures. He connects some of the peculiarities with the toad's nocturnal habits, and takes a comparative survey. The development of the eye in general is briefly discussed.

**Nerve-endings in Crocodile.†**—R. Hulanicka has studied the minute structure of nerve-endings in *Crocodilus niloticus* and *Alligator lucius*, and in so doing breaks almost new ground. She describes the free nerve-endings on the palate: the tactile cells of the tongue, jaws, and ventral surface; the tactile papillæ of the scales; the mucosa of the tongue and the palate; the tactile corpuscles; and the taste-buds, which contain special cells not previously detected.

**Nervous System of Amphioxus.‡** — H. L. Kutchin describes the structure and distribution of the peripheral nerves of the rostrum, the buccal region, the velum, the branchial region, and the area posterior to the atriopore. Attention is also directed to the so-called "spinal ganglia" of Dogiel, which are interpreted as artefacts, to the structure of the dorsal nerves, to their sensory endings, and to the ventral nerves. Very satisfactory figures are given.

**Degeneration of Nerve-cells in Embryonic Nerve-cord.§** — A. Weber calls attention to the occurrence of cellular degeneration in the course of development. Some cells disappear, and others more useful or more favoured take their place. He refers particularly to germinative cells which equip the internal wall of the medullary canal of the embryo skate. After having produced a number of neuroblasts, the elements in question mostly die and disappear. The degeneration goes on without seeming to impair the karyokinetic activity, and it is in trying to multiply still further that they die. What persists longest in the moribund element is the attraction sphere with its radiations. The import of this is discussed.

* Zeitschr. wiss. Zool., cv. (1913) pp. 537–73 (1 pl. and 6 figs.).
† Arch. Zool. Exper., liii. (1913) pp. 1–14 (3 pls.).
‡ Proc. Amer. Acad., xlix. (1913) pp. 571–624 (8 pls.).
§ Anat. Anzeig., xliv. (1913) pp. 356–64 (1 pl.).

**Membranes of Notochord in Cyclostomes and Fishes.*** — O. Schneider finds that the elastica interna is almost always present. It is usually a fenestrated membrane with predominantly longitudinal meshes, within which there is a reticulum of thinner and irregular fibres. In Cyclostomes it is not coherent or separable, but a membrane is hinted at in the occasional union of individual fibrils.

The elastica interna reaches its highest differentiation in the intervertebral region of Selachians. In sturgeons it extends all along the vertebral column. In Teleosts it is usually confined to the intervertebral regions.

In the fibrous sheath, in the vicinity both of the elastica interna and of the elastica externa, there are often elements of an elastic nature. These are short fibrils or spindle-shaped strands in Cyclostomes and Selachians and some Teleosts, but in most Teleosts and in Ganoids a network may be formed. There are cellular elements in the fibrous sheath of sturgeons. It is probable that both elastica interna and elastica externa arise directly from the notochord epithelium.

**Stroma of Suprarenal Cortex.**†—P. Snessarew describes in the cortical region of the suprarenal bodies a very fine fibrillar connective-tissue reticulum, which appears to have at once a supporting and an isolating function.

**Double Innervation of Striped Muscle.**‡—J. Boeke finds that striped muscle is innervated by two independent hypolemmal nerve-endings—motor and sympathetic, the latter probably being a tonus-innervation. The sensory nerve-endings are always epilemmal; the other two are hypolemmal.

**Mitochondria in Adult Nerve-cells.**§—J. J. Schirokogoroff refers to the fact that most investigators of nerve-cells doubt the presence of mitochondria in the cells of the central nervous system of adult warm-blooded animals. By using special methods he has convinced himself of the presence of mitochondria in all the ganglion cells of the rabbit's central nervous system. He has also seen mitochondria in the nerve-cells of the retina.

**Glans-penis of Felidæ.**‖—E. Retterer and H. Neuville have studied the minute structure of the glans-penis in lion, tiger, panther, leopard, serval, etc. In spite of its conical shape, the glans of Felidæ is homologous with that of man, dog, and horse. It consists essentially of a prolongation of the corpora cavernosa which are at first erectile and adipose, but become eventually bony. In all the feline race, the "balanic" mucosa bears projecting papillæ which have at the base of the glans a corneous covering and represent organs of sexual excitation.

* Zool. Jahrb., xxxvi. (1913) pp. 171–214 (7 pls.).
† Arch. Mikr. Anat., lxxxii. (1913) 1te Abt., pp. 408–13 (3 figs.).
‡ Anat. Anzeig., xliv. (1913) pp. 343–6 (10 figs.).
§ Anat. Anzeig., xliii. (1913) pp. 522–4 (1 pl.).
‖ C.R. Soc. Biol. Paris, lxxv. (1913) pp. 314–17.

**Glans Penis in Rodents.***—E. Retterer and H. Neuville find that there is considerable diversity in the detailed structure of the glans penis in rodents. They describe that of squirrel, marmot, hamster, and jerboa. The os penis in the latter is very remarkable. Its anterior end is flattened, posteriorly it becomes triangular, and the edges of the triangle are elongated into branches. The surface of the glans in the jerboa is covered with papillæ which bear secondary papillæ and towards the apex there are two horny "odontoid" points. The os penis of the hamster is trifurcate. The terminations of the penial nerves end on the odontoids and this doubtless secures multiplication of sensations.

**Penis of Bats.**†—E. Retterer and H. Neuville have studied the structure of the penis in *Vesperugo pipistrellus*, *Rhinolophus ferrum equinum*, and *Pteropus medius*. They find that the glans is covered by a stratified pavement epithelium, without a stratum corneum; it is surrounded by a prepuce externally covered with hairs. The penis is characterized by the strong development of erectile tissue both in the corpus cavernosum and in the glans. In the horseshoe bat and in the fox bat the os penis is confined to the glans; in the pipistrelle it extends far back behind the base of the glans.

### *c.* General.

**Effect of Röntgen Rays on Organs of Chicken.**‡—Hans Unzeitig finds that chickens can stand about two hours' exposure to a given intensity of Röntgen rays. For a few days following there is a marked reduction of body weight. Feathers often fall off. The bursa fabricii becomes smaller and lighter, and in one case almost disappeared. The lymphocytes of the cortical substance are destroyed in large numbers; the number of follicles is reduced; after the fifth day or so regenerative processes often set in. The testes are very susceptible; there is marked loss of weight and great destruction of sperm-cells. The interstitial cells do not seem to be affected. The spleen loses greatly in weight and there is a marked reduction of lymphocytes.

**"Lymphatic System" in Fishes.**§—B. Možejko finds that fishes have no lymphatic system in the strict sense. Certain veins take on lymphatic function and become more or less sinusoid. A true lymphatic system occurs first in Amphibians. The so-called "lymphatic system" in fishes represents a stage in evolution, and may be called "veno-lymphatic."

**Remarkable Cyprinodont.**‖—C. Tate Regan describes *Phallostethus dunckeri* g. et sp. n., a remarkable new Cyprinodont from Johore. The largest male was 25 mm. in length, the largest female 29 mm. The male has a relatively large muscular appendage (the "priapium") attached between the expanded hypocoracoids and free distally, bearing the anus

* C.R. Soc. Biol. Paris, lxxv. (1913) pp. 345–7.
† C.R. Soc. Biol. Paris, lxxv. (1913) pp. 381–3.
‡ Arch. Mikr. Anat., lxxxii. (1913) 1te Abt., pp. 380–407 (1 pl. and 2 figs.).
§ Anat. Anzeig., xlv. (1913) pp. 102–4.
‖ Ann. Nat. Hist., xii. (1913) pp. 548–55 (2 figs.).

on one side at about the middle of its length and the genital opening at its posterior end, just behind the articulation of an external movable forwardly directed serrated bone (the "ctenactinium"). Anteriorly the appendage ends in a long slender bone extending forwards to beneath the chin, curved towards the side on which the serrated bone lies and away from that on which the anus opens. For this bone the name "toxactinium" is proposed. The priapium is an intromittent organ: it is unlike any other copulatory organ among Fishes. The vas deferens is coiled in a remarkable way to form a sort of epididymis. Another remarkable feature is the wide separation of the openings of the urinary and genital ducts.

**Statocysts of Marine Invertebrates.***—W. v. Buddenbrock has continued his study of these structures, with especial reference to *Arenicola*, *Myxicola infundibulum*, *Branchiomma vesiculosum*, and *Solen vagina*. He finds that *Branchiomma* can bore tail foremost vertically into the mud, and the same is probably true of *Myxicola*. The statocysts effect an increase of the tonus of the longitudinal muscles on the side that is undermost, and cause their contraction. There is also a musculo-sensory regulation which always tends to bring the tail parallel to the head. The two factors co-operate to bring about the vertical positively geotropic boring. If both statocysts are removed from *Branchiomma*, it loses the power of boring vertically from any initial position. The removal of one statocyst has no effect. The statocysts have nothing to do with the perception of oscillations in the water.

## INVERTEBRATA.

### Mollusca.

#### *a.* Cephalopoda.

**Minute Structure of Argonaut's Food-canal.**†—W. Gariaeff has studied the gullet and the cæcum of the female Argonaut. The former shows a thick-layered cuticula perforated by fine canals, then the epithelium with distal basal corpuscles, and then a fibrillar basal membrane in continuity with the connective-tissue, in which there are obliquely striped muscle-fibres. The lumen of the cæcum is divided by a large number of septa covered with high cylindrical ciliated epithelium. There are also mucin cells and strongly developed glandular cells.

**Minute Structure of Cuttlefishes.**‡—F. R. Tippmar has made a study of various parts of numerous Cephalopods. He deals with the disposition of the muscle-fibres in the mantle, the structure of the skin and subcutaneous connective-tissue, the integumentary structures (including the luminous organs of *Mastigoteuthis*), the innervation of the mantle, and the body musculature in general. He has also notes on the post-embryonic development of *Calliteuthis reversa*.

* Zool. Jahrb., xxxiii. (1913) pp. 441–82 (13 figs.).
† Anat. Anzeig., xiv. (1913) pp. 38–45 (2 pls.).
‡ Zeitschr. wiss. Zool., cvii. (1913) pp. 509–73 (2 pls. and 39 figs.).

### δ. Lamellibranchiata.

**Structure of Pearls.***—Fr. Alverdes has studied this in *Margaritana*, *Unio*, *Mytilus*, and *Ostrea*. He distinguishes between nucleated and non-nucleated pearls. A nucleus is a central body which is not composed of one of the shell-substances. The centre is often a periostracum centre. The pearl-sac is always ectodermic, but its origin remains obscure. The nucleus of a pearl may be a parasite, an ovum, or a fragment of tissue, and some have reported a nucleus made from a quartz fragment or the like. In such cases the ectoderm cells are displaced, and a sort of cyst is formed in which a pearl develops. By introducing ectoderm cells into the mantle parenchyma the author was able to bring about the origin of pearl-sac-like cysts, in which concentric layers of nacre were laid down.

**Epithelium of Anodonta cellensis.**†—W. Siebert gives a detailed account of the minute structure of the epithelium on various parts of the mantle, on the foot, and on the labial palps. The various forms of ciliated, mucus, and sensory cells are dealt with, and the system of currents is mapped out. In an appendix the author discusses the occurrence of lime in the connective-tissue and the wandering cells.

## Arthropoda.

### α. Insecta.

**Histogenesis of Wing-musculature in Diptera.**‡—S. Hänsel finds that the whole of the wing-musculature in *Pachygaster meromelas* arises from indifferent cells lying at the basis of the appendage-disks of the mesothorax. These unite in two nucleated strands crossing one another. The anterior strand forms the longitudinal and the anterior vertical muscles; the posterior forms the posterior-vertical elevators of the wings. Only unimportant parts of the larval longitudinal and dorso-ventral musculature are utilized. The larval muscle-nuclei probably pass through changes by which, in part at least, they become imaginal nuclei. They thus form a part, though an inconsiderable part, of the imaginal myoblast. The tendons are purely epidermic. The histolysis of the larval musculature occurs by autolysis without any assistance from phagocytes. It appears that the general statement may be made, that the wing-musculature in Diptera is always due to two embryonic or post-embryonic dorso-ventral primordia, with a little help from certain larval muscles.

**Horse-fly of Philippines.**§—M. Bruin Mitzmain has made a study of *Tabanus striatus* Fabricius, which he finds may aid *Stomoxys calcitrans* in the transmission of surra (*Trypanosoma evansi*). The eggs (270–425) are chiefly laid on particles of wood: the incubation period is 3–5 days; the larvæ are essentially aquatic and very cannibalistic: the larval period lasts for six weeks or more; there are three distinct moults.

* Zeitschr. wiss. Zool., cv. (1913) pp. 598–633 (2 pls.).
† Zeitschr. wiss. Zool., cvi. (1913) pp. 449–526 (39 figs.).
‡ Zool. Jahrb., xxxvi. (1913) pp. 465–512 (3 pls. and 18 figs.).
§ Philippine Journ. Sci., viii. (1913) Sect. B, pp. 197–221, 223–34 (7 pls.).

From the time the eggs are laid till the flies emerge is about 52 days. Both sexes have a lapping organ, in addition to which the females have a distinct piercing instrument. The "rain-trees" serve to harbour great numbers of resting horse-flies.

**Genitalia of Diptera.***—P. E. Keuchenius has studied Syrphidæ in particular. He calls attention to the asymmetrical position of the testes. They are almost invariably invested by a *Tunica externa* and a *T. interna* or *propria*. These investments are continued on to the vasa deferentia. The accessory glands, seminal vesicle, and the ductus ejaculatorius are minutely described. It is striking that nowhere, around the testes or vasa deferentia or accessory tubes, or beginning of the ductus ejaculatorius, are there muscle-fibres to be found. It is concluded that the contraction of the abdomen, caused by the abdominal muscles, together with the muscles of the sacculus ejaculatorius, play a part in propelling the sperm and the accompanying fluid.

**Vesicular Secretion of Malpighian Tubes.**†—P. Shiwago describes the process by which vesicular plasmic structures appear on the free surface of the cells lining the Malpighian tubes, and lose their connexion with the cells, and fall into the lumen. The detailed structure of the cells after feeding and after starving is discussed, with special reference to the changes in the mitochondria.

**Changes of Peripheral Nerves during Metamorphosis.**‡—Sorokina-Agafonowa has studied this in the meal-worm (*Tenebrio molitor*). The nerve-strand which is seen in the sac-like limb during the pupa-stage shows a definite number of collaterals which abut on the hypodermis and end in bipolar cells; a single multinuclear cell divides into a group of bipolar cells. The young myoblasts seem to link themselves on by means of amœboid prolongations to fine threads coming from the nerve-strand.

**Embryonic Malformation in Meal-worm.**§—Jar. Križenecký describes in *Tenebrio molitor* two cases of consertio segmenti, where segments are connected in an oblique or almost dove-tailed fashion. It was previously recorded by Megusar in the same animal. It is perhaps of widespread occurrence among larvæ. It arises during the period of embryonic development.

**Excretory System of Gryllidæ.**‖—L. Bordas describes the occurrence of a collecting reservoir or urinary bladder into which the Malpighian tubules open and from which a ureter proceeds to the junction of mid-gut and hind-gut. The minute structure is discussed. The internal epithelium of the tubules consists of large irregular cells, with large nuclei, and long cilia. The bladder shows a very delicate external

* Zeitschr. wiss. Zool., cv. (1913) pp. 501–36 (3 pls.).
† Anat. Anzeig., xliv. (1913) pp. 365–70.
‡ C.R. Soc. Biol. Paris, lxxv. (1913) pp. 369–71.
§ Anat. Anzeig., xlv. (1913) pp. 64–73 (8 figs.).
‖ Bull. Soc. Zool. France, xxxviii. (1913) pp. 212–17 (3 figs.).

membrane with some circular fibres, a basal membrane, and a layer of long cylindrical epithelial cells with short cilia. The ureter is sinuous with internal folds of epithelium. It is covered by a thick musculature with a thin layer of external longitudinal fibres and a thick layer of circular muscles. Within this the wall shows a basal membrane, a chitinogenous epithelium, and an internal intima of chitin with folds and minute denticulations.

**Crop of Mallophaga.***—Bruce F. Cummings finds that the crop presents three types of structure in Mallophaga. It is just an expansion of the lower part of the œsophagus in Amblycera: it is a large diverticulum in most Ischnocera: it is a long narrow-necked sac in Trichodectidæ. In Amblycera the crop-teeth are characteristic in the different genera; in Trichodectidæ they are absent; in other Ischnocera there is a characteristic patch in the anterior cæcum of the crop. Plateau suggested that proventricular teeth in general are used for straining, not for mastication. In Amblycera it seems unlikely that there can be any masticatory function, for the teeth are long, slender, and sharp, and their development is not correlated with powerful muscular folds. In the Ischnocera the short scattered teeth may be of assistance in clearing out the food which collects in the anterior cæcum.

**Oogenesis in Podurids.**†—L. de Winter has studied in *Podura* the development of the ovarian cells before the differentiation of the oocytes into ova and vitelline cells, and in the course of this differentiation. Finally the ovarian cavity is found to be occupied with full-sized ova and some masses of vitelline cells and some liquefied residue. The vitelline cells are nothing but abortive ova, which are unfavourably situated. In the first phase of the nutrition of the ova, there is an accumulation of fatty material; in the second phase albuminoid material is secured. In the second phase the ova occupy the surface of the ovary; they absorb nutritive materials from the hæmocœl; they utilize material from the ovarian cavity; they engulf vitelline cells and absorb products of the disruption of vitelline cells. The author compares the ovary of *Podura* with that of other insect types.

### β. Prototracheata.

**New Forms of Peripatus.**‡—C. T. Brues gives a preliminary account of *Peripatus manni* sp. n., which is closely related to *P. sedgwicki* Bouvier from the Caribbean coast of South America, and *P. dominicæ* Pollard subsp. *haitiensis* subsp. n. Both were collected in Haiti by W. M. Mann.

### δ. Arachnida.

**Study of Trichotarsus osmiæ.**§—A. Popovici-Baznosanu has investigated the life-history of this mite which occurs in the cells of *Osmia*, one of the solitary bees. He describes the ovum, the hexapod

* Ann. Nat. Hist., xii. (1913) pp. 266–70 (3 figs.).
† Arch. Biol. Soc., xxviii. (1913) p. 197–227 (4 pls. and 3 figs.).
‡ Bull. Mus. Zool. Harvard, liv. (1913) pp. 519–21.
§ Arch Zool. Expér., lii. (1913) Notes et Revue, No. 2, pp. 32–41 (12 figs.).

larva, the octopod nymph, the adults, the *hypopus*-stage, and the encysted nymph. The last-named stage is a nymph about to be transformed into an adult, but arrested in its development. It can remain dry but alive for years. The *hypopus*-stage arises from a transformation of a nymph; it is a stage adapted for dispersal, not for dormancy.

### ε. Crustacea.

**Eye of Ocypoda Ceratophthalma.***—J. Dembowski finds that the eye of this crab is not pseudoconic as Doflein reported, but euconic. The crystalline cells lie between the cone and the lens. The eye has a long horn, the cavity of which is filled with loose connective-tissue and groups of gland-cells. No ducts or openings were to be seen. There are also glands on the dorsal side of the eye itself—separated from the optic portion by a hypodermic membrane.

**Maxillary Glands of Squilla.**†—W. N. F. Woodland describes the minute structure of these interesting glands. To begin with, the gland is a pocket of the ectoderm. Later on, it consists of two wide sacs which communicate only by a narrow duct. There is the distal end-sac and the proximal kidney proper. Their lumina become invaded and almost obliterated by numerous invaginations. The entire exterior is invested by two layers of squamous epithelium, between which lies a division of the hæmocœl. The inner layer only is closely applied to the surface of the entire gland, and becomes involved in all the invaginations just referred to. The mass of the gland shows (*a*) hæmocœlic spaces, morphologically outside the gland, lined by squamous epithelium which originally covered the surface, and (*b*) spaces bordered by the gland-cells and representing all that is left of the originally wide lumen.

The author notes that each half of the "liver" has a single duct opening into the pyloric region, and that each duct opens independently. There are two large rectal glands. The nauplius eye persists in the adult.

**Abnormalities in Copepods.**‡—C. Dwight Marsh calls attention to the fact that abnormal or freak structures in the genera of *Cyclops* and *Daphnia* are remarkably rare. While there is great variability in the species of *Cyclops*, unusual structures seldom occur. In *Diaptomus*, which shows hardly any variability within species limits, freak organs are still more rare. The author puts on record a few abnormalities in *Cyclops* and *Diaptomus* which he has come across in the course of his systematic work on Copepods.

**Development of Cypris incongruens.**§—Kurt Müller-Calé gives an account of the early development. The centrosomes of the oocyte nucleus persist, but do not share in the directive division. They come into activity again in the first cleavage. The polar bodies are very vigorous and divide mitotically once or oftener. At the fourth cleavage

* Zool. Jahrb., xxxvi. (1913) pp. 513–24 (1 pl.).
† Quart. Journ. Micr. Sci., lix. (1913) pp. 401–30 (1 pl. and 9 figs.).
‡ Trans. Wisconsin Acad., xvii. (1911) pp. 195–6 (1 pl.).
§ Zool. Jahrb., xxxvi. (1913) pp. 113–70 (6 pls. and 25 figs.).

they usually sink into the blastoderm cavity, and degenerate when the endodermic immigration occurs.

The cleavage is total, approximately equal, and radially symmetrical. A blastosphere of 128 cells is formed. The immigration of the primary endoderm is started by a polar proliferation and localized "primary delamination." The mid-gut appears as a gradually increasing vesicle among the primary endoderm nuclei, cell-boundaries having become indistinct. The remaining nuclei form the mesoderm nuclei. The author describes the formation of the apical plate, the œsophagus, the ventral nerve-cord, and so on, and compares the mode of development in *Cypris incongruens* with that in other Entomostraca. Five types of development are distinguished, depending chiefly on the amount of yolk and on the way in which it is utilized.

**Thersitina gasterostei Pagenstecher.***—Robert Gurney has some notes on this parasitic Copepod, the females of which occur in abundance under the opercula of the stickleback, especially *Gasterosteus aculeatus*. It is probable that, as in the nearly related *Ergasilus*, the female is fertilized once and for all during the free-swimming stage. No males were found below the operculum; spermatophores have been seen attached to a free-swimming female: there is a large receptaculum seminis: it is probable that spermatozoa remain alive within the female for about five months: it is probable that a mature female lays two, or perhaps three, lots of eggs and then dies, giving place to a new generation; there may be five generations within the year, overlapping to some extent. The author describes the male for the first time. The life-history is also described.

## Annulata.

**British Fresh-water Leeches.†**—Henry Whitehead gives an account, based on Harding's Revision (1911), of eleven species of Hirudinea found in Britain, and adds notes of his own observations.

## Nematohelminthes.

**New Nematodes from Soil.‡**—N. A. Cobb gives the characters of no fewer than twenty-six proposed new genera and of a type of each, found in soils (fresh and non-brackish). Most of them are injurious to vegetation. Useful diagnostic tables are given, and attention must be called to the ingenious way in which the author has been able to condense a long paragraph of characters into a single line of formula with numbers and signs.

**Vulvar Annulus in Nematode.§**—L. G. Seurat describes in *Maupasiella weissi*, a Nematode from the cæcum of *Macroscelides*, a peculiar brown or black chitinoid annulus, about a millimetre in width, which

* Ann. Nat. Hist., xii. (1913) pp. 415–24 (4 pls.).
† Essex Naturalist, xvii. (1913) pp. 61–85 (2 pls.).
‡ Journ. Washington Acad. Sci., iii. (1913) p. 432–44 (1 fig.).
§ C.R. Soc. Biol. Paris, lxxv. (1913) pp. 326–30 (6 figs.).

surrounds the posterior end of the body in the mature female and hides the anus and the vulva, leaving only the tip of the tail free. It does not occur in the unfertilized female.

**Structure of Onchocera volvulus.***—L. Külz and F. W. Bach communicate some notes on the structure of this Nematode (= *Filaria volvulus*), which is known to cause fibrous tumours and abscesses in natives of Cameroon.

**Blood Filaria of Camel.**†—Antonio Pricolo describes *Filaria hæmatica cameli* sp. n. from the blood of the camel. He has found the adults as well as the larvæ. The larvæ are found usually, if not always, at night. The parasites were found chiefly in the vessels of the lungs and the testes, causing aneurism-like enlargements, apparently of little importance.

**Spermatogenesis and Oogenesis in Sclerostomum.**‡—K. Kühtz has studied these processes in various species of *Sclerostomum* found in the horse. He calls attention to the strong development of the rhachis in the male; it extends far into the maturation zone. In the female the rhachis is much less strong and disappears before the beginning of the maturation zone. There are eleven chromosomes in the nuclei of the spermatagonia, twelve in the nuclei of the oogonia. The spermatocytes show five tetrads and a monosome. The first or second maturation division is unequal. Six equivalent tetrads are seen in the polar body formation. There is an expulsion of an achromatin residue of the germinal vesicle.

In the ejaculatory phase the spermatozoon is elongated, but in the uterus this degenerates into a spherical form which effects fertilization. In isolated cases a segmention spindle is seen without there having been any antecedent union of pronuclei. The eggs leave the body in a morula-stage.

**Strongylus capillaris.**§—Antonio Pricolo describes under this title a new species, 5–7 mm. in length, 90–100 $\mu$ in maximum thickness, which occurs as a parasite in the small intestine of dromedaries, and appears to be associated with hæmorrhage, hyperæmia, and catarrh of the intestinal mucosa.

**Structure of Male Reproductive Organs in Acanthocephala.**‖ Willy Bieler has studied the testes, vas deferens, cement glands, and other parts of the male reproductive system in seven species of Acanthocephala from fishes, and finds that the structure of the cementing apparatus shows considerable specificity and may be used for systematic purposes. No other part of the system is of use in classification.

* Centralbl. Bakt. Parasitenk., lxx. (1913) pp. 321–6 (6 figs.).
† Centralbl. Bakt. Parasitenk., lxxi. (1913) pp. 199–200.
‡ Arch. Mikr. Anat., lxxxiii. (1913) 2te Abt., pp. 191–265 (3 pls. and 8 figs.).
§ Centralbl. Bakt. Parasitenk., lxxi. (1913) pp. 201–2.
‖ Zool. Jahrb., xxxvi. (1913) pp. 525–78 (1 pl. and 15 figs.).

**Human Parasites in Manila.***—B. C. Crowell and R. W. Hammack report on the intestinal parasites observed in 500 consecutive autopsies on people of all ages in Manila. They found *Ascaris lumbricoides* in 41·2 p.c., *Trichiuris trichiura* in 34·4 ; hookworm in 16·6, *Tænia saginata* and *Cysticercus cellulosæ* in 0·2. *Oxyuris* in 1, *Clonorchis sinensis* in 0·4. *Schistosomum japonicum* in 0·2, malaria in 5, and amœbic colitis in 5 p.c.

### Platyhelminthes.

**Peculiar New Trematode.†**—G. A. MacCallum describes *Thoracocotyle croceus* g. et sp. n., found clinging to the gills of the Spanish mackerel (*Scomberomorus maculatus*) in the New York markets. The name refers to the peculiar barrel-like or thorax-like arrangement of the chitinous ribs forming the skeleton of the suckers. The body is elongated (4·5 mm. by 0·75–0·9 mm.), with bilaterally placed ventral marginal clasping suckers extending along more than half the body-length. The testicular mass is single, dorsal, with elongated seminal vesicle and protrusible cirrus. The ovary is in a single coil ; the uterus is elongated, opening anteriorly with the cirrus through an unarmed genital pore. There seem to be only three or four relatively large elliptical ova (0·18 mm. by 0·06 mm.) with a tapering filament at each end about 0·27 mm. long.

**Loxogenes arcanum.‡**—H. L. Osborn discusses some histological peculiarities in this rare Trematode which has been found in frogs in Minnesota and elsewhere. The mature worm was found within cysts in the vicinity of the pylorus, which seems an extraordinary fact. A description is given of alimentary, excretory, and reproductive systems. A remarkable fact is that there are spines on the outer ends of the genital passages and on the cavity of the ventral sucker. The subcuticular cells are discussed at some length.

**New Trematodes in Marine Fishes.§**—G. A. MacCallum describes *Acanthocotyle bothi* sp. n. from the gills of *Bothus maculatus* ; *Distomum trachinoti* sp. n. from the intestine of *Trachinotus carolinus* ; *D. carangis* sp. n. from the rectum of *Caranx crysos*, and *Podocotyle morone* from the gills of *Morone americana*. In *Podocotyle* at about one-quarter of the length from the caudal end there are given off six pedicelled suckers, 4 mm. in length by 0·15 mm. in width. Each pedicel is surmounted by a sucker which is strengthened by a peculiar chitinous formation. At or near the caudal end there are two small suckers, and there is an ordinary oval sucker on each side of the mouth.

**Histological Studies on Turbellarians.‖**—Paul Lang has studied *Planaria polychroa* Schmidt in reference to the regenerating epithelium, the accessory eyes, and the structure of the pharynx. In the regenera-

* Philippine Journ. Sci., viii. (1913) Sect. B, pp. 157–74.
† Centralbl. Bakt. Parasitenk., lxviii. (1913) pp. 335–7 (4 figs.).
‡ Zool. Jahrb., xxxvi. (1913) pp. 271–92 (1 pl. and 2 figs.).
§ Centralbl. Bakt. Parasitenk., lxx. (1913) pp. 407–16 (11 figs.).
‖ Arch. Mikr. Anat., lxxxii. (1913) 1te Abt., pp. 339–64 (1 pl. and 2 figs.).

tion of the epithelium after a wound the adjacent cells spread over the wound till they meet in the middle. A thin epithelium with few nuclei is formed and parenchyma cells wander into it, insinuating themselves among the elongated old cells. Both sets of cells multiply amitotically and a normal epithelium is retored. But its cells cannot multiply mitotically. The structure and the regeneration of the pharynx are discussed.

Besides the main eyes there are accessory eyes (one or two) in about 50 p.c. of cases. They lie in front of the main eyes, nearer the middle line. They are smaller than the main eyes, but may show the same structure, though with small pigment-cup and fewer visual cells. Not to be confused with accessory eyes are abnormal or supernumerary eyes of inconstant form, position, and structure.

### Echinoderma.

**Development of some Echinoderms.***—Th. Mortensen describes the bipinnaria of *Asterias glacialis* (in which two dorsal pores were present in about 50 p.c. of cases); the bipinnaria of *Luidia ciliaris* (the grown female has no fewer than 200 millions of eggs); the ophiopluteus of *Ophiactis balli* (in which recurrent rods are present in the skeleton so that two large meshes are formed in each half of the body); the larva of *Ophiocoma nigra*: the echinopluteus of *Spatangus purpureus*, which is 3·5 mm. in length with long processes—all except the pre-oral with a conspicuous red point; and the larva of *Holothuria nigra*, which is a typical Auricularia with a star-shaped spicule at the posterior end.

**Ova of Echinaster sepositus.**†—F. Rosen describes the ovum of this starfish, which is unusually rich in yolk. At the beginning of the ovum's growth there is one nucleolus; it grows greatly and falls into hundreds of small nucleoli. Some of the nucleolar forms are deceptively like tetrads, but there are quite distinct chromosomes and tetrads. The chromosomes retain their continuity on to the maturation division, and are quite independent of the nucleolar apparatus.

**Development of Sea-urchins.**‡—L. v. Ubisch has studied *Strongylocentrotus lividus*, *Echinus microtuberculatus*, and *Arbacia pustulosa*, and confirms in the main the accounts of the development given by MacBride and Theel. He describes the primordia of the chief organs and the differentiation of the water-vascular system, the epineural canals, the nervous system, the skeleton, Aristotle's lantern, the gut, the cœlom, and so on. Some abnormal duplex larvæ are described.

### Cœlentera.

**Study of Eleutheria.**§—Anna Drzewina and G. Bohn have studied the polyps and medusoids of *Eleutheria dichotoma* and *E. claparedii*. They fed them on minute supra-littoral Copepods, which are stung by the ends of the arms. A detached end may go on for several days

* Journ. Marine Biol. Assoc., x. (1913) pp. 1–18 (15 figs.).
† Anat. Anzeig., xliv. (1913) pp. 381–3 (4 figs.).
‡ Zeitschr. wiss. Zool., c. (1913) pp. 409–48 (3 pls. and 20 figs.).
§ Arch. Zool. Exper., liii. (1913) pp. 15–60 (37 figs.).

capturing and paralysing Copepods. Starving brings about reduction of size. The creatures showed great indifference to high temperatures (30° C.) and scarcity of oxygen. The number of arms varies from five to twelve, and a temporary absence of oxygen causes a developing bud to become an arm attached to the parent medusoid. Wounds are quickly healed, two portions can be united readily; there is great regenerative capacity; in short, there is extraordinary plasticity.

**Germ-cells of Leptomedusæ.***—I. Apstein has studied the history of the germ-cells and the development of the gonads in *Octorchis gegenbauri* and other Leptomedusæ. In *Octorchis* the ova always differentiate in the ectoderm. The oocytes of the first order appear in association with the endoderm. The ova dispose themselves with their maximum surface on the supporting lamella, become attached to it, and are surrounded by it. The older ova lie topographically in the endoderm, but they are really in the supporting lamella. Those that get free from this come to nothing. The ova have always a membrane. Their food is fluid. They show no amœboid movement, nor any formation of a syncytium. Environmental influences have a demonstrable effect on the history of the ova. There is no true migration. The germ-cells are moved by an extension of the germinal zone, not by their own movement. In some other cases, such as *Euchilota maculata*, *Obelia*, *Phialidium*, the ova differentiate in the endoderm. Whether the germ-cells differentiate in the ectoderm or the endoderm, their definitive position is in the supporting lamella. The male germ-cells always appear in the ectoderm, but become embedded in the supporting lamella.

**Nematocysts of Polykrikos and Campanella.**†—E. Faure-Frémiet describes in the Dinoflagellate *Polykrikos* nematocyst-like structures, to which Bütschli has previously called attention. Besides trichocysts there are explosive nematocysts (ten to fifteen in number in all individuals) which pass through a trichocyst-like stage. In some specimens of the large Vorticellid *Campanella umbellaria* there are somewhat similar structures which require further study. The author found only one instance. They differ from the nematocysts of *Polykrikos* not only in being inconstant, but in their minute structure.

### Porifera.

**Hexactinellid and Radiolarian Spicules.**‡—A Schwan makes an interesting comparison between these, showing how much they have in common in architecture and disposition. They serve similar functions, giving the living substance support, cohesion, and elasticity.

### Protozoa.

**Inheritance of Size in Paramœcium.**§—H. S. Jennings and K. S. Lashley find that, as a result of conjugation, the progeny of the two in-

* Zool. Jahrb., xxxvi. (1913) pp. 579–616 (2 pls.).
† C.R. Soc. Biol. Paris, lxxv. (1913) pp. 366–8.
‡ Zool. Jahrb., xxxiii. (1913) pp. 603–16 (11 figs.).
§ Journn. Exper. Zool., xv. (1913) pp. 193–9.

dividuals that have conjugated become more alike in their average length, so that by-parental inheritance occurs in respect to body size (as well as in respect to rate of fission). The members of pairs in the culture examined showed, owing to assortative mating, a coefficient of correlation in body length of 0·3881; this was increased as a result of conjugation to such an extent that their progeny showed a coefficient of 0·5744—an increase of 48 p.c.

**Remarkable Protistan Parasite.***—H. M. Woodcock and G. Lapage describe a new type, *Solenomastix ruminantium* (Certes), which occurs in the rumen of the goat in two forms, crescents and ovals. The crescents present a homogeneous non-granular appearance, with a definite envelope, with a single large flagellum arising from the concavity of the crescent. They may move by the flagellum or by the body alone. There is no proper nucleus, the chromatin being present in the form of a peripheral layer of granules, or there may be one or two large masses projecting into the cytoplasm. Division is by equal binary fission transverse to the long axis.

The ovals resemble the crescents in general, but have no flagellum, although capable of active movement. The chromatinic substance may be in a narrow peripheral layer with or without granules. In others there is a lighter central zone and a darker peripheral zone, perhaps chromatinic. Perhaps the second type of oval gives rise to the first, and perhaps the crescent may become an oval of the first type.

The new type is not a Dinoflagellate, nor a Schizosaccharomycete, nor a Spirochæte. It may be regarded as a Proflagellate.

**Urceolaria synaptæ.**†—N. L. Cosmovici has studied this Infusorian from the intestine of Synaptids. There is a crown of cilia in the interior of the urn (the "Kranz" cirri of others). The foot of the urn is lined with active vibratile cilia (the "bâtonoïdes" elements of Schneider). The micronucleus appears in the resting-stage like a homogeneous mass, lodged in an excavation of the aboral end of the macronucleus. The cilia of the peristomial ring are usually immobile, but they move when the animal is at rest. There is conjugation and fission. The marine habitat, the presence of cilia at the foot of the urn, and the simple triangular form of the vestibule (cytopharynx) lead the author to regard *Urceolaria* as a primitive member of the Urceolarinæ.

**New Chytridiopsid.**‡—G. Tregouboff describes *Chytridioides schizophylli* g. et sp. n. from the intestine of a millipede (*Schizophyllum mediterraneum*) common at Banyuls-sur-mer. It presents a considerable resemblance to *Chytriopsis socius* of *Blaps*. But in its mode of sporulation with transient partitioning of the contents of the cyst and in its amœboid schizozoites it approaches the Chytridineæ.

* Quart. Journ. Micr. Sci., lix. (1913) pp. 431–57 (2 pls. and 2 figs.).
† Bull. Soc. Zool. France, xxxviii. (1913) p. 233.
‡ Arch. Zool. Expér., lii. (1913) Notes et Revue, No. 2, pp. 25–31 (2 figs.).

**Spirochæts of the Intestine in Birds.***—C. Lebailly finds abundant Spirochæts in the terminal portion of the intestine of fowls, partridges, crows, starlings, sanderlings, plovers, and other birds. He names and briefly describes a number of new species of *Treponema*.

**Schizotrypanum cruzi.**†—Kurt Nägler finds that mice, rats, guinea-pigs, rabbits, dogs, and cats can be infected with this Trypanosome. He was not able to transfer it to canaries, lizards, or pigs; or to find that it was carried by insects. The stages which Chagas called male and female are really vegetative phases. Divisions occur in the peripheral blood-vessels and may be observed even two hours after death.

**Schizogony of Female Gametocytes of Laverania malariæ.**‡—N. H. Swellengrebel describes stages which appear to represent a schizogony of the young half-moon stages of the female gametocytes.

**Flagellates of Larval Tipula.**§—Doris L. MacKinnon notes that at least eight flagellates and two amœbæ live as parasites or more probably symbionts in the rich bacterial flora of the intestine of the larval crane-fly. The largest and healthiest-looking grubs were generally found to have the richest intestinal fauna.

The encystment of a beautiful little monoflagellate, *Rhizomastix gracilis* Alexeieff, is described. The cysts showed no trace of fusion of nuclei, nor any indication of a sexual process. They seem to be simply multiplication cysts.

A description is given of *Tetratrichomastix parisii* subg. et sp. n., a flagellate with a slender and rather poorly developed axostyle and with five free flagella, four anteriorly and one posteriorly directed. The nucleus is oval or round (1) compact, rich in chromatin blocks, or (2) feebly siderophilous, with a few scattered chromatin granules and a well-defined nuclear membrane. There is no visible cytostome.

* C.R. Soc. Biol. Paris, lxxv. (1913) pp. 389–91.
† Centralbl. Bakt. Parasitenk., lxxi. (1913) pp. 202–6 (1 pl.).
‡ Centralbl. Bakt. Parasitenk., lxx. (1913) pp. 179–81 (1 pl.).
§ Quart. Journ. Micr. Sci., lix. (1913) pp. 459–70 (2 pls.).

# BOTANY.

## GENERAL,

### Including the Anatomy and Physiology of Seed Plants.

### Cytology,

#### including Cell-Contents.

**Chromosomes of Allium.***—D. M. Mottier and M. Nothnagel have studied the mitosis of the pollen-mother-cells of *Allium cernuum*. The results of the investigation differ in many points from those obtained with *A. Cepa*, and are as follows:—Prior to synapsis the nucleus consists of a network of linin and chromatin granules, with one or more nucleoli but without knots, and there is a tendency to form a continuous spireme. During synapsis there is no union of two spiremes, but a real contraction of the nuclear network, and the spireme is a direct transformation of the latter. The hollow spireme is a thick chromatin cord, and where splits are present these always close before cross-segmentation. A rearrangement of the spireme takes place, resulting in an entanglement of loops and parallel parts twisted upon one another, and during this process transverse division occurs. Each bivalent chromosome results from the approximation, usually side by side, of different lengths of the spireme, and may therefore be regarded as two somatic chromosomes that were previously arranged end to end. The prevalent form of bivalent chromosomes is that of a large ring. The daughter-segments split longitudinally during metaphase, preparatory to the second or homotypic mitosis. In the daughter-nuclei the chromatin segments elongate, become waved, and form an interrupted spireme by the union of the free ends. This spireme forms a crown open at both the polar and antipolar sides, and there is no fusion of the ends into knots.

**Relation between the Nucleus and Crystal-formation.**†—J. A. Samuels has studied the cytology of the nucleus in connexion with the development of crystals in the cells of the perianth of *Anthurium*. Polyhedral crystals are very numerous in the outer cells, less numerous in the more internal cells; raphides occur less frequently, and are found in the central cells of the bracts of the perianth. At the time of crystal-formation the protoplasm accumulates in the cell, while the nucleus takes up a peripheral position where the cytoplasm is densest, and the whole mass becomes enveloped in a membrane. Later on, those cells in which polyhedral crystals are developing exhibit striations

* Bull. Torrey Bot. Club, xl. (1913) pp. 555–65 (2 pls.).
† Comptes Rendus, clvi. (1913) pp. 1275–7.

diverging from the nucleus to the crystals. Immediately the crystals are formed both striations and nucleus disappear. When raphides are being formed, the wall of an adjacent and more internal cell disappears, while its nucleus and protoplasm fuse into a single mass; several neighbouring cells behave in a similar way, until a single large cell is formed containing a large central nucleus, from which raphides diverge. As before, completion of the crystals is accompanied by disappearance of the nucleus. The author believes this to be the first instance described of such a fusion, and regards it as having great significance in proving the intimate relation of the nucleus and the physiological processes of the cell.

**Movements of Plasmodia.***—V. Vouk publishes the second part of a paper dealing with the rhythmic movements of *Didymium nigripes* and *Chondrioderma difforme*. The chief results are as follows: The streaming starts in the plasmodia and is of a slow amœboid nature. The amplitude of the movement is the course traversed by a particle of the plasma, and it increases with the circumference of the plasmodium. The duration of the movement is proportional to the amplitude. The movement itself is very sensitive to light, the ultra-violet rays being specially harmful; it is uninfluenced by gravity, and there is no evidence of geotaxis. Poisons cause degeneration of the plasmodia. The internal osmotic pressure of a plasmodium appears to be about $\frac{3}{10}$ of the atmosphere. The author disagrees with Klebsschen, who states that plasmodia never live for more than two or three weeks.

## Structure and Development.

### Vegetative.

**Cutinization of Roots.**†—H. Mager has studied the cutinization of the root of *Funkia Sieboldiana*, in order to discover the cause of this general phenomenon. In normal roots examined in July, the epiblem cells were distinctly outlined almost to the growing point and cutinization had already commenced. At a distance of 2 to 3 cm. behind the growing point a single layer of semi-cutinized cells merged into short, usually non-cutinized cells, but wherever the root had suffered any injury these short cells together with the adjacent parenchyma cells became more or less cutinized. Roots were then cultivated in tap-water and in various culture solutions; in the former case there was little difference beyond a decrease in the number of root-hairs and later cutinization; in a complete culture solution there was no important difference at all; in solutions of higher osmotic pressure cutinization showed a proportional increase. Roots grown in dry earth and in a damp atmosphere in the absence of fluid water also exhibited increased cutinization. At the beginning of November, fresh roots were examined and found to be fully cutinized, but when placed in water or in a culture solution, the

* Zeitschr. Bot., v. (1913) pp. 405–6.
† Flora, n.s. vi. (1913) pp. 42–50 (4 figs.).

cutinized cells began to break down. This fact, interpreted in the light of the foregoing experiments, induces the author to regard Meyer as incorrect in stating that the cutinization of the root is a safeguard against loss of food materials: on the contrary, it appears to be a protection against loss of water under conditions of physiological dryness of soil.

**Root-cap of the Leguminosæ.***—E. Tiegs has studied the origin of the root-cap of *Vicia villosa*, *Pisum sativum*, and *Trifolium repens*, and finds that it arises through growth of the dermatogen and of the cells adjoining the suspensor. These "limiting cells," as they are termed by the author, divide so as to give rise to root-cap above and plerome and periblem below, and they are regarded by many authors as the transverse meristem characteristic of the majority of roots, but this view appears to be incorrect. The origin and mode of growth of the root-cap in the Leguminosæ is extremely like that found in the Cruciferæ, and in *Pisum* it resembles that of *Helianthus*. The central portion of the root-cap, i.e. the columella, arises from the daughter-cells of the "limiting cells," and its breadth depends upon their number. It is highly probable that the periblem and plerome arise from their own initial cells, for such cells can be found in the main root of *Pisum sativum* and *Trifolium repens* and in the lateral roots of *Vicia villosa*.

**Secondary Growth in Palms.**†—J. C. Schoute publishes the results of his comprehensive investigations as to the growth in thickness of palms. The author's method consisted in a comparison of cross-sections, made at equal heights above the soil, of specimens of different ages. The first section of the paper deals with the presence of secondary thickening, and in the 96 species examined 31 showed an undoubted growth in thickness, in 27 it was absent, and doubtful in the remainder. The second section deals with the anatomical details of secondary growth: the results agree with those of Eichler and others. Secondary growth takes place in the outer part of the central cylinder, and the chief zone of growth is the sclerenchyma associated with the vascular bundles. This growth is due to division of the outer radially elongated sclerenchyma-cells, while the inner cells thicken early and take no part in secondary growth. This explains the cessation of growth in thickness in older parts of growing stems. In a few cases, in which a protoxylem was present, there was secondary growth in the xylem parenchyma. The growth in the sclerenchymatous tissues causes changes in the other tissues. The epidermal and cortical cells become tangentially flattened, and soon afterwards the epidermis splits and cork and lenticels are formed. The medullary parenchyma has many schizogenous spaces, and the cells are much elongated. In many palms, e.g. *Pinanga coronata*, secondary growth only proceeds until that part of the stem is covered with leaves: in other species it continues longer. The author terms secondary thickening like that of the palms, "diffuse" thickening, as opposed to the normal cambial thickening.

* Jahrb. wiss. Bot., lii. (1913) pp. 622–47 (1 pl. and 14 figs.).
† Zeitschr. Bot., v. (1913) pp. 392–4. See also Ann. Jard. Bot. Buitenzorg, xi. (1912) pp. 1–209.

### Reproductive.

**Embryology of Arisæma.***—F. L. Pickett has studied the development of the embryo-sac of *Arisæma triphyllum*, and although most of the results agree with those of previous investigators, the author has discovered a few variations which have not been described before. The origin of the megaspore mother-cells from a single primary cell is doubtful, the first division of the tetrad having probably been mistaken for a division of a primary cell into embryo-sac initials. The tetrad is composed of potential megaspores, some of which will develop into the embryo-sac or sacs. As in other Araceæ, more than one embryo-sac may be formed. It is doubtful whether the polar nuclei ever fuse, while the antipodal cells are rarely fully developed.

**Embryology of the Euphorbiaceæ.**†—G. Donati has studied the embryology of eight species of Euphorbiaceæ, and finds that in seven of them the development is normal; in *Poinsettia pulcherrima*, however, the two embryo-sacs have each sixteen cells and nuclei. This is the fourth instance of the kind in this family, and appears to indicate that further investigations will reveal further abnormalities.

**Embryology of the Dianthaceæ.**‡—R. Perotti has studied specimens of six different representatives of the Dianthaceæ in order to determine (1) the origin of the embryo-sac; (2) the number of embryo-sac mother-cells and of embryos in the nucellus; (3) the origin and structure of the large suspensor-cells found in *Stellaria media* and other species. The author finds that in *Stellaria media*, *Lychnis dioica*, *Silene Cucubalus*, *Tunica prolifera*, and *Gypsophila saxifraga*, the archesporial cell does not develop directly into an embryo-sac, but undergoes a previous tangential division. In these species the mother-cell arises from the lower cell and in *Cerastium glomeratum* from the upper cell. In all six species there is usually a complete tetrad-division, and the lowest cell forms the embryo-sac. *Silene Cucubalus* frequently has a multicellular archesporium, several embryo-sac mother cells, and several embryo-saes. In *Cerastium glomeratum*, *Lychnis dioica*, and *Silene Cucubalus*, the suspensor has a bladder-like cell of a haustorial nature similar to that found in *Stellaria media*. In *Tunica prolifera*, *Gypsophila saxifraga*, and *Saponaria officinalis*, the adjacent cell is also much enlarged, while the remaining suspensor cells are reduced both in size and number.

**Anatomy and Germination of Heteromorphous Seeds.**§—H. Baar has studied the anatomy and the physiology of the germination of heteromorphous seeds of *Chenopodium album* and *Atriplex nitens*. The difference in appearance of the seed is accompanied by difference in structure; this especially applies to the thickness of the seed-coat with which is closely connected the capacity of the seed for absorption of

* Bull. Torrey Bot. Club, xl. (1913) pp. 229–35 (2 pls.).

† Zeitschr. Bot., v. (1913) p. 792. See also Annal. di Bot., xi. (1913) pp. 395–9 (1 pl.).

‡ Zeitschr. Bot., v. (1913) pp. 792–3. See also Annal. di Bot., xi. (1913) pp. 371–85 (3 pls.).

§ S.B. Akad. Wiss., cxxii. (1913) pp. 21–40 (2 pls.).

water and hence the time elapsing before germination. The experiments tended to show that it was not the diminished absorption of oxygen but the decrease of water which affected germination. Different seeds behaved differently under the influence of light. One experiment made with *Atriplex* seemed to indicate that when the seeds are placed in water, there is an outward diffusion of some substance having the power of retarding germination.

The present work shows that, although there may be differences in the stages of development, the adult plants obtained from the two kinds of seeds are equally strong, and show no material difference in structure.

### General.

**Organisms in Nectaries.***—I. V. Schuster and V. Ulehla publish a preliminary paper in connexion with their study of the organisms found in nectar-secreting structures. They have examined 32 different species of woody and herbaceous plants, and find that the presence of minute fungi and bacteria is of extremely common occurrence. In 23 of the plants examined the nectaries were infected with a yellow species of bacteria, also even more frequently with a yeast fungus typically found in *Lamium album*. To a smaller extent red yeast fungi and torula species were also found. Under special conditions, e.g. where there is a stigmatic cavity, as in *Viola tricolor* or in the slimy buds of poplar, infection can only be brought about by a single species, which is always present. This circumstance, together with the fact that such common forms of mould fungi as *Mucor*, *Penicillium*, *Aspergillus*, etc. are never found in nectar, points to the conclusion that nectar is the habitat of various species of specially adapted bacteria and yeast fungi. That the latter are not parasitic or harmful is shown by the perfectly normal ripening of the fruit and seed of infected flowers.

## CRYPTOGAMS.

### Pteridophyta.

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

**Phylogenetic Studies of Ferns.**†—F. O. Bower finds in *Metaxya rostrata* Presl. (*Alsophila blechnoides* Hook.), an interesting step in the phylogeny of the Ferns—a more primitive member of the Cyatheaceæ, which provides evidence that the arborescent habit of the Cyatheaceæ is secondary and derived. *Metaxya* is distinct from *Alsophila* in the following characters:—creeping habit, simple hairs (not scales), solenostelic structure of axis, undivided leaf-trace, flat receptacle, simultaneous origin of numerous sporangia, almost vertical annulus interrupted at insertion of sporangial stalk. It holds a similar independent position to that of *Lophosoria*. Bower discusses the value of the point of origin of the sorus as a constant systematic character, and divides the leptosporangiate ferns into two series according as the sori originate from the

* Ber. Deutsch. Bot. Gesell., xxxi. (1913) pp. 129–39 (1 pl.).
† Ann. of Bot., xxvii. (1913) pp. 443–77 (3 pls. and figs.).

margin or the surface of the frond. In *Davallia* and *Nephrolepis* the sorus, marginal in origin, is carried by subsequent growth on to the lower surface. The position of the nascent sorus is, like the character of the sporangium, of prime importance, and takes precedence of the anatomical characters of the axis.

## Bryophyta.

(By A. Gepp.)

**Riccia Frostii.***—C. A. Black gives a morphological account of *Riccia Frostii*—structure of thallus, reproductive organs, sporophyte, spore-formation, etc. The air-chambers originate between adjacent up-growing filaments, and when mature are of various sizes and are separated by unilamellate plates of green tissue. The plants are dioicous; and the reproductive organs are not definitely grouped. The spore-mother-cell nucleus diminishes gradually in size during the successive mitoses; no centrosomes or centrospheres were observed. The spore contains a very small nucleus surrounded by food material, principally oil. It has two protective coats; and later the endospore is formed. The exospore is marked with irregular ridges. In the spermogenous tissue the final division is diagonally placed: no cell-wall was found between the resulting triangular cells. The blepharoplast, originating in an angle of the cell, elongates and becomes applied to the transformed nucleus and terminates in a thickened end bearing two cilia. The number of chromosomes is eight for the gametophyte, and sixteen for the sporophyte.

**Tetraphidopsis.**†—H. N. Dixon describes the male inflorescence of the rare New Zealand moss, *Tetraphidopsis novæ-seelandiæ*, and shows that the plant is identical with the older species *Meteorium pusillum* Hook. f. & Wils. He also shows that Limpricht was in error in reducing *Weisia Welwitschii* Schimp. as a synonym of *Campylostelium strictum* Solms, the two species being distinct in habitat and in the structure of their leaves, capsule, and peristome.

**Ditrichum and Thuidium.**‡—H. N. Dixon discusses the history of *Ditrichum flexifolium* (Hook.) Hampe, a South African moss, and finds that it is identical in structure with some eight other species, which he now reduces to synonymy. The distribution of the plant thus extends from South Africa to Asia, Australia, and South America. He also publishes critical notes on some species of *Thuidium* from Australasia and Oceania, adding a description of *T. orientale* Mitt., a new species from Penang.

**Dicranoloma.**§—H. N. Dixon begins a series of studies in the bryology of New Zealand by publishing a monograph of the sixteen species of *Dicranoloma* found in New Zealand. He figures the structure

* Ann. of Bot., xxvii. (1913) pp. 511–32 (2 pls.).
† Journ. Bot., li. (1913) pp. 244–7.
‡ Journ. Bot., li. (1913) pp. 324–30.
§ New Zealand Institute, Bull. No. 3 (Wellington, 1913) 29 pp. (4 pls.).

of each, and supplies diagnoses of five which had been issued with name only by C. Müller. Dixon calls attention to the exceeding difficulty attached to New Zealand bryology, owing to the creation of numerous new species by C. Müller, W. Colenso and R. Brown (of Christchurch), and the impossibility of obtaining authentic specimens.

**North American Sphagnum.***—A. Le R. Andrews treats of the section *Acisphagnum*, which shows a high development in its structure, It is divisible into *Squarrosa*, *Cuspidata*, *Acutifolia*. In *Squarrosa* he includes *S. Angströmii* Hartm., *S. teres* Angstr., *S. squarrosum* Crome; and shows how, by their cell-structure and the shape of their leaves, they may be distinguished from one another and from other species.

## Thallophyta.

### Algæ.

(By Mrs. E. S. Gepp.)

**Oceanic Plankton.**†—H. H. Gran contributes a chapter on the plankton collected on the 'Michael Sars' expedition, to the report of that voyage lately published. He used a steam centrifuge capable of centrifuging 1200 c.cm. of sea-water at a speed of 700–800 revolutions per minute, thereby discovering that the minute nannoplankton is far more abundant than the larger plankton. He found also that pelagic life is most abundant at depths of 10–20 metres, but becomes extremely scanty below 100 metres; and he agrees with Nathansohn that marine plant life thrives best where ascending currents bring upward a supply of nitrogenous compounds derived from the decomposition of organic matter in the deep sea. Gran also finds that tropical collections of plankton show that the species are numerous and mostly rare, whereas in colder waters there are few species but great aggregations of individuals.

**Diatoms in Sea-urchins.**‡—G. Antonelli records fifty-three species of diatoms which he found in the digestive tract of sea-urchins collected at Trani on the Adriatic. The predominant species belonged to *Limnophora* and *Synedra*. *Cocconeis* and *Navicula* were also abundant, as well as species of *Pleurosigma*, *Hyalodiscus*, *Biddulphia*, and *Surirella*. Among the rare genera were *Coscinodiscus*, *Cerataulus*, *Actinoptychus*, *Amphora*, and *Grammatophora*.

**Nuclear Division in Spirogyra.**§—M. L. Merriman writes on nuclear division in *Spirogyra crassa*. He finds that:—1. A spireme originates from material derived from both nucleolus and nuclear network. The materials constituting this spireme are aggregations varying in appearance, in number, and in staining capacities. 2 These aggregations are not the chromosomes. They greatly exceed in number that

* Bryologist, xvi. (1913) pp. 59–62, 74–6.
† Murray and Hjort, The Depths of the Ocean. London: Macmillan, 1912, Chap. vi.
‡ Att. Pontif. Acc. Rom. Nuov. Linc., lxvi. (1912–13) pp. 25–33.
§ Bot. Gaz., lvi. (1913) pp. 319–30 (2 pls.).

published for chromosomes in any species of *Spirogyra*, although a comparative study of plates of other investigators indicates that these are the bodies heretofore designated as chromosomes. 3. This spireme in the pachyneme-stage is composed of deeply-stained short filaments, intermixed with material of a granular nature. There is evidence that this granular material was derived from the nucleolus, the filamentous from the nuclear network. 4. These two materials amalgamate to form one of intensive staining capacity. The amalgamated material retains the spireme form. This spireme as a whole is spherical: later it elongates, becoming cylindrical. Cross-sections of the loops reveal their tubular structure. 5. This spireme does not appear to split either transversely or longitudinally, but separates at various points as would a viscid mass if pulled in opposite directions. Fourteen or more tubular chromosomes for each daughter-nucleus result from the elongation of the coils of the spireme. These are not to be considered "pseudo-chromosomes." 6. At this stage, and subsequently, chromidia are discharged into the cytoplasm. It is probable that these chromidia are concerned in the development of pyrenoids. 7. There is no evidence throughout the karyokinesis of an equational division of autonomous bodies. The advantage of this form of division over direct divisions appears to be in the opportunity for escape of the chromidia from the nucleus. 8. *Spirogyra crassa* does not, in the behaviour of its nucleus in karyokinesis, present a unique case, for the stages can be homologized with similar stages in *Allium*, as typical of the higher plants.

**Haplosiphon filiformis.***—K. Yendo has made a thorough examination of Ruprecht's type-material of this species, preserved at St. Petersburg, and finds it consists of four different species. Three of these are already known under other names. The fourth is here described as forming the type of a new genus, *Ruprechtiella*. The differences between the characters of Ruprecht's plants are discussed, and the synonymy given of the species to which they belong.

**Melbourne Fresh-water Algæ.**†—A. D. Hardy writes a short account of some algæ of the Zoological Gardens, Melbourne, collected from pools supplied from the Yan Yean reservoir and the watershed of the Maroondah. The pools are all shallow with no conspicuous benthos. In March 1910 *Botryococcus Braunii* was visible at the surface: and diffused in abundance were *Scenedesmus quadricauda*, *Merismopedia glauca* and *Ankistrodesmus quaternus*, the latter hitherto recorded only from Burmah. These specimens are discussed, and theories put forward as to how they reached the Melbourne ponds. The author suggests the foreign birds from the Calcutta market as the possible carriers of the spores in dried mud on the legs. Twenty-three species in all are recorded from the ponds. For convenience the author adds a note on *Euglena spirogyra*, here recorded for the first time from the southern hemisphere. Peculiarities in several of the species are figured.

* Trav. Mus. Bot. Acad. Imp. Sci. St. Pétersbourg, x. (1913) pp. 114–21.
† Victorian Naturalist, xxx. (1913) pp. 89–95 (1 pl.).

**Laminaria Zoospores.***—J. Lloyd Williams, replying to a paper by G. H. Drew,† in which the zoospores of *Laminaria* were described as gametes on account of the fusions observed, shows that the colourless fusing organisms seen by Drew were Monads—not zoospores of *Laminaria*. The genuine pear-shaped zoospores, with their prominent bent chromoplasts, never fuse. When they settle down they become spherical, and are invested with a wall; and the curved chromoplast divides at the bend. A long tube grows out at one side of the spherical spore-case: and into this pass the two chloroplasts and most of the other contents. But the nucleus remains behind and divides: the two daughter-nuclei then move into the tube. An enlargement is formed at the distal end, and, becoming separated off by a transverse wall, is found to contain the chloroplasts, one of the nuclei, and most of the other cell-contents. The second nucleus remains in the tube and degenerates. The new cell grows, and by cell-division may form a simple or branched protonema, which may rest for months or may give rise to a germling in a fortnight. In the curious process of germination a cell of the protonema becomes pear-shaped, with a thick mucilaginous wall at the pointed end. At this end the cell contents are forced out enclosed in a thin pellicle. The escaped cell divides; and the basal cell of the row puts out one or more rhizoids, which often grow along the outside of the empty cell—not inside as figured by Drew. Williams examined *Laminaria*, *Alaria*, and *Chorda*, and found the same process in each. There is no doubt that the swarming bodies are asexual.

**Life-history of Zanardinia.**‡—S. Yamanouchi describes the life-history of *Zanardinia*. He begins with the mitosis in the negative cells of the gamete-bearing plants, the formation of the gametes, the fertilization and germination of the fertilized female gametes, and the apogamous germination of the unfertilized female gametes. Then there is described the mitosis in the vegetative cells of the zoospore-bearing plants; the formation and germination of the zoospores; and finally, there is a brief statement concerning an alternation of generations in the life-history of *Zanardinia*. The following is the summary of the results:—1. The nucleus of the gamete-bearing plants contains twenty-two chromosomes; and the male and female gametes contain the same number. 2. In the union of the gametes the number is doubled; and forty-four chromosomes appear in the fertilized sporeling, which develops into the *Zanardinia* plant containing forty-four chromosomes. 3. The nucleus of the zoospore-producing plants contains forty-four chromosomes; and the number is reduced in zoospore formation, the zoospore containing twenty-two chromosomes. The zoospore with the reduced number of chromosomes germinates and develops into an individual with twenty-two chromosomes. 4. It is evident that the gamete-bearing plants come from zoospores, and that the zoospore-bearing plants come from fertilized gametes, so that the two generations alternate in the life-history. 5. The female gametes of *Zanardinia* may germinate apogamously. There is no irregularity in the mitotic process,

* Rep. Brit. Assoc., Dundee, 1912 (1913) pp. 685–6.
† Ann. of Bot., xxiv. (1910) p. 177.
‡ Bot. Gaz., lvi. (1913) pp. 1–35 (4 pls. and 24 figs.).

twenty-two chromosomes being invariably present. The individual produced shows external morphological characters similar to those of the product of the fertilized gamete; but the fate of the apogamous individual was not determined.

**Iridescent Florideæ.***—F. C. von Faber writes on the organization and development of the iridescent bodies of Florideæ. His investigations were made on species of *Nitophyllum* and *Tænioma*, collected in the Malay Archipelago. He finds that they show in intensive light a peculiar steel-blue gleam which gradually disappears if the alga is exposed to a weaker light. This gleam, which has been observed in many other Florideæ by other workers, is caused by iridescent bodies in the cells. They are able to move phototactically, are positively phototactic, and in intensive light they glide to the outer wall of the cell, where they act as a kind of curtain. The chromatophores, like the iridescent bodies, show amœboid movements, and are negatively phototactic; in intensive light they range themselves in profile. The iridescent bodies have a protein nature of a distinct structure; under the influence of strong light small globular bodies arise in them which apparently represent a product of assimilation and are the true cause of the iridescence. In diffused light these globular bodies disappear and the stalk-like portions withdraw to the side walls of the cell. The stroma of the iridescent bodies is, therefore, not destroyed, but has the power in intensive light of returning to the outer wall, where, under the influence of light, the globular bodies may be again formed. The iridescent bodies arise from the same original material as the chromatophores. Small spindle-shaped bodies are formed in the apical cells and even in the tetraspores, some of which develop into chromatophores, some into iridescent bodies. The latter act as light-reflectors probably to weaken off not only the chemical but also the thermal effect. This reflection is worked on a simple physical principle, that of the clouded media. The structure of the bodies which are in the act of protecting from light show that they disperse the short-waved rays—the blue. Thus the light reflected from these bodies has a bluish colour.

**Irish Marine Algæ.**†—A. D. Cotton publishes a list of 120 marine algæ collected by Praeger at Saltees off the south coast of county Wexford. Previously only 63 species had been recorded for the region. Notes on several of the records add to the interest of this paper, which, taken in connexion with the Clare Island report by the same author, forms a valuable addition to British marine botany. The microscopic fungus *Mycosphærella Ascophylli* Cotton, was present in the receptacles of *Ascophyllum*.

**Marine Algæ.**‡—G. B. de Toni publishes notes on three species of marine algæ, *Æodes marginata* Schmitz, *Sebdonia Monardiana* Berth., and *Neurocaulon reniforme* Zan. He discusses their history, distribution, habit, reproductive organs where known, and the time of year when

* Zeitschr. Bot., v. (1913) pp. 801–20 (1 pl.).
† Irish Naturalist, xxii. (1913) pp. 195–8.
‡ R. Comitato Talassografico Italiano, Memoria xxx. (1913) 14 pp.

these appear. He recommends that attention should be paid by collectors to this point: and also that individuals arising from sexual and asexual plants respectively should be raised under culture, for a comparison of their cytological characters.

**North American Marine Algæ.***—B. M. Davis publishes a report on the algal vegetation of Woods Hole and its vicinity. The first section deals with the ecology of the flora, the coast, the sea bottom, tides and tidal currents, the effect of ice, depth of water, light, temperature, and seasonal changes, and salinity of the water. Characteristic algal associations are described, numbering 57. This section is accompanied by 47 descriptive charts. The second section is a catalogue of the marine flora, with notes concerning the distribution of the individual species.

**Australian Marine Algæ.**†—A. H. S. Lucas publishes the first instalment of his notes on Australian algæ, and includes descriptions of three new species—*Nitophyllum sinuosum* (Botany Bay), *Polysiphonia compacta* (Port Jackson), and *Ptilonia intermedia* (Tasmania): the second of these has a nine-siphon structure. In discussing *Turbinaria* he suggests that the evesiculose *T. Murrayana* may be a simple unbranched reef-form of *T. decurrens*. *Spermatochnus Lejolisii*, found at Port Stephens, is a European species. Some of the plants are figured.

**New Japanese Algæ.**‡—K. Yendo describes three new species of Japanese algæ and a new form of *Coilodesme bulligera* Strömf. One of these novelties forms the type of a new genus, *Benzaitenia*, and is parasitic on *Chondria crassicaulis* and *Laurencia paniculata*. It is fully described and figured. The vegetative organs are reduced to a mere aggregation of cells, which in the young plant are embedded in the parenchymatous host-tissue, and require staining to differentiate them. It belongs to the Dasyeæ. The antheridia, tetraspores, and cystocarps have all been found.

## Fungi.

(By A. Lorrain Smith, F.L.S.)

**Morphological and Biological Study of Rhizopus Artocarpi.**§ The fungus studied by A. Sartory and H. Sydow was sent to them from the Philippine Islands by C. F. Baker. It was originally found in Java. The mycelium is white at first, but becomes brown or even black. Upright tufts are formed, and some of the filaments bear sporangia. The spores are very variable in size, from 8 $\mu$ to 20 $\mu$ in diameter, and are globose or ovoid or often angular, clear brown in colour, and striate. The authors grew the mould on various media, and give the results of the experiments.

* Bull. Bur. Fisheries, xxxi. (1911) pp. 443–544, 795–833 (charts).
† Proc. Linn. Soc. N.S.W., xxxviii. (1913) pp. 49–60 (5 pls.).
‡ Nyt Mag. Naturvid., li. (1913) pp. 275–88 (2 pls.).
§ Ann. Mycol., xi. (1913) pp. 421–4 (9 figs.).

**Study of Sclerotinia.***—W. A. Matheny had remarked that the fungus *Sclerotinia fructigena* grows always on pome fruits in Europe, and that a form considered identical with it grows only on stone fruits in the United States. He has therefore experimented with artificial cultures on different fruits, and has decided that the European species is different from the American brown-rot: the former is of slower growth; the conidial tufts differ in size, shape or colour, and the conidia of the European form are larger, while asci and ascospores apparently correspond in size, but the spores of *S. fructigena*, the European fungus, are sharply pointed at each end and are free from guttulæ. The American species he refers to *S. cinerea*.

**Study of Lembosia.**†—T. Theiszen has written an account of the genera *Lembosia* and *Morenoella*, members of the family Hemihysteriaceæ. They grow on leaves and are found in warm climates, Ceylon, Brazil, etc. The genera have frequently been confused with *Asterina* and *Microthyrium*. The characters of the different species (sixty in all) are described, and their history traced. Synopses of genera and species are added.

**Germination of Æcidiospores.**‡—Otto Kunkel has made experiments on the æcidiospores of *Cæoma nitens* taken from leaves of *Rubus frondosus*. On germination they produced a promycelium in much the same way as the æcidiospores of *Endophyllum Sempervivi*. The promycelium consists normally of five cells—a stalk cell without a nucleus, and four nucleated cells. From each of the latter a sterigma is produced bearing a sporidium. The sporidia germinate immediately, either forming a secondary sporidium or a germ-tube. The author questions if the *Cæoma nitens* can have any connexion with *Puccinia Peckiana*, as these facts seem to prove a short life-cyle. The only other instance of æcidiospores known to function as rusts is that of *Endophyllum*.

**Study of Perennial Rusts.**§—E. W. Olive divides rusts as annual and occupying a limited area of the host tissue, or as perennial and unlimited, pervading practically the whole host-plant with the possible exception of the roots. Among these unlimited species are *Puccinia Podophylli*, *P. obtegens*, and *Uromyces Glycyrrhizæ*, the forms that were examined.

Olive found three states of mycelial distribution: an intermingled growth of binucleate sporophyte and uninucleate gametophyte in the same host, giving rise to spermogonia followed by æcidiospores and finally by teleutospores in *P. Podophylli*, or by confluent uredo- and teleutosori in *P. obtegens* and *Uromyces Glycyrrhizæ*.

There was also an unlimited growth of the perennial sporophytic mycelium alone in the two latter forms, producing secondary uredo- and teleutospores in confluent sori.

* Bot. Gaz., lvi. (1913) pp. 418–32 (6 figs.).
† Ann. Mycol., xi. (1913) pp. 425–67.
‡ Bull. Torrey Bot. Club, xl. (1913) pp. 361–6 (1 fig.).
§ Ann. Mycol., xi. (1913) pp. 297–311 (1 pl.).

Lastly there was found a localized binucleate sporophyte mycelium in *P. Podophylli*, which gave rise to a sorus of teleutospores, and in the other two species to the "summer generation" or "repeating generation," producing secondary uredo- and teleutospores.

No fusion of nuclei was observed in any preparation. The aecidiospores of *P. Podophyllii*, as well as the uredospores of the other two species, are regarded as secondary in origin and apogamously derived, arising solely from binucleate mycelium.

The gametophytic or uninucleate mycelium produces only the pycnidia or so-called spermatia, and in instances where the two kinds of mycelium are intermingled, the uninucleate appears usually to predominate in young tissues over the binucleate. In older and more mature tissues the reverse is the case.

**Rusts of Nova Scotia.***—W. P. Fraser has published a paper which includes not only descriptive accounts of the species occurring in Nova Scotia, but also a general life history of the rust fungi; the various forms that occur; and an account of culture methods, specialization, etc. The cytology is also described so far as known.

Under enemies of the rusts he describes *Darluca filum* and *Tuberculina*, and the larva of a species of *Cecidomyia*. The economic aspect of rusts in Nova Scotia is also fully dealt with. All the genera recorded in North America have been found in the district, with the exception of two —*Gallowaya* and *Hyalospora*.

**Contribution to a Knowledge of Black Yeasts.**†—These yeasts are the product of dark-coloured fungi and are generally known as *Saccharomyces niger* or *Torula niger*. W. Will has made an extensive cultural study, and distinguishes three forms. 1. Yeast-cells elongate-ellipsoid. 2. Yeast-cells ovoid. 3. Yeast-cells globose. All of these forms are closely related morphologically and physiologically, and are probably only varieties of one original species. No higher development of the organism was obtained, and Will considers that the old names must be dropped: though until more definite results are obtained he does not feel able to give a more accurate designation.

**Culture of Polyporus squamosus.**‡—S. R. Price made cultures of the fungus from the spores on different pieces of wood. Growth was very slow, but finally various structures were formed—without, however, any appearance of a hymenium. At a later date a system of irregular pores appeared on one surface of a long spathulate stalk developed in bright light and supplied with a peptone solution.

Special attention was paid to the wood-destroying characters of the mycelium. It takes two months to appear after spore-infection of the wood and after a few months more produces "oidia." The mycelial growth was generally stronger in darkness than in the light—but both extremes, darkness and a bright light, were unfavourable to the formation of fruiting structure. The wood-cells were delignified from the lumen outwards, the middle lamella remaining intact.

* Proc. and Trans. Nova Scotia Inst. Sci. Halifax, xii. pp. 313–445 (figs.).
† Centralbl. Bakt., xxxix. (1913) pp. 1–26 (14 figs.).
‡ New Phytologist, xii. (1913) pp. 269–81 (1 pl. and 4 figs.).

**Mycological Notes.***—F. von Höhnel devotes almost the whole of his paper to the microscopic structure of *Mycena*, more especially to the cystidia that occur in the gills. He finds that their form is very constant, though occasionally more or less variable within the species. They may be slender, threadlike, or cylindrical, cone-shaped or globose with intermediate forms. The swollen globose cystidia have frequently fungus-like or blunt thorn-like processes confined to the tip of the cystidium or covering the whole free portion. The tips are, however, mostly simple, though occasionally branched or forked. The sharply pointed are the most constant in form. These bodies are most easily examined when the fungus has just reached maturity: at a later stage they are apt to be overlooked.

Von Höhnel gives a synopsis of the 60 to 70 species studied by him according to the occurrence and form of the cystidia. In each group a certain number bear cystidia only at the edge, others over the surface of the gills. In one, *M. cyanorhyza*, there are no cystidia.

The paper also includes notes on some fungi with descriptions of *Yoshinagella* g. n. (Dothideaceæ) from Japan, which forms stromata on the upper surface of *Quercus glauca* and *Endogenella* g. n. (close to *Endogone*). Only chlamydospores were found in the species *E. borneensis*, which was found on soil in Borneo. An index to species mentioned in the text is given.

**Toxicity of Nitrates to Monilia sitophila.**†—It had been proved by various workers that inorganic salts harmful to certain organisms were rendered innocuous when accompanied by organic substances. Otto Kunkel has made an experimental study of the subject, selecting for experimentation the mould *Monilia sitophila*, which is a rapid grower and develops well on many different media. As a result he found that the concentration at which various inorganic salts are toxic to the fungus depends on the kind of organic substances contained in the media to which these salts are added: thus the ferric nitrate that inhibits the growth of *Monilia* in starch media had little or no effect on its growth in peptone media. The various results with the different combinations of salts are set out in detail.

**Fixation of Nitrogen by Soil Fungi.**‡—A research on this subject was undertaken by H. N. Goddard to determine which of the soil fungi were most apt to fix free nitrogen, etc. His results were largely negative, and did not bear out the work done by other students. He found that many fungi live habitually in the soil and carry on there their life-history in whole or in part. Many of these have been described and figured. They are uniform in very differents oils and are also rather uniformly distributed at different depths, at least as low as 14 cm. Tillage and manuring seem to produce little change. They may be isolated as pure cultures by the use of 20–30 p.c. of gelatin in the culture medium. None of the forms studied, including at least fourteen species,

* SB. Akad. wiss. Math.-Nat. Kl. cxxii. (1913) pp. 255–309 (7 figs.).
† Bull. Torrey Bot. Club, xl. (1913) pp. 625–39.
‡ Bot. Gaz., lvi. (1913) pp. 249–305 (16 figs.).

showed any power of assimilating free nitrogen when grown in nitrogen-free media. *Myceliophora* and *Fusarium* show no such power even in nitrogen-containing media. Other results of more or less interest are also recorded by the writer.

**Tuberization in Spiranthes autumnalis.***—C. Beau records a series of observations on the connexion between mycelial infection and the formation of tubers in this orchid. The adult plant possesses two to five large tuberized roots surmounted by the floral axis and bearing a lateral rosette. The cortex of the root is invaded by the endophytic mycelium. From their older roots arise tubercles at the end of the flowering season which eventully grow into the new roots and are also occupied by the endophyte, though only when development is complete. If they are separated from the parent plant before this stage they are (and remain), fungus-free. Beau thus proved that tuberization was not an effect of mycelial invasion. Different results were obtained by growing the orchid from the seed. Germination of the seed is normally dependent on the presence of the fungus.

**Plant Diseases.**—C. O. Farquharson† has recorded various diseases observed by him in Southern Nigeria. Two rubber diseases (on the roots of *Hevea brasiliensis*) have been traced to the fungi *Fomes semitostus* and *Hymenochæte noxia*. A stem disease which arises generally at the forks was caused by *Corticium salmonicolor*. It frequently kills the whole crown of the tree. The two former fungi were also found on the roots of cacao-trees. Canker of cacao and pod diseases were also noted.

Cotton was found to be peculiarly liable to physiological diseases, such as discoloration of the leaves, the specific causes being imperfectly known; the leaves are attacked by several fungi.

J. J. Taubenhaus and T. F. Manns ‡ have published an account of the diseases to which the sweet-pea (*Lathyrus odorata*) is liable in the United States. Mosaic disease is frequent; the cause of the leaf-spotting is unknown, but it is infections, and can be induced by inoculation. The roots are attacked by *Thielavia basicola* and by *Rhizoctonia vagans*. Stem or collar rot is caused by *Sclerotinia libertiana*, which attacks the seedlings at all stages and quickly causes rotting of the tips, with subsequent collapse of the plant. Species of *Fusarium* also cause diseases of roots and stems; leaves are destroyed by *Glomerella rufo-maculans* and by powdery mildew, which in this country has been identified as *Erysiphe Polygoni*.

H. Müller-Thurgau § gives the final paper on a disease of vine-leaves caused by *Pseudopeziza tracheiphila*, which in some districts has done great damage. The author describes the development of the fungus from the spore, having obtained cultures on dead leaves. He discusses

* Comptes Rendus, clviii. (1913) pp. 512–15.

† Ann. Rep. Agric. Dept., 1912, pp. 6–9. See also Bull. Agric. Intell. Rome, iv. (1913) pp. 1454–5.

‡ Dept. Pl. Path. Delaware Coll. Exper. Stat. See also Bull. Agric. Intell. Rome, iv. (1913) pp. 1455–7.

§ Centralbl. Bakt., xxxviii. (1913) pp. 586–621 (1 pl.).

the wintering of the fungus, the attack of the leaves, and the conditions that favour susceptibility or immunity Finally, he gives methods of combating the disease, through soil-treatment, selection of immune stocks, spraying with fungicides, etc.

In a full account of diseases of rice, E. J. Butler* gives a description of several which are due to fungoid attacks. *Tilletia horrida* is allied to the well-known bunt of wheat. It is believed that it enters the seedling while still below ground, just as in wheat-bunt. Nothing is noticed until the grains are formed, and then these are found to be a mere mass of spores. The mycelium occurs in the stem tissues of the affected plants, and in the grain it develops chiefly under the skin of the grain, that is, below the outer wall of the ovary The spores adhere to healthy grains, and so the new crop becomes contaminated.

A false smut, *Ustilagonidea virens* is an Ascomycete which forms a green sclerotium on the maturing grain. Ascospores have not been found, but conidia are formed freely, which reproduce the disease. Sclerotia have also been found at the base of rice-stems, which prevent any formation of flower or seed. The life-history or parasitism of the fungus *Sclerotium Oryzæ* is unknown.

F. T. Brooks † contributes a paper on silver-leaf disease, wherein he sums up all that is known as to the origin and nature of the disease which is specially harmful to plum-trees in this country, though many other trees are also attacked. It is mainly due to the fungus *Stereum purpureum*, though other agencies also produce the same effect—either other fungi or certain physiological conditions not rightly understood. Possibly excessive pruning may account in some instances for the attack. Grease-banding is another factor that seems to favour the disease; the bark becomes rotten under the grease, and the fungus settles on the wounded area. Exposed surfaces should always be protected, and affected trees or parts of trees should be removed.

A parasite on grass new to this country has been described by G. Massee,‡ *Cladochytrium graminis*; it has been notified from various localities. At present it has only been observed on species of *Festuca* and other grasses with small leaves, and in consequence is most prevalent on lawns, tennis-grounds, etc. The fructification is borne on the leaves but falls to the soil, where it continues to mature, and finally attacks the roots.

Carlo Ghirlando § publishes an account of a diseased condition of oranges and lemons, due to a form of the fungus *Cladosporium herbarum*. It formed rather wide-spreading dark spots on the skin, and on microscopical examination it was found that the mycelium had penetrated through the skin down to the pulp of the fruit. He also found a form of *Alternaria* constantly present.

* Agric. Res. Inst. Pusa, Bull. No. 34 (1913) pp. 28–36 (1 pl. and 2 figs.).
† Journ. Board Agric., xx. (1913) pp. 882–90 (2 pls.).
‡ Journ. Board Agric., xx. (1913) pp. 701–3 (1 pl.).
§ Atti Soc. Tosc. Sci. Nat., xxii. (1913) pp. 27–32.

## Lichens.

(By A. Lorrain Smith, F.L.S.)

**Study of Usneaceæ.***—H. Heber Howe is issuing papers dealing with the citations, original descriptions, and type localities of all described species of *Usnea*. In Part I, now published, he gives the species recorded in North America, twenty-eight in number. A synoptic key to these species is provided, and a map showing type localities.

The North American species of *Ramalina* have also been studied by the same author.† The genus is represented in that country by eight distinct species. Heber Howe relies on spore-forms as a leading feature of his classification of the species, the thalline characters serving for further delimitation. He notes that the specimens all show a pale yellow reaction with potash, those on mineral substrata being more pronouncedly yellow.

## Schizophyta.

### Schizomycetes.

**Bacillus hypertoxicus.**‡—Rappin obtained from the viscera and living blood of persons infected by curds and milk in an epidemic at Cholet a bacillus which he designates *B. hypertoxicus*. The bacillus is from 1–5 $\mu$ in length, non-motile, stains well but not by Gram's method, and has a granular appearance. It is easily cultivable both aerobically and anaerobically in the usual media. It forms indol and ferments lactose bouillon. To the guinea-pig and rabbit it is highly pathogenic.

**Amylolytic Microbes of the Intestinal Flora of the Elephant.**§ The microbes which attack starch are found in great quantity in the intestinal flora of the elephant. They are, says J. Schiller, either essential anaerobes, potential anaerobes, or essential aerobes. The majority change starch to sugars; others produce sugars which are transformed into acids; others use up the sugars formed. Those that make sugars preponderate. Among the amylolytic microbes two groups may be distinguished, one proteolytic, the other peptolytic. The proteolytic group includes *B. perfringens*, *B. sporogenes*, *B. megaterium*, *B. mesentericus fuscus*, *B. glycobacter liquefaciens* sp. n., *B. subtilis*. The peptolytic group contains *B. glycobacter peptolyticus*, *B. glycobacter coagulans* sp. n., and *Streptococcus amylolyticus* sp. n.

**Cladothrix dichotoma.**—P. Linde discusses the morphological characters and physiological properties of this organism. After a short review of the literature, he discusses the nature of the vegetative cells, the sheath, and other elements. The size of the cells varied considerably with the conditions of food supply. No true single nucleus was

* Proc. Thoreau Museum Nat. Hist., i. (1913) pp. 15–25.
† Bryologist, xvi. (1913) pp. 65–74 (3 pls. and 3 figs.).
‡ C.R. Soc. Biol. Paris, lxxv. (1913) pp. 110–12.
§ C.R. Soc. Biol. Paris, lxxv. (1913) pp. 304–5.
|| Centralbl. Bakt., 2te Abt., xxxix. (1913) pp. 369–94.

present, but scattered chromatin granules were observed. At the poles of the cells were clear homogeneous protoplasmic masses. Granules of volutin and fat were found, as in certain true bacteria, such as *Sphærotilus volutans*. The form and arrangement of the flagella resembled that of the spirilla. As regards the arrangement of the cells, the breadth of the sheath and the pseudo-dichotomy, the author's work confirms that of previous workers. He could find no confirmation for the observation of Ellis that the spirilla appeared in the development of *Cladothrix*. He considers *Cladothrix dichotoma* Cohn and *Sphærotilus natans* Knetzing to be identical organisms. There is no occasion to separate this species from the Eubacteria (A. Meyer) or Haplobacteria (A. Fischer), but the old view which regards the thread-bacteria as highly-developed allies of the true bacteria is probably correct.

**Bacillus septicæmiæ ranarum.***—F. Venulet and L. Padlewski describe an organism associated with epizootic disease among frogs. The disease is associated with œdema, more particularly of the extremities, and great weakness. Pure cultures were readily obtained from heart-blood, lymph-sac, liver, or spleen. The bacillus is a slender Gram-negative rod, possessing one flagellum, motile, and not forming spores. It is pathogenic for certain fishes, crabs, guinea-pigs, rabbits, and pigeons. The organism forms a toxin to which guinea-pigs and rabbits are susceptible.

**Morphology of Gram-negative Bacilli.**†—K. Shimidsa discusses the appearance presented by indian-ink preparations of *B. coli* and certain other Gram-negative organisms. The central point of each organism shows a black spot, concerning which a number of hypotheses have been enunciated. The author has examined various preparations of these organisms, and concludes that the spot is an area of thinning and that each bacillus is a bi-concave oval disk.

**Contagious Abortion in Mares.**‡—B. B. Lautenbach, after reviewing the existing knowledge upon the subject, gives an account of his investigations on the cause of this disease. Material from eighteen cases of abortion was examined. Cultures from four of these remained sterile: nine gave growth of an organism similar to *B. paratyphosus* A: other organisms of the paracolon and allied types were found in two of these instances. Complement binding, agglutination, and inoculation experiments were carried out. The above organism was found to be pathogenic for mice and guinea-pigs. The author regards it as the causal agent of the disease.

**Physiological Properties of Bacillus coli.**§—C. Revis has studied the changes of fermentative properties shown by *B. coli* and certain allied organisms when grown in peptone water containing malachite-green or brilliant-green. Generally speaking, these reagents—more particularly the latter—have the power of so modifying the character

* Centralbl. Bakt., 1te Abt. Orig., lxxi. (1913) pp. 343-8.
† Centralbl. Bakt., 1te Abt. Orig., lxxi. (1913) pp. 338-42.
‡ Centralbl. Bakt., 1te Abt. Orig., lxxi. (1913) pp. 349-77.
§ Centralbl. Bakt., 2te Abt., xxxix. (1914) pp. 394-410.

of the organism that the gas-producing property in the presence of certain test-substances is reduced or entirely lost, and in certain cases the acid-producing property is also diminished. The author discusses the character of these variations. To a certain extent new permanently varying types may be produced by cultivation in the presence of such reagents.

**Bacillus Ureæ.***—A. Viehoever has carried out an extensive research upon the properties of the group of organisms, which have the power of decomposing urea, which are associated with the ammoniacal changes that occur in standing urine. The types investigated included *Urobacillus pasteurii* Miguel, *Urobacillus leubii* Beijerinck, *Bacillus pasteuri* Migula, *Bacillus probatus* A.M. et Viehoever, isolated by the author of this paper, and *B. Freudenreichii* Migula. Methods of culture, vegetative properties, morphology, biophysical and biochemical reactions, are discussed in great detail. The powers of resistance to certain toxic substances are investigated, and quantitative determinations of the urea-destroying power of known quantities of bacteria are carried out. As regards *B. probatus*, it would seem that this species might be regarded as one of the nitrite bacteria, possessing the property of converting ammonia into nitrite. It is capable of growth in a nitrogen-free medium to which has been added ammonium carbonate.

**Flora of Pasture and Milk.**†—A. Wolff has studied the relation between the bacterial flora of the pasture and of the milk of grazing animals. It was found that, as regards the commoner bacterial types, a very close relationship exists; such types as *Bacillus trifolii*, *B. herbicola*, *B. lactorubefaciens* being recovered from both sources. This circumstance is probably due to primitive methods of milking the animals and to the use of the hay and straw as litter in the stables.

**Keratomycosis Mucorina.**‡—V. Cavara gives an account of a case of corneal infection with a mould belonging to the genus *Mucor*, but which, as far as concerns its pathogenic properties, does not correspond with any species hitherto described. It has received the name of *Mucor cornealis*. The author refers shortly to records of pathological conditions due to moulds, and comes to the conclusion that this is the first case of corneal infection with organisms of this genus. There are well-marked differences between this infection and keratomycosis aspergillina. The author considers in detail the morphological, cultural and pathogenic properties of *M. cornealis* as well as the clinical and pathological features of the disease.

* Centralbl. Bakt., 2te Abt., xxxix. (1913) pp. 209–359.
† Centralbl. Bakt., 2te Abt. Orig., xxxix. (1914) pp. 411–19.
‡ Centralbl. Bakt., 1te Abt. Orig., lxxii. (1913) pp. 23–37.

# MICROSCOPY.

## A. Instruments, Accessories, etc.*

### (1) Stands.

**Watson's Vulcan Metallurgical Microscope.†**—This Microscope (fig. 5) has been produced for the immediate examination of metals at the various stages of manufacture and machining. The manipulation

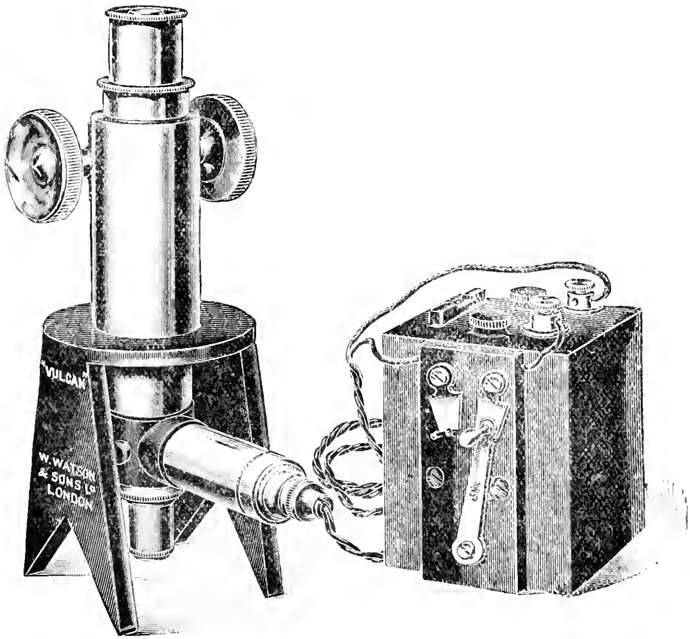


Fig. 5.

of the whole equipment is so simple that no adjustments are necessary other than the rackwork focusing. The instrument can, therefore, be used by those who are not microscopical experts. The stand is so arranged that it will find its own level on any cylinder of metal: for flat surfaces it stands on the four points. The focusing of the objective is by diagonal rackwork and pinion. At the lower end, immediately

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

† W. Watson and Sons' Special Catalogue: Microscopes and Accessories for Metallurgy, p. 5.

above the objective, a modification of the Watson-Conrady new condenser vertical illuminator is fitted, the light from a 4-volt lamp and dry battery being directed to this reflector through a condensing lens. It is important to note that the relative positions of the light, the reflector, etc., are all fixed and cannot be disturbed, so that the whole instrument is in working order directly the light is switched on. Any objective, high or low, can be used, but the power usually recommended is $\frac{2}{3}$ inch.

**Winder's Special Metallurgical Microscope for Observing Structure of Metals under Strain.***—This instrument has been designed by B. W. Winder, and is made by Messrs. Watson. It is intended to

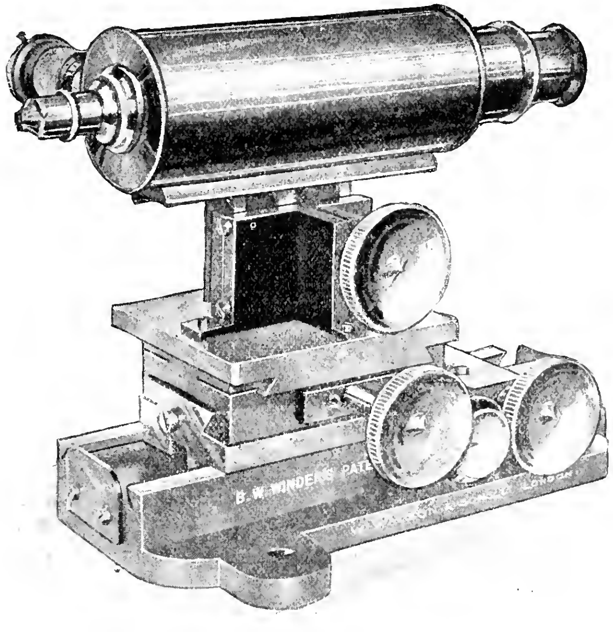

FIG. 6.

work in conjunction with a testing-machine during the time that metal is being tested for its breaking-strain. A testing piece, which has been duly shaped and etched, is placed in the jaws of the testing machine and the Microscope is focused upon it so as to observe and note, either visually, or by projection or photographically, the molecular changes which take place. To accomplish this the Microscope must be supported so as to be unaffected by the vibrations of the testing-machine, and by the shock when breakage takes place. During the process the test-piece of metal becomes gradually stretched, and, in order that observa-

* W. Watson and Sons' Special Catalogue: Microscopes and Accessories for Metallurgy, pp. 16, 17.

tions may be continuously maintained on one spot, the changing position requires readjustment of the instrument. The Microscope is, therefore, equipped so as to meet all these requirements. It will be noticed that all the milled heads are grouped on one side of the instrument so as to be readily accessible. The mechanical movements include:—coarse and fine adjustments to focus, rackwork adjustment to lower and raise the body, horizontal screw adjustment. In each case the mechanical movements are amply sufficient for the purpose in view. A Watson-Conrady condenser vertical illuminator is fitted at the side of the Microscope and built as a part of it. For ordinary visual work the 4-volt lamp is sufficient; but for projection purposes it will be necessary to use an arc-lamp, and the makers have specially adapted the "Argus" arc-lamp for the purpose. It can be used in any supply circuit and requires only four amperes of current, suitable resistance being of course inserted. Fitted to the lamp is an aplanatic bullseye of such a diameter that, when it is in proper position, the parallel beam of light which issues from it will keep the vertical illuminator filled with light during all the vertical movement that would be necessary in observing the testing-piece. For projection purposes it will generally be found that a sheet of cardboard, or of linen, free from creases and about 24 × 18 in., set up at a distance of 6 or 7 feet from the Microscope eye-piece, will be the most suitable. It is found that the structural changes which take place in the test-piece are of great importance, the information thus conveyed being not only very interesting but very valuable.

**Watson and Sons' Micrometer Microscope.***—The production of a Micrometer Microscope that will give readings of the accuracy that is invariably desired is fraught with complications and difficulty. Many instruments are made which are stated to give measurements to several thousandths of an inch, but they frequently fail to give even accurate readings in hundredths, not only on account of infinitesimal backlash and strain in the screw movements, but also because of the lack of exact co-ordination between the divided scales and the pitch of the screw, on the drum heads of which fractions of the scales have to be read. Messrs. W. Watson have produced an instrument (fig. 7) which they hope will satisfy the utmost demands in respect of accuracy. It will be noticed that the Microscope is made on the same principle as an ordinary instrument in the upper portion. It has coarse and fine adjustments to focus, the vital portion being the stage. The subject to be measured is placed between adjustable jaws A, and in order to save time, a quick-acting screw B is provided, by means of which a long subject can be moved rapidly across the field to the extreme point that is to be set. The horizontal movement is then effected by means of a standard micrometer screw C, which may have a thread in milimetres or inches, reading to $\frac{1}{1000}$ in. or $\frac{1}{100}$ mm. The scale D exactly corresponds with the screw. It is verified to be in correspondence with the screw thread, that is, if the screw thread is reputed to produce a movement of $\frac{1}{40}$ inch

* W. Watson and Sons' Special Catalogue: Microscopes and Accessories for Metallurgy, pp. 19–20.

or 0·5 mm. per turn, as the case may be, that amount will be recorded on the scale with unerring accuracy, and thereby enable fractions to be read on the drum of the micrometer. To obviate backlash, the screw works against a spring which is coiled in a box, thereby abolishing the inaccuracies that creep in on account of strain and backlash. The range of screw movement with the micrometer is one inch. If a greater length is required than this, the stage is moved by means of the quick-acting screw for a further inch, and a pivot bar F, exactly one inch in length is interposed between the end of the micrometer and the

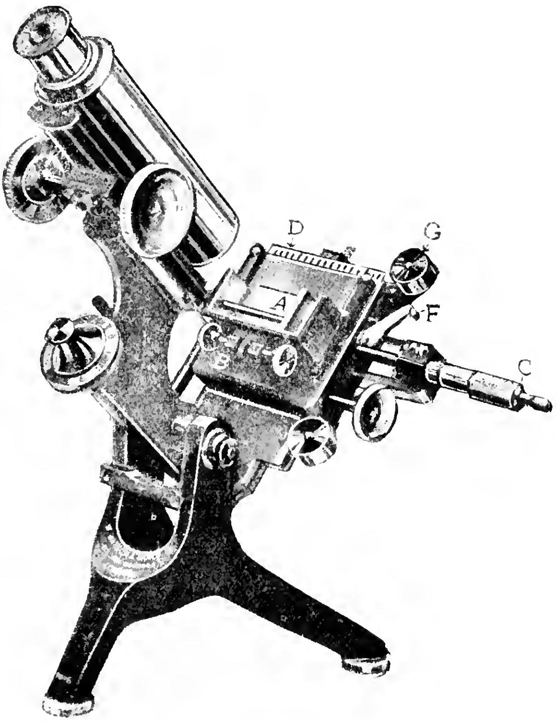


Fig. 7.

stage plate. This enables measurements up to 2 inches in length to be taken. The vertical movement is effected by means of a rack-and-pinion which again is maintained with a tension coiled spring shown at G. A divided scale of the same accuracy, reading by means of a vernier to $\frac{1}{10}$ mm. or $\frac{1}{250}$ in., whichever may be preferred, is fitted. The greater portion of the measurements are intended to be made in conjunction with the horizontal movement, hence the vertical movement is not provided with the same conveniences for fine measurement. These could, however, be provided, if required. The eyepiece is fitted with a single line for setting and reading, the two ends of the subject to be measured being carried by means of the stage micrometer screw, so that the extreme edge is exactly on the eye-piece line. The eye-piece can be rotated for vertical measurements. For measuring screws a divided circle is fitted to the top of the body tube, so that by rotating the eyepiece, and reading on the divided circle in conjunction with the stage movements, the diameter, angle, and depth of cut can be exactly ascertained.

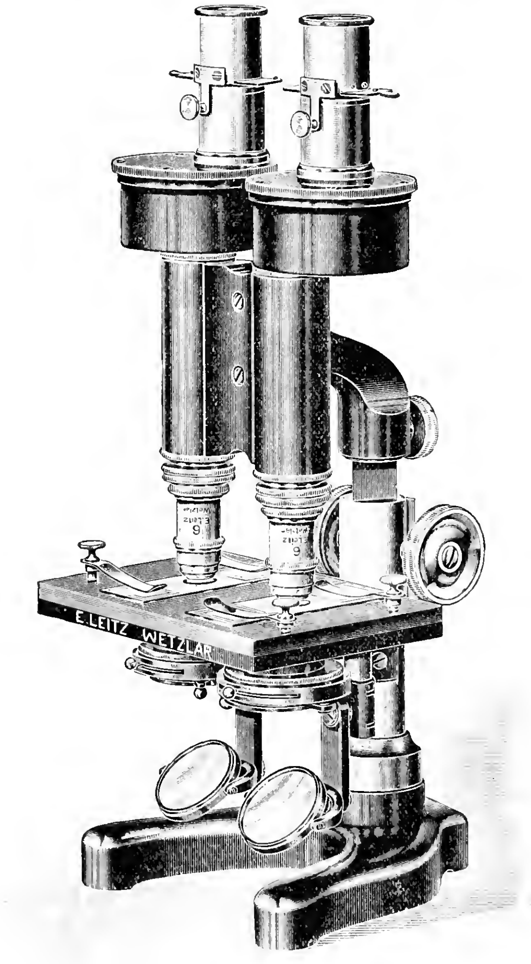


Fig. 8.

**Leitz' Double Microscope.***—C. Metz describes this apparatus, which has an optical equipment essentially different from other forms of appar-

* Zeitschr. wiss. Mikrosk., xxx. (1913) pp. 188–91 (2 figs.).

atus intended for observation with both eyes. It consists of two Microscopes combined on a single stand. Each of these Microscopes possesses a complete optical equipment: mirror, illuminating apparatus, objective, and ocular. The stage is unusually large so as to receive two preparations. The coarse adjustment, which is by rack-and-pinion, acts simultaneously on the two combined tubes. Two fine screws between the tube and objectives serve as fine-adjustment. For regulation of the ocular width an arrangement is adopted similar to that used in the Greenough Microscope, and, as in the same instrument, the images are directed upwards by Porro prisms. The upper tube parts, containing the Porro prisms and the oculars, are both movable. The result is that the optical axes are moved parallel to one another and thus impinge on the observer's ocular width; both images therefore enter his eyes. The images overlap in accordance with that wonderful property of the eye, whereby an image received from the one eye is conveyed by means of a central nerve station to the other. But these images are usually not alike. If the objects can be so arranged that the resultant images group themselves separately in one field of view, both objects can be compared without any further precautions. If the objects do not lend themselves to this, as indeed is usually the case, the semicircular stops are applied to both oculars to stop out half of each field of view in such a manner that in the eye two semicircular fields form a complete circular field, in which both objects separated by a scarcely visible line of demarcation can be observed and compared. If it be desired to observe consecutively both complete images in quick succession, the stops can be opened and shut by a left and right movement. This property makes the double Microscope especially adapted for the comparison of healthy and unhealthy organs, or of adulterated and normal foodstuffs. It would be also possible to compare two objects under different conditions of magnification, of illumination, of bright and dark ground, of ordinary and polarized light. With the usual accessories the instrument could be used as a petrological Microscope for the examination of minerals. Its application to colorimetric and spectroscopic tests readily suggests itself. It is, moreover, pre-eminently suitable for stereoscopic observations.

Fig. 8 shows this instrument externally.

### (3) Illuminating and other Apparatus.

**Zeiss Pocket Refractometer for Mineralogists and Jewellers.*** F. Löwe describes this instrument, which has been constructed at the suggestion of the gem expert W. Rau, and which involves an adaptation of the Bertrand-Leiss refractometer. The principle of this refractometer depends on observing the angle of total reflection of rays incident on a face of the crystal, the rays having previously passed through a flint-glass hemisphere horizontally placed and rotatory about its vertical axis. Fig. 9 shows a portable form of the instrument. The mirror *Sp* is adjustable and reversible, so that it can be used for downwards or

* Zeitschr. f. Instrumentenk., xxxiii. (1913) pp. 108–11 (2 figs.).

upwards light. The light can also reach the crystal K horizontally through a diaphragm: H is the hemisphere. After total reflection at the flint-glass-crystal surface the light rays pass into the reflection-prism P, and through the ocular-scale Sk. in which lies the limit-line (Grenzlinie) and are observed through the ocular O, which can be tilted about the hinge A, and is independent of the ocular scale. The ocular tube can be inclined by means of the position-screw St, and the hemisphere can be rotated by the screw-head G. It will be noted that the hemisphere partly functions as a telescope objective. The angle really measured is that between the normal to the crystal face and the limit-

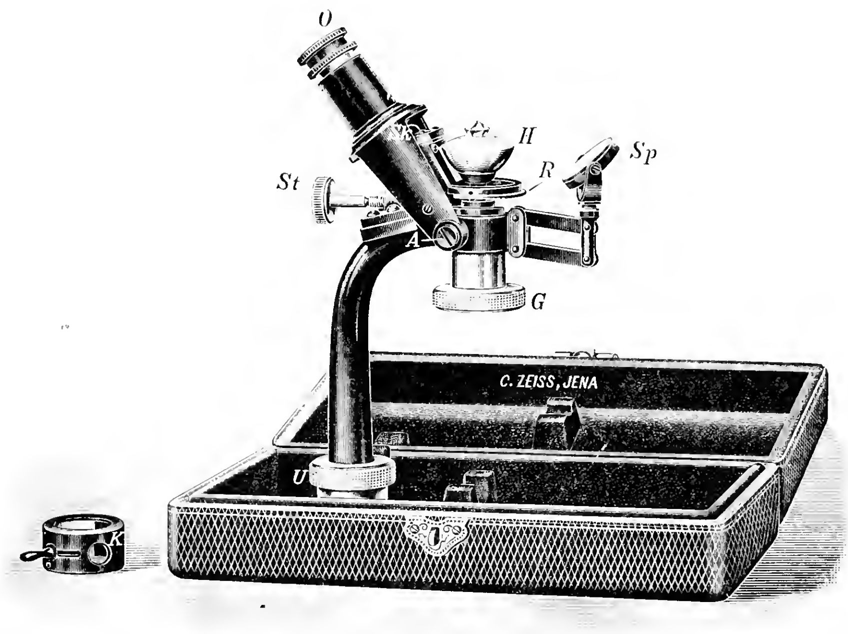


FIG. 9.

rays yielding the limit-line, i.e. the limit-angle of total reflection. The pillar of the instrument is provided with a bayonet-clutch by which it can be secured to a cast-iron base for laboratory use. In the portable form the same clutch is attached to an arrangement on the floor of the case. A diaphragm cap fits on to the ring R, so that extraneous light can be excluded and the incident beam admitted through a little window. Ordinary daylight suffices for the illumination, and the accuracy attainable is within one to two units of the third place of decimals. The readings are taken on the cylindrical-shaped ocular scale Sk and range up to $n_D = 1 \cdot 85$. The axis of this cylinder is such that, on being tilted into the vertical position, it would, if the prism were removed, pass through the centre of the hemisphere H. When the ocular is tilted about the hinge A, the limit-line can be brought into its axis, and therefore can be read off with all desirable sharpness.

**Watson-Conrady Condenser Vertical Illuminator.***—This instrument is shown in fig. 10, and is intended to obviate the difficulties experienced in working with a vertical illuminator. The objects attained by this piece of apparatus are :—1. Bringing the illumination under a control as complete as that which is obtained with transparent objects and the best substage apparatus. 2. Obtaining the brightest possible illumination from small sources of light. 3. Simplifying and rendering certain the correct placing of the illuminant, whether it be supplied as a fixed portion of the apparatus or separately. 4. Rendering unnecessary the usual short mounting to objectives for metallurgy. Reference to the diagram will show that it is built on the plan of a condenser system in miniature complete with lenses and iris diaphragm. The reflector, which is mounted in a central box, is a large transparent plate. For general purposes a small 4-volt electric lamp may be fixed in a suitable position at the end of the condenser system, and, when work is to be

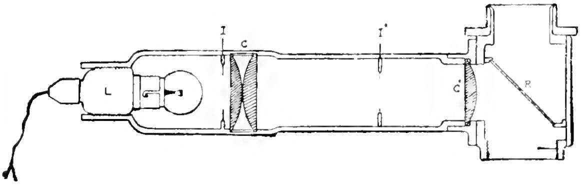


Fig. 10.

done, it is only necessary to switch on the current from the battery and everything will be found to be in good order. With this an illumination can be obtained sufficient for visual or photographic purposes. A specially constructed 25 candle-power lamp of small size is also supplied with fittings to attach to the illuminator, and this lamp can be connected to the ordinary current supply. If an independent illuminant is used, it should be set about $1\frac{1}{2}$ in. from the outer end of the tube. Any small source of light can be used, such as the edge of an oil lamp flame, or, if a very brilliant illumination is required for projection, a small arc-lamp should be used, such as the makers' "Argus."

The apparatus is used in the following manner :—The illuminator is attached to the nose-piece of the Microscope, the objective is screwed into it, and approximately focused on the polished metal objects. The light is turned on, and the illumination is then regulated by the inner iris diaphragm so as to cover the extent of the object actually under observation. This eliminates a large amount of stray light, and a consequent gain in contrast in the image is obtained. The iris diaphragm nearest the illuminant is then used in precisely the same manner as that of the ordinary substage condenser, and by its means the cone

* W. Watson and Sons' Special Catalogue: Microscopes and Accessories for Metallurgy, pp. 28–9.

of illumination is adjusted to give the best effect. The illuminator can be fitted with a permanently attached metallic filament lamp, which reduces to a minimum the trouble of setting-up and adjustment. Further, it enables metallurgical work to be done on an ordinary Microscope.

**Wychgram's New Low-current Microscopical Lamp.***—E. Wychgram points out that a microscopist's lamp should satisfy the following requirements :—Stability and compactness, with light-control : applicability both to optical bench and to work-table ; maximum light-production with minimum energy-consumption : simplicity of construction and of eventual repairs ; absolute invariability of the position of the light-spot. The author points out that all these requirements are only satisfied by the use of right-angled carbons, the horizontal crater carbon lying in the optical axis. Even in such lamps of small dimensions the invariability of light-spot can be depended on. Automatic action combined with applicability either to optical bench or to work-table is not so easily attained, and, so far as the author knows, is only attained by a new form of Leitz lamp, which has, furthermore, the advantage of extreme compactness. This new Leitz lamp consists of a plane-sided rectangular box containing the rackwork for the carbon-holders. The positive carbon is moved forward parallel to the upper surface and lies horizontally in the optical axis : the negative carbon is vertical and parallel to the front surface. Behind the box and secured to it is a clock-work, which, although of equal thickness, is half as large as the lamp-box : it is worked with a pendulum with a hair-spring and simple escapement, and can be delicately regulated. The clockwork is controlled externally so that the approximation of the carbons equals the velocity of carbon consumption. The gearing is large and strong, and the risk of magnetic attraction of the steel parts appears to be insignificant. A small hand-wheel regulates the coarse adjustment, the combustion of the lamp, and the length of the arc, exactly as in the Zeiss-Wenle lamp. Some of the lamp data are :—Current intensity, 4–5 amp. ; length of positive and negative carbons, 15 cm. : thickness of positive carbon, 8 mm. : ditto of negative, 6 mm. ; combustion duration, 2 hours ; periodicity of clockwork, 8–10 hours ; focal length of condenser lens, 75 mm. ; weight of lamp without foot, 1·36 kgm. ; thickness of pillar for rider, 10·8 mm. ; minimum distance at which the lens yields an image of crater, 80 cm.

The lamp is easily equipped with a U–V filter and can, therefore, be adapted to luminiscent investigations.

**New Safety Device for High-power Lenses and Cover-glasses.** This instrument (fig. 11) was exhibited and described by C. E. Heath at the November Meeting last year.† A gives the plan and elevation ; B shows it in use on an ordinary stage ; C is a modified form as adapted to an open mechanical stage. In use the apparatus is placed over the objective threads and the lens screwed home. The tube is then racked up till the chain can be slipped over the milled head so as to

* Zeitschr. wiss. Mikrosk., xxx. (1913) pp. 203–5.
† See this Journal, 1913, p. 644.

hang on its stem. When racked down and the focus found, the chain can be drawn taut by turning the adjusting screw at the bottom. The coarse adjustment is thus deprived of further extension downwards, while the fine adjustment is left quite uncontrolled. The protection given by the first form is the more reliable as the fine adjustment is limited also.

For a somewhat similar device see this Journal 1904, p. 114, where a "Focusing Safeguard" devised by S. E. Dowdy is described and illustrated.

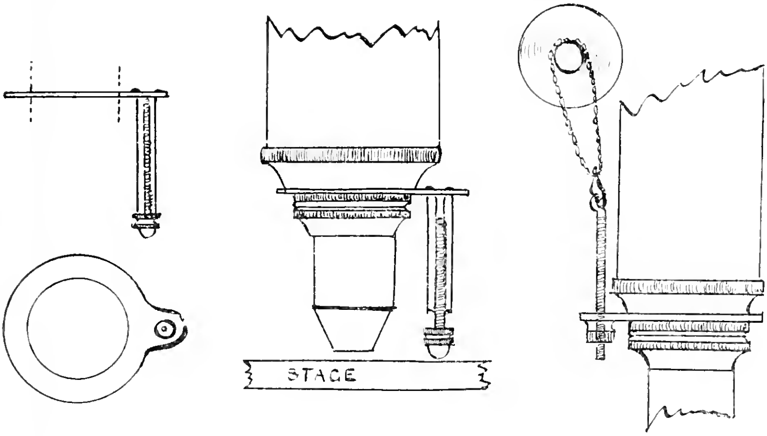


FIG. 11.

**New Epidiascope.***—W. Freiherr of Wieser has designed some improvements in Zeiss' epidiascope for the purpose of producing episcopic projections of very large objects. His desire was to make the apparatus capable of showing the corpse of a fully grown person, and he has been quite successful in attaining his purpose.

**Simple Method for Obtaining Photomicrographs.**†—K. Huldschinsky describes a simple and inexpensive method of obtaining photomicrographs when a projection apparatus is not at hand. He uses for this purpose Leitz' drawing apparatus (fig. 12), which consists of a small mirror obliquely placed over the tube of the Microscope; the most convenient light-source being Leitz' hand-regulated arc lamp, and the picture to be drawn being projected on to a sheet of paper near the Microscope. For the paper, however, the author substitutes a photographic plate. He screens off the whole light-field between mirror and plate with black paper, and, furthermore, confines the light within a piece of black cardboard inserted so as to enclose object, objective and Abbe condenser. The screen-paper might be replaced by a cardboard box.

* Anat. Anzeig., xlv. (1913) pp. 21-31 (4 figs.).
† Zeitschr. wiss. Mikrosk., xxx. (1913) pp. 206-7 (1 fig.).

with blackened inner surfaces, the mirror being set obliquely in one of its sides. The box has a lid for the adjustment of the image, and laterally a catch for the insertion of the plate. The plate must be laid on a frame of corresponding size whose under surface can be raised or lowered to the height required for the image. In arranging the adjustment a piece of white paper the size of the plate is first laid in the frame. The insertion of the actual plate must naturally be performed in complete

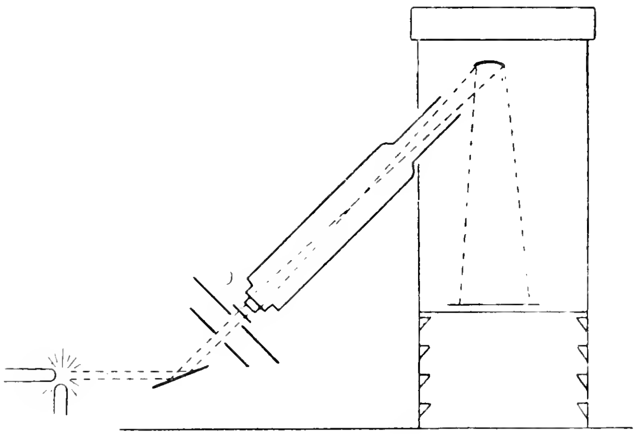

Fig. 12.

darkness. The light-exposure depends on the light-strength and magnification, and varies from fractions of a second up to two seconds. The author finds that with this apparatus very useful photomicrographs can be taken.

### (5) Microscopical Optics and Manipulation.

**Exercises in Scientific Microscopy.***—Part 2 of this series has now been published, and has been compiled by H. Ambronn and H. Siedentopf. It is exclusively devoted to Abbe's theory of the Microscopic image. All the usual grating experiments with their effects on pleurosigma angulation are collected and described in such a form that they may be easily followed by the student. The experiments are copiously and clearly illustrated.

Ainslie, M. A.—**Microscopical Measurement of Magnifying Power: Measurement of Numerical Aperture.**
[Two very practical and interesting letters on the above subjects.]
*English Mechanic*, xcviii. (1913) pp. 60 and 111.

Orueta, Domingo de—**La luz ultra-violeta y sus aplicaciones en microscopia con un resumen de los trabajos hechos en el laboratorio del autor durante el año 1911 y primer semestre de 1912.**
[The author gives a very complete account of ultra-microscopical methods and of the results obtained.]
Reprinted from the *Revista de la real Academia de ciencias exactas, fisicas y naturales de Madrid* (1913) 92 pp. (14 pls.).

* Ubung. zur Wiss. Mikrosk. Leipzig: S. Hirzel, Heft 2, 28 pp. (39 figs.)

### (6) Miscellaneous.

**Quekett Microscopical Club.***—The 493rd Ordinary Meeting of the Club was held on November 25, 1913, the President, Professor A. Dendy, F.R.S., in the chair. The President described a "Red Water Phenomenon due to *Euglena*." J. Burton (Hon. Sec.) read a note "On the Disk-like termination of the Flagellum of some *Euglenæ*." Earliest reference to this was *Science Gossip*, 1879. Saville Kent, "Manual of Infusoria," p. 382, refers to the same phenomenon. After careful investigation the writer had to come to the conclusion that there is no disk, no bulb, or sucker, or anything of the sort or the end of the flagellum. The appearance is due to the "kinking" of the protoplasm of the flagellum, a quite common occurrence, and the "disk-like" appearance is observed when the distal end has happened, in coiling or kinking, to touch a part of the flagellum just behind the end, and has, in fact, overlapped and adhered to it. J. Burton also read a note on "A Method of Marking a given Object for Reference on a Mounted Slide." When the object is large enough to be recognized with a hand-lens, place a dot of water-colour over it large enough to be seen with the naked eye. When dry turn a small ring of dark cement round it on a turn-table. When the cement is hard, remove the water-colour with a damp brush. For objects too small to be recognized without a higher power—find and centre the object with a suitable power. For the objective first employed substitute a water-immersion say, a $\frac{1}{10}$; put on the front lens as small a drop of water as can be used, carefully focus, and centre. Then rather sharply raise the Microscope tube, and a tiny circular spot of water will be left on the cover-glass over the desired place. Colour this drop with water-colour, dry and ring as before. Any close-working objective may be used for this purpose if a water-immersion is not available. E. M. Nelson, F.R.M.S., "On the Measurement of the Initial Magnifying Powers of Objectives."

The 494th Ordinary Meeting was held on December 23, 1913. B. M. Draper exhibited and described "A Live Box for the Observation of Insects and similar Objects." He also recommended the use of the ordinary concave Microscope mirror, employed with lamp and bullseye, for the illumination of any large opaque object under the lowest powers. The mirror should be made removable, and can then be fixed, when required, to the upper side of the stage on the end of a jointed arm giving universal movement. B. M. Draper, "Dark-ground Illumination with the Greenough Binocular Microscope." The best form of patch-stop was found to be two small circular patches placed side by side and opposite the two front lenses of the twin objectives. E. M. Nelson, F.R.M.S., "A Peculiar Form of Diatom." E. M. Nelson, F.R.M.S., "On *Amphipleura lindheimeri*." A coarser form of this well-known test has been found having 67,000 striæ per inch instead of about 77,000 in the older form. The new *Lindheimeri* may be recognized by its very long terminal nodules, each nodule being one-third of the whole length of the valve.

In the old form the ratio was one-fifth. The length-breadth ratio in the new form is 7 : 5, in the old 8 : 5.

WRIGHT, F. E.—(1) **Graphical Methods in Microscopical Petrography.**
(2) **Graphical Plot for Use in the Microscopical Determination of the Plagioclad Feldspars.**
*Amer. Journ. Sci.*, xxxvi. (1913) pp. 509–42 (10 pls.).

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Cultivation of Cladothrix dichotoma.**†—The material for cultivation was obtained from a ditch in the neighbourhood of a sewer. The water was turbid and contained organic impurities. In the month of July a strong growth of green plants was found at the edge of the ditch. Some leaves were taken, examined for the presence of cladothrix, and placed in a 0·5 per 1000 meat extract fluid in glass cylinders provided with close-fitting lids. These cylinders were kept, some in daylight, some in the dark. Vorticellæ and such types died out within twenty-four hours. After two or three days filaments of cladothrix were seen attached to the leaves. These were freed from the leaves and transferred to fresh fluid. After several such transferences to remove as far as possible extraneous organisms, the filaments were transferred to agar plates containing 0·05 p.c. meat extract. The cladothrix filaments on this medium soon outgrew the other organisms. A pure culture thus obtained was sealed up and kept under anaerobic conditions. It was found alive after two months.

P. Linde further describes the characters of the culture. It contained threads of varying dimensions, and it was thought possible that more than one species was present. Single-filament cultures were examined by means of the Indian ink method, and it was found that the same variations in size were to be observed.

**Egg-broth.**‡—A. Besrekda and F. Jupille have found that many organisms grow well on a medium containing four parts of white of egg (10 p.c. solution) in distilled water, one part of yolk (10 p.c. solution), and five parts of peptone broth. Such organisms as pneumococci, meningococci, gonococci, *B. melitensis*, and *B. pertussis* of Bordet and Gengou grew luxuriantly, and retained their vitality for several months. On a modified medium, containing 100 c.cm. of broth without peptone, 20 c.cm. of white (10 p.c.), and 5–20 c.cm. of yolk of egg (10 p.c.) tubercle grew with remarkable luxuriance and rapidity. A tuberculin

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

† Centralbl. Bakt., 2te Abt., xxxix. (1913) pp. 372–5.

‡ Ann. Inst. Pasteur, xxvii. (1913) pp. 1009–17.

prepared from such a growth was found capable, when combined with serum from a tuberculous patient, of binding complement.

**Cultivation of Spirochæta recurrens.***—S. Hata gives an account of his work undertaken in order to confirm that of Noguchi upon the cultivation of *S. recurrens*. Noguchi used fresh ascitic fluid in which a small piece of rabbit-kidney was immersed. This is inoculated with a small quantity of blood containing *S. recurrens*, and the organism multiplies when incubated at 37° C. for two to three days. The maximum growth is reached on the eighth day. Spirochætes thus cultivated show a tendency to rapid degeneration. Hata found it quite unnecessary to cover the ascitic fluid with paraffin oil as Noguchi had recommended. He found also that serum could be substituted for ascitic fluid. Blood was drawn from the veins of a horse into a tall cylinder, and set aside for the serum to separate. Serum is then put into tubes and mixed with normal saline: one part of serum to two of saline. The depth of fluid in each tube is about 7 cm. The tubes are placed in a water-bath at 58° C., heated slowly to 70° C., and kept at that temperature for thirty minutes. This semi-coagulated mass is a satisfactory substitute for Noguchi's ascitic fluid. Small pieces of rabbit's kidney are pushed into the mixture to rest at the bottom of the tubes. Hata found that the buffy clot from normal horse's blood may be used instead of kidney with equally good results. This part of the clot is cut into small pieces and pushed down to the bottom of the tube. This medium may be used in place of Noguchi's; the materials are more readily obtained, and uniform results are obtained.

**New Medium for Cultivating Gonococcus.**†—Aug. Lumière and J. Chevrotier declare that the medium they have devised is eminently suitable for the cultivation of gonococcus. It is prepared as follows: A solution of 6 grm. of albumen in 1000 c.cm. of beer wort is autoclaved at 115° C. The medium is filtered while hot, and, after having been alkalinized, it is sterilized again at 110° C. for ten minutes.

It is advantageous to add 1·5 c.cm. horse or ass serum to 15 c.cm. of the wort medium, but this addition is in no wise indispensable. During sterilization it is important that the tubes should be kept sloped. This recommendation presumably refers to the second sterilization. Gonococcus, whether old or recent, flourishes in this medium, and its cultivation is as easy as that of the majority of micro-organisms. The authors mention that different races of gonococcus, recognizable by their size, retain their primitive characteristics even unto the tenth generation.

### (3) Cutting, including Embedding and Microtomes.

**Leitz' New Sledge Microtome.**‡—This apparatus, which is described by S. Becher, resembles the Minot type of microtome to the extent that the knife is stationary and the object movable. As will be seen

* Centralbl. Bakt., 1te Abt. Orig., lxxii. (1913) pp. 107–12.
† Comptes Rendus, clvii. (1913) pp. 1097–9.
‡ Zeitschr. wiss. Mikrosk., xxx. (1913) pp. 192–202 (2 figs.).

from figs. 13 and 14, the object-portion consists essentially of a heavy metal block, of rectangular shape, which slides in a groove made in the upper surface of the heavy base-plate. The longer lower edges of this block are to a certain extent rounded off so as to minimize friction, and the movement is kept true by the presence of the vertical lateral faces of the block against the vertical faces of the groove. A slight allowance is made in dimensions, so that the block runs smoothly in its groove and jamming is impossible. As the block has been intentionally made very heavy, it cannot jump when the object meets the knife. Moreover, the object-holder is placed in the axial line of the block, and this arrangement secures that the resistances of object and knife are

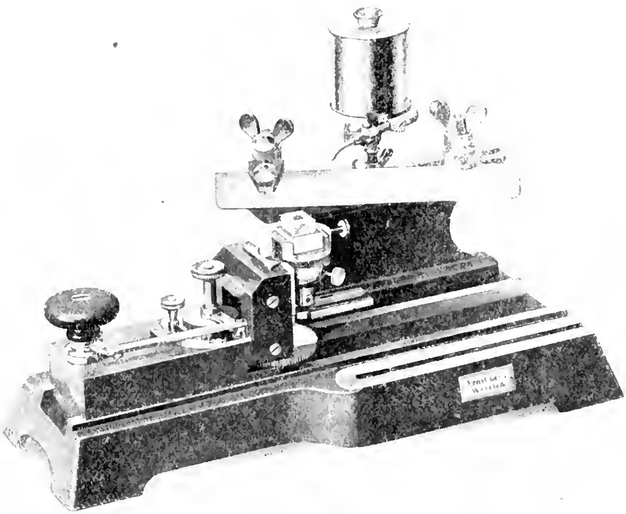

Fig. 13.

collinear with the axis of movement. The effect is, therefore, still further to reduce any risk of oblique disturbance of motion.

The object-block is operated by a knob rotatory on a vertical axis and geared to a disk, which again is geared to the object-holder. The disk is divided into 20 divisions, each of which corresponds to an elevation of 1 $\mu$ of the object-holder. The pointer of the disk is therefore set to correspond with the required thickness of section. A right turn of the operator's hand on the knob, puts the gearing into action, and therefore causes the elevation of the object; a left turn then brings the knob back to zero. The order of operations would be: rotate knob to right, push forward, cut, draw back, rotate knob to left. Or the order might be: rotate knob to right, push forward, cut, rotate knob to left, draw back. It is found that after a little practice one hand can perform these actions automatically, and therefore operate the whole machine. Thus the operator's other hand is free to look after the section-ribbon or for other purposes. The essential part of the object-holder is a micrometer spindle gripped by Leitz' well-known forceps-nut. The spindle itself glides without lateral disturbance in a swallow-tailed groove in the base-plate and is clamped from below. The knife may be fastened with one clamp or with two, and the knife below is provided with a scale for controlling the knife-inclination. The pillars for knife-attachment are connected with a broadened portion of the base-plate. The pillar used for single-clamping is permanent, but that used for the second clamp (fig. 14) works in a groove and is secured in its required position

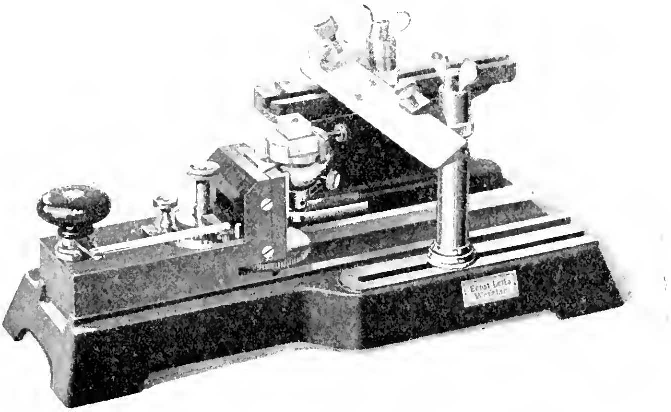

FIG. 14.

by a butterfly-nut attached to its base. The knife can be raised by the insertion of metal rings under the clamps. The author speaks highly of the accuracy and uniformity of the sections obtained by this machine.

**Modification of Altmann's Method of Staining Chondriosomes.*** H. Kull gives the following procedure:—Fixation in 3·5 p.c. bichromate of potassium, 80 c.cm. + 20 c.cm. 40 p.c. formalin for twenty-four hours, after which the pieces are transferred to the bichromate solution without formalin for three to four days. The pieces are then washed in running water and paraffin sections made. Celloidin sections may be prepared by Rubaschkin's method (see this Journal, 1907, p. 633).

Another method of fixation by means of osmic acid mixtures gives

* Anat. Anzeig., xlv. (1913) pp. 153-7.

good results. Small pieces are placed for twenty-four hours in a mixture of 7 parts of 1 p.c. chromic acid, 7 parts of 3 p.c. potassium bichromate, and 4 parts of 2 p.c. osmic acid. After removal they are washed in distilled water and then placed in a mixture of 1 part acid acet. pyrolignosum rect. and two parts of 1 p.c. chromic acid. After twenty-four hours they are washed for half an hour in distilled water, and then placed for three days in 3 p.c. bichromate of potassium. They are then washed in running water and afterwards embedded. The preparations are then treated in the following manner:—1. Stain, heating to vaporization, with Altmann's acid-fuchsin (20 grm. acid-fuchsin in 100 c.cm. anilin water). 2. Wash with distilled water. 3. Stain for 1 to 2 minutes in a saturated aqueous solution of thionin, or in a 0·5 p.c. aqueous solution of toluidin blue. 4. Wash in distilled water. 5. Differentiate with 0·5 p.c. solution of aurantia in 70 p.c. alcohol (20 to 40 seconds controlling under the Microscope). 6. Dehydrate in 96 p.c. alcohol, 7 absolute alcohol, 8 xylol of balsam.

The balsam used by the author is Merck's glass-hard balsam dissolved in pure benzol. Preparations mounted in this medium have kept unchanged, while controls mounted in other varieties of balsam have materially deteriorated.

**Diagnosis of Rabies.***—Lena Negri Luzzani gives the technique by which the specific parasite of rabies may be demonstrated. She first describes the procedure for opening the skull and removing that portion of the brain known as the cornu ammonis. A minute portion of the nervous substance is placed on a slide and teased out with very dilute acetic acid. In this way a fair number of nerve cells may be isolated and the intracellular parasite detected. When it is not possibie to carry out the foregoing technique at once, or if the examination has been negative, it is advisable to immerse small pieces of the cornu ammonis in Zenker's fluid: Bichromate of potassium, 2·5; corrosive sublimate, 5; water, 100; adding before use acetic acid 5. The small pieces are sufficiently fixed in from two to four hours, and then they are washed in water for a few minutes. Very little bits are then teased out on a slide and examined as before. It is easier to find the parasite after fixation by Zenker than in the fresh material. In certain cases it is necessary to investigate by means of sections. Paraffin sections are made in the usual way and then stained by Mann's method. The staining solution consists of aqueous solution of eosin, 1 p.c. 45 c.cm.; aqueous solution of methylen-blue, 1 p.c. 35 c.cm.; distilled water 100 c.cm. The eosin and methylen-blue solutions are to be mixed when required for use. The sections remain in the stain for about half an hour, and on removal are immersed in absolute alcohol for several minutes. When dehydrated they are differentiated in alkaline alcohol (absolute alcohol, 30 c.cm.; caustic soda dissolved in absolute alcohol, 5 drops). Differentiation is continued until the sections lose the blue and become quite red. After a rapid wash in absolute alcohol the sections are plunged in tap-water, and then in distilled water acidulated with acetic acid. In the last bath

* Ann. Inst. Pasteur, xxvii. (1913) pp. 1039-62 (1 pl. and 3 figs.).

they turn blue again; and then follow dehydration in absolute alcohol, xylol, balsam. Under the Microscope the parasites are stained red, and exhibit their characteristic appearance while the nucleus and cytoplasm are blue.

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

**Use of Glycerin-jelly in Mounting Microscopical Objects.†** L. W. Stansell, after remarking that mounting with this medium is quite simple, gives the following procedure:—The jelly in the stock-bottle is allowed to become liquefied by standing in the water-oven; should it contain air-bubbles, time must be given for these to rise and escape. A few clean 3-in. by 1-in. glass slips are ready upon a flat bench; then, with a glass rod, one drop of the limpid jelly is carefully placed on the centre of each slide, the drop not being allowed to fall from the glass rod, but almost *placed* in position. The drop of jelly soon sets to a clear, lens-like form, usually free from air-bubbles. Should one, however, be seen, it can be dispersed with a warm needle, or else by the same means drawn to one side and pushed out of the way before the jelly sets. These prepared slides are ready for immediate use, or if preferred they can be stored in a box out of the dust for some days until wanted. It is important to have objects for mounting in the moist condition; particles of fibre from feeding-stuffs will already be in that state if the material has been prepared for the determination of cellulose; they can be taken direct out of the final washing water. Portions of dry leaves, mosses, and similar structures are soaked for some days in a preservative fluid consisting of distilled water 2 parts, rectified spirit 1 part, and glycerol 1 part. Each specimen is kept in a small bottle or tube with a little of the fluid; it gradually penetrates and will displace the air, more speedily if put in a warm place. Some tissues previous to this soaking may even be boiled in distilled water and allowed to remain there till cold. The air-free water helps to dissolve out residual air. A simple method of preparation to employ for leaves—tea, for instance—is to raise cautiously to boiling in a test-tube with dilute nitric acid, and then freely dilute with water. If the structures float owing to imprisoned air, further boiling in water is necessary before proceeding to wash. The cuticle separates and can easily be stripped off. The fragments of husk, cuticle, etc., are taken while wet and gently laid with forceps upon the flat bead of solid jelly, the excess of water or other fluid allowed to drain off for a moment, and then the slide slowly warmed over a very small flame. The jelly melts, and the object *in situ* will sink into the liquid jelly without as a rule the introduction of a single air-bubble. The cover-glass is applied and gradually lowered, placing a flattened bullet on it to keep it in position, then left for some minutes till the slide has set. Not much pressure should be exerted, or the cover-glass may have a tendency to spring up afterwards. At this stage the mount admits of microscopical examination. When this is completed, the processes of finishing the slide can be proceeded with, or, if desired, held over, and the slide reserved for treatment with others. Sediments and other finely divided

* Journ. Soc. Public Analysts, September 1913.

objects need different treatment. When mounting the deposit obtained from a water, or the washed residue from Demerara sugar, a conical settling-glass is provided, and when all suspended matters have settled, as much as possible of the supernatant fluid is decanted off until only a drop or two remains. The drop that is left, containing the residue of suspended matter, is poured over the bead of glycerin-jelly already solidified on a slide. By now placing this slide overnight in a level position in a desiccator, the water will be found next day to have become absorbed, leaving the sediment in position on the surface of the jelly. If now gently warmed and a cover-glass adjusted, any fine residue of suspended matter from water can be more successfully retained and fixed by such means than the usual methods of treatment allow.

### (6) Miscellaneous.

**Crystallization of Coumarin.***—At the November Meeting, 1913, G. H. Beaumont exhibited slides illustrating the crystallization of Coumarin (from Tonkin Bean). These slides were prepared by fusion. When cooled at the ordinary temperature, Coumarin crystallizes in a translucent grey-white mass, and shows little or no colour when viewed by polarized light. When allowed to cool more slowly it sometimes exhibits characteristic fan-like crystallization which is weakly doubly refracting. When crystallized under pressure it becomes highly doubly refracting, and exhibits the fine colour effects which were shown in the exhibits.

## Metallography, etc.

**Arsenic in Commercial Copper.***—P. Jolibois and P. Thomas have studied the microstructure of copper-oxygen, copper-arsenic, and copper-oxygen-arsenic alloys, to ascertain if copper can be deoxidized by additions of arsenic. It was found that arsenic additions did not affect the quantity of cuprous oxide present in oxygen-containing copper, but altered the appearance of the cuprous oxide globules, causing them to be larger and less numerous. Arsenic forms copper arsenide which enters into solid solution in copper, and accordingly does not deoxidize copper. Antimony has a similar effect. Tin, zinc, and magnesium remove oxygen from copper, and lead has some deoxidizing effect. Ammoniacal cupric chloride solution was used for etching.

**Acicular Constituents of Alloys.**†—F. Robin describes in detail constituents which appear in the form of needles in copper-aluminium and copper-tin alloys, and in special bronzes obtained by adding another element to one of these binary alloys. The mode of formation of martensite-like constituents, their true constitution, and the structural modifications which they undergo when heated, are discussed. Acicular constituents occur only in a few series of alloys, and appear to be dependent on the quenching of a solid solution which is unstable at ordinary temperatures. The reagent used for etching the aluminium bronzes was made up of ferric chloride 5 p.c., water 5 p.c., hydrochloric acid 30 p.c., isoamyl alcohol 30 p.c., ethyl alcohol 30 p.c., and was found to be suitable for all copper alloys, and for nickel.

**Manganese-silver Alloys.**‡—G. Arrivaut, in the course of an investigation of this binary system, has studied the microstructure of the alloys prepared. The manganese-silver system is peculiar in that the compound found, $MnAg_2$, forms a continuous series of solid solutions with silver, but is nearly insoluble in manganese.

**Microscopical Examination of Standard Steels.**§—H. S. Rawdon describes the microstructure of specimens which had been used for taking heating and cooling curves of a number of steels supplied by H. M. Howe, and containing 0·03 to 1·45 p.c. carbon. Though the thermal treatment had been carried out in a high vacuum, there was distinct evidence of slight decarburization of the surface.

**So-called Fibrous Structure in Steel.**‖—The arrangement of the constituents in a section taken from a steel casting which has been

* Rev. Métallurgie, x. (1913) pp. 1264–70 (14 figs.).
† Bull. Soc. d'Encouragement, cxix. (1913) pp. 12–41 (29 figs.).
‡ Rev. Métallurgie, x. (1913) pp. 1257–63 (8 figs.).
§ Bull. Amer. Inst. Min. Engineers, No. 78 (1913) pp. 1095–8 (6 figs.).
‖ Zeitschr. Anorg. Chem., lxxxi. (1913) pp. 156–69 (22 figs.).

suitably annealed is much the same whatever may be the direction of the polished face of the section. But in rolled or forged steel the constituents are commonly arranged in parallel bands or strings, and the appearance of a microsection accordingly depends upon the direction of the polished face with respect to the directions of flow of the steel during the mechanical working operations. P. Oberhoffer has studied this laminated structure in a large number of boiler plates, structural steels, and other hot-worked shapes. The laminated structure was found to persist after heating to temperatures not excessively high, followed by slow cooling. The origin of such banded structures probably lies in the action of slag-inclusions as nuclei upon which the ferrite crystallizes during cooling through the critical ranges.

**Cold-rolling of Steel.***—H. Hanemann and C. Lind have studied the various properties of a steel strip containing 1·2 p.c. carbon at each stage of the manufacturing process, consisting of successive cold-rollings and annealings. Before the first cold-rolling the material consisted structurally of lamellar pearlite and a cementite network. At an early stage in the process the material had become wholly converted into granular pearlite, the excess cementite changing into small granules indistinguishable from the eutectoid cementite. Steel in which the carbide is contained in the form of granular pearlite is in the softest possible condition, capable of enduring without permanent injury severe change of form by cold-working, and is thus peculiarly adapted for cold-rolling. By a suitable final hardening or annealing, the granular pearlite may be replaced by a structure having greater strength.

**Annealing of Steel Castings.**†—P. Oberhoffer has studied the effect upon the properties of two steel castings, containing respectively 0·23 and 0·66 p.c. carbon, of annealing at different temperatures. The gradual replacement of the coarse casting structure by a fine-grained structure as the annealing temperature is raised, is illustrated by a series of photomicrographs. To remove completely the coarse ferrite network of the casting structure, the annealing temperature must not be lower than the temperature of first separation of ferrite.

**Structure of a Broken Axle.**‡—M. Füchsel describes the microstructure of a railway-wagon axle, manufactured about twenty years ago, which broke in use. The ferrite and pearlite ran in parallel bands, forming a remarkably well-developed coarse, laminated, or banded structure. Numerous slag-inclusions were present in the ferrite. The individual ferrite grains of which the bands consisted were not elongated in the direction of the length of the bands. Such a structure indicates that the axle was rolled at a high temperature and slowly cooled. Annealing at 850° C., followed by cooling at a moderate speed, completely removed the banded structure, the ferrite and pearlite now being well mixed. A similar fine uniform structure was found in an

* Stahl und Eisen, xxxiii. (1913) pp. 551–5 (9 figs.).
† Stahl und Eisen, xxxiii. (1913) pp. 891–6 (22 figs.).
‡ Stahl und Eisen, xxxiii. (1913) pp. 1487–9 (5 figs.).

axle made according to present-day requirements, and forged after rolling. It is shown that poor mechanical properties accompanied the coarse, banded structure.

**Microstructure of a Boiler Plate.*** — Matweieff indicates some peculiarities in the structure of a boiler plate containing 0·06 p.c. carbon, after fifteen years' service. Neumann lines probably indicated that the material had been distorted when cold. The existence side by side of large and small ferrite grains might be the result of cold-work followed by annealing.

**Fluidity of Rails.†** —Babochine has found that steel rails which, in use, flow laterally to an undesirable extent, are commonly coarse in structure and contain well-formed lamellar pearlite. Better wearing qualities are accompanied by finer and more sorbitic structures.

**Cracked Boiler Plates.‡**—R. Baumann has examined thirty boiler plates from various sources which had developed cracks. Peculiarities of structure are described and illustrated with numerous photomicrographs.

**Microstructure of Sintered Iron-bearing Materials.§**—B. G. Klugh gives photomicrographs of sections of flue-dust and similar materials after they had been agglomerated by heating. In the description of the microstructure, the relative porosity of the products of different sintering processes is the chief point considered. When high temperatures are used the nodules become entirely coated with a clear violet-tinted glass of silicate of iron.

**Metals, Crystalline and Amorphous.‖**—W. Rosenhain defends the theory which explains certain properties of metals by the conception of an amorphous condition of the metal distinct from its normal crystalline condition. The theory consists of three propositions:—1. That mechanical disturbance of the surface of crystalline metal, as by polishing, produces a thin surface film of amorphous metal. 2. That a similar amorphous layer is formed within a metal crystal by the internal rubbing which occurs on surfaces of slip during plastic deformation. 3. That the crystals of which a piece of metal is composed are separated from each other by thin films of under-cooled liquid or amorphous metal acting as an intercrystalline cement. The whole question is reviewed on broad lines.

**Micrometry as applied to Alloys.**—C. H. Mathewson¶ discusses the application of the Microscope in the quantitative determination of the

* Rev. Métallurgie, x. (1913) pp. 1271–3 (3 figs.).
† Rev. Soc. Russ. Met., 1912, pp. 523–42, through Rev. Métallurgie, x. (1913) Extraits, pp. 613–17 (10 figs.).
‡ Stahl und Eisen, xxxiii. (1913) pp. 1554–61 (35 figs.).
§ Bull. Amer. Inst. Min. Engineers, No. 77 (1913) pp. 813–28 (13 figs.).
‖ Engineering, xcvi. (1913) pp. 509–11, 537–9 (1 fig.). Paper read before British Association, 1913.
¶ Met. and Chem. Eng., xi. (1913) pp. 619–21.

composition of alloys, and describes the procedure he has adopted for the determination of aluminium in zinc-aluminium alloys, of oxygen in copper, and of iron in zinc, by measurements of areas occupied in photomicrographs, by entectics, or by compounds. The outlines of constituents may be traced upon finely ruled squared paper, and the number of squares included in the area counted. In measuring areas occupied by entectics, coalescence must be taken into consideration.

Z. Jeffries * has used for the same purpose a vertical photomicrographic apparatus having a glass plate, thinly coated on its upper surface with paraffin-wax, in the place of the camera screen. The areas are measured on the waxed surface with a planimeter. The addition of starch to the paraffin-wax increases its opacity and permits the use of a thinner coating.

**Long-focus Microscope, and its Applications in Metallography.**†—F. Robin describes a Microscope designed for the examination of polished sections while they are being heated. By placing an achromatic biconcave lens in the Microscope tube, just behind the focus of the objective, the magnifying power is considerably increased, and moderately high magnification is obtained without reducing the distance between specimen and objective. Such an instrument, constructed by Nachet, gave a magnification of 200 diam., with a distance between specimen and objective of 5 cm. Oblique illumination is used. When used for the examination of specimens during heating the Microscope is horizontal. The specimen is held in a suitable clamp, heated by a Bunsen burner, and contains a small hole for the reception of a thermocouple.

The microscopic appearances during oxidation of various steels, and other metals and alloys, by heating in air are described, and the relative rates of oxidation of the different constituents are shown as curves, the relative thicknesses of the oxidation films being calculated from the wave-lengths corresponding to the colours observed. An allotropic change occurring on heating may make itself evident by a sudden change in the progress of oxidation. The development of the crystal boundaries of metals and alloys during heating has also been studied in the same way. Antimony, bismuth, and zinc exhibited this phenomenon clearly. The visibility of the grain boundaries of a heated specimen appears to be due to an actual difference of level between adjoining crystals. An explanation of the development of this difference in level is suggested, depending on differences in the expansion of the crystals in different directions. The temperatures at which the grain boundaries first appeared were determined for a number of metals and alloys. Observations, by the same method, of appearances during heating connected with the sub-division of the large grains of metals, with the development of fissures, and with fusion are described.

**Improved Vertical Illuminator.**‡—F. E. Wright describes a device fitted to a vertical illuminator of the glass-plate type, which enables

* Met. and Chem. Eng., xi. (1913) p. 668.
† Bull. Soc. d'Encouragement, cxviii. (1912) pp. 204–31 (22 figs.).
‡ Journ. Washington Acad. Sci., iii. (1913) pp. 14–16 (1 fig.).

the observer to produce an aperture of any desired size in any part of the field. By its use the reflection of light from the objective-lens surfaces into the observer's eye can be largely prevented.

**Microscopic Examination of Metals by means of Polarized Light.*** H. Hanemann and K. Endell discuss the application of polarized light in metallography, describe J. Königsberger's apparatus for the observation of opaque bodies in reflected polarized light, and indicate by examples how isotropic and anisotropic constituents of metals and alloys may be distinguished.

* Stahl. und Eisen, xxxiii. (1913) pp. 1644–6 (1 fig.).

# PROCEEDINGS OF THE SOCIETY.

## MEETING

HELD ON THE 17TH DECEMBER, 1913, AT 20 HANOVER SQUARE, W., PROFESSOR G. SIMS WOODHEAD, M.A. M.D., ETC., PRESIDENT, IN THE CHAIR.

**The Minutes** of the Meeting of November 19, 1913, were read and confirmed, and were signed by the President.

**The List of Donations** (exclusive of exchanges and reprints) received since the last Meeting was read as follows, and the thanks of the Society were accorded to the donors :—

| | From |
|---|---|
| Heron-Allen, E., and A. Earland, Foraminifera of the Clare Island District | *The Authors.* |
| An Old Microscope | *Miss Sparks, through Messrs. R. and J. Beck.* |
| Coumarin Sections | *Mr. G. M. Beaumont.* |
| Portable Microscope by Bate | *Messrs. Evershed and Son.* |
| Stevens, Fungi which cause Plant Diseases | *The Publishers.* |

**Mr. Watson Baker** (for W. Watson and Sons, Ltd.) demonstrated a new Condenser Vertical Illuminator. This apparatus had been devised to overcome the difficulty of setting the illuminant in relation to the vertical illuminator with accuracy. At the same time a condenser system with iris-diaphragms was introduced, which gave the same control in the examination of opaque metal subjects as is obtained with a sub-stage condenser and transparent objects. Projecting from the vertical illuminator itself, and attached to it, was a tube containing the condenser system, two iris-diaphragms, and a 4-volt electric lamp, which was lit by a small portable battery. With one iris-diaphragm the illumination was controlled, and with the other the field of illumination could be restricted with a nicety, thereby controlling the troublesome glare. With this vertical illuminator it is unnecessary to shorten the mounts of the objectives.

The thanks of the Society were unanimously accorded to Mr. Watson Baker for his demonstration.

**Mr. R. Finlayson** then exhibited a "Circular 12-celled Slide for Opaque Objects," which consisted of a circular piece of mahogany, with a spring attached to fit it on to the stage of the Microscope, and a central projecting peg over which the card containing the sunk cells is placed—a device which would be found very handy in the demonstration of seeds or any other opaque object.

**The President** congratulated Mr. Finlayson on the simplicity and apparent efficiency of his little device, and the thanks of the Society were cordially voted to him.

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**Dr. Shillington Scales** was then requested to read a paper by Dr. Felix Jentsch, which had been brought to the notice of the Society by Mr. Ogilvy, on "The Binocular Microscope."

Dr. Shillington Scales said that the paper he was about to read was an exceedingly interesting one. Mr. Conrad Beck, who was present that evening, would be good enough to give them a supplementary paper to that of Dr. Jentzsch, dealing with the various types of binocular Microscopes, and he and Mr. Ogilvy together had arranged this extremely interesting exhibit.

At the conclusion of Dr. Jentzsch's paper, the President said that before opening the discussion on the extremely interesting communication which had just been read, he would ask Mr. Conrad Beck to give his paper on "The Binocular Microscopes of the Past, and a new form of the Instrument."

(Before Mr. Beck had finished his paper and demonstration, the President was obliged to leave on account of the lateness of the hour, and the Chair was then taken by Mr. Barnard.)

Mr. Rheinberg opened the discussion by saying that he had been exceedingly interested in hearing the admirable papers just read. Dr. Jentzsch's paper, he thought, had been splendidly worked out in every way.

There was one little point to which his particular attention had been drawn, and that was that this Microscope would actually seem to do even more than Dr. Jentzsch claimed for it, inasmuch as although, according to all the canons and laws of optics, one could not obtain stereoscopic effects with it with high powers, yet on another occasion afforded him by Mr. Ogilvy he had certainly seen preparations under this Microscope which undoubtedly appeared to him (and he thought also to others) to be stereoscopic. How this could occur was a point of great interest.

One thing on which he would like to remark, pertained to one of the points to which Mr. Beck drew attention, and that was as regarded the parallelism of the two eye-pieces. He was not at all sure that despite the parallelism of the eye-pieces, the eyes in viewing the Microscope image at an apparent distance of 8 or 10 inches did not unconsciously converge, and it occurred to him, though he only threw out the suggestion with great diffidence, that it was just possible that this led to slight alterations in position of the image details on the retina of one eye as compared with their position on the retina of the other eye, which might lead to something in the nature of a stereoscopic effect.

In this connexion one had only to remember that as had been proved convincingly by Abbe many years ago, stereoscopic effects with the

Microscope when a single objective is employed, depend mainly on the way in which the image-forming rays produce "parallactic shifts" in the two retinal images. That was a rather complicated subject upon which he would not digress at any length, but of course by "parallactic shifts" he referred to the way in which on the retina of the eyes of the observer points in any one plane of an object were displaced relatively to points in any other plane of the object, and the manner in which this displacement differed for the two eyes.

(Mr. Rheinberg here demonstrated his point on the blackboard.)

These matters, it appeared to him, might also have an interesting bearing on the question which Mr. Beck brought forward as to the best arrangement of the tubes, namely, as to whether they should be parallel or whether they should be converging at a certain angle, and he thought that was a very interesting point which had not yet been thoroughly cleared up and would repay some more careful work. He would like to congratulate the authors of these two papers on the extremely interesting instruments they had brought to the notice of the Society.*

Mr. Cheshire said that it seemed to him, so far as he understood Dr. Jentzsch's Paper, that he had made the matter of the stereoscopic relief perfectly plain. He was inclined to think that Mr. Beck and Mr. Rheinberg had not quite understood the paper. He thought that Dr. Jentzsch said quite clearly that when his Microscope was used with an interocular distance equal to that of the observer, there was no true stereoscopic effect, but that if the interocular distance of the instrument were set wrongly, then one obtained either orthoscopic or pseudo-stereoscopic effects according as the interocular adjustment of the instrument was less or greater than the interpupillary distance of the observer.

In regard to the paper generally, he thought that the Society was to be congratulated on such an accession to its records—it was an epoch-marking paper, and especially so from a side which had not been touched upon, and that was from the psychological side.

There was one other point he would like to mention. Dr. Jentzsch in his paper had said that the upper focal-plane of the objective was the position in which division took place; Mr. Beck on the other hand had disagreed, saying that it should take place in the principal plane. He personally thought it *should* be in the focal plane, because division took place as though in the Ramsden disk which was the exit-pupil of the system, the entrance-pupil being the diaphragm in the lower focal plane of the condenser.

What had been said in regard to the arrangement of the prisms was interesting because the explanation of the phenomena was given as far back as the year 1738 in Smith's Optics. [Here Mr. Cheshire demonstrated his meaning on the blackboard by an illustration of a pair of eyes looking at two points, one at infinity and the other at a fixed point.] It was a very remarkable thing that Smith in 1738 said that the phe-

* Mr. Rheinberg writes to say that since the above remarks were made he has learnt from a competent observer that the same stereoscopic effect with high powers had been observed under certain conditions, when using an Abbe stereoscopic eye-piece.

nomenon of the enlarged circle might also be seen very plainly in looking at distant objects through a pair of spectacles held away from the eyes.

Mr. Rheinberg said that Mr. Cheshire had referred to his (the speaker's) remarks in regard to stereoscopic effects, and had said that by having the oculars nearer or farther apart different images could be obtained with the result that pseudoscopic or orthoscopic effects came about. From this he feared he had not made it sufficiently clear that he had been referring solely to high power microscopy. When the Ramsden disks were large, then it was possible of course to allow different parts of these to enter the two eyes: but this, as had been pointed out in the paper by Dr. Jentzsch himself, was not feasible when they were small as they were with high powers, to which he was more particularly referring.

Mr. Blood said that there was one point about Dr. Jentzsch's paper which had specially appealed to him personally, and that was what had been said in regard to the use of binocular Microscopes being of benefit where there was any idiosyncrasy in colour vision. He himself had noticed that his left eye was more sensitive to the blue end of the spectrum and his right to the red end—whether this were owing to his using the left eye a good deal with a green screen he could not say: but he had had a curious example of this idiosyncrasy recently when looking at some organism which he had had quite a difficulty in distinguishing with his right eye, after having seen it clearly as a bluish-green object among a number of green ones with his left.

He thought Mr. Beck's form of binocular more convenient to use than Leitz's, though it was quite possible that after working a Leitz for a long time one could get used to it. There were one or two disadvantages, however, which seemed to be offered by Mr. Beck's instrument, one being the varying length of the tube, which would clearly make it unsuitable for high power objectives, unless fitted with a correction collar.

Another small objection, in his opinion, to the Beck Microscope was that in the alteration of the tube-length correction was interfered with from the fact that the light of the side tube came through a considerable length of glass. In the same way a spherical correction was interfered with by the use of thicker covering glasses.

Another point, when speaking of the Abbe binocular, Mr. Beck had said that the only disadvantage in the D-shaped diaphragm was that one lost half the amount of light, but it must not be forgotten that half the aperture was lost also, whether it was cut off at the upper focal plane of objective or at the Ramsden circle. Personally, when using a Wenham binocular he had found it a good plan not to slide the prism quite home, but to let it merely cover about one-third of the diameter of the object-glass only, leaving two-thirds of the area of the object-glass, or even more, in the direct tube. He had found that with one good image, a very imperfect image with the other eye was sufficient to give a sense of stereoscopic relief as well as relief to physical strain, and as, like most other microscopists, he had found that the eye *not* generally used was the one most sensitive to light, curtailing the amount of light received by this eye was quite satisfactory, and in fact was rather an advantage.

Dr. Shillington Scales said he wished to convey his sincere thanks to Dr. Jentzsch for his paper, and to Mr. Ogilvy for having brought it forward, and he quite agreed with Mr. Beck and Mr. Cheshire in thinking it probably marked a new departure. Many drawbacks which had hitherto been attached to binocular Microscopes would also seem to have been met. There was one part of the paper, however, which he could not quite follow. While all were agreed on the great advantage of using two eyes instead of one in microscopical work, he failed to see what bearing the discussion had in regard to the respective parts played by rods and cones as affected by comparative darkness and light. Von Kries' theory is that the function of the cones is to give us vision of the chromatic and achromatic order in daylight, and that of the rods and visual purple vision of the achromatic order in twilight or after rest in the dark. As daylight failed the rods came into play, giving us achromatic vision, but he did not see how this theory bore upon the advantage of binocular vision, except in a very general way. In regard to the question raised by Mr. Blood, as to seeing certain colours better than others, he wondered whether recent work in connexion with sensitivity to various colours might shed any light upon this subject. As light failed or was reduced, the blue-green part of the spectrum took on an increased comparative sensibility and showed itself on the retina. This applied to the periphery rather than the fovea cerebralis. Whether this had any bearing on the subject he did not know. Personally, he used the very least amount of light possible, as, apart from the care of the eyes, he considered more could be seen by reducing the amount of light (he was not here referring to the use of the diaphragm), especially when dealing with stained preparations. This was one of several physiological questions raised by Dr. Jentzsch's paper.

Mr. Barnard agreed with what had been said in regard to the advantage of the binocular Microscope over the monocular. He was in the habit of doing biological work, and, unlike those mentioned by Dr. Jentzsch who would not use both eyes alternately in monocular work, he did do this, but there was no doubt that the fatigue experienced by the unused eye did in a short time spread itself over both eyes. With a binocular instrument, however, he felt that he could work for an almost indefinite time with a light of moderate intensity. There was, of course, the question raised by Mr. Blood in regard to the difference in sensitiveness to colour of the two eyes, which he had himself experienced lately in an interesting manner when working with the ultra-violet Microscope. Here he experienced considerable difficulty in focusing with the right eye, but the difficulty was less when using the left.

The only practical objection which had been raised in regard to Mr. Beck's instrument was that referred to by Mr. Blood. The alteration in tube which occurred as the result of adjustment for intra-ocular distance was a point for consideration, and might in extreme cases be a real objection to the particular method adapted.

Mr. Beck, in reply to Mr. Rheinberg's remarks on stereoscopic effects, said that no doubt when the Ramsden circle was small, as was the case with high-power eye-pieces, more careful placing of the eyes was necessary, but it was quite simple to get full stereoscopic effect even with an almost microscopic Ramsden circle. He thought this might be attributed to the fact that it was by no means necessary to cut off the entire half of the rays to get stereoscopic effects: it was only approximation to the bisection of the rays that was required, and quite as much as was necessary for differentiation of depth could be obtained. With a high-power objective the stereoscopic depth was exaggerated, and so the Ramsden circle could be cut down to a slight extent. Where there were two isolated objects, one behind the other like grains of sand, or diatoms, it was an extraordinarily interesting sight to see these cross each other.

With reference to Mr. Cheshire's remarks about the Ramsden disk, he knew that it was sometimes said that the latter was the conjugate image of the back focal plane of the object-glass. This was a wrong definition. The Ramsden disk was the smallest aperture after leaving the eye-piece, and was the conjugate image of the back equivalent plane, or, speaking roughly, of the aperture of the object-glass. With a low-power object-glass the image of the back focal plane was about an inch or two behind the eye-piece of the Microscope. If the back focal plane of the object-glass were used for bisecting the rays for a binocular Microscope, they had already somewhat intermingled at this plane, and in most cases it would be impossible to make a division of this plane.

In reference to what had been said about correction being interfered with by a large piece of glass, the whole point was that if light were coming directly through a parallel plate of glass, the aberration was practically nothing, but if at a great angle the effect was very serious. The angle at which the light passed through the thick plate of glass at the back in the case under discussion was very nearly parallel, a parallel plate placed in front of a telescope, it had no result whatever, and the effect of placing a block of glass behind the object-glass was almost the same as in the telescope, whereas even a very thin plate placed between the object-glass and the object where the angle of the light was very great produced a large aberration.

There had been a good deal of discussion as to the absorption of light by the glass: if it was first-class optical glass the absorption was so small as to be considerably less than 1 p.c. The light absorbed by an 8-in. piece of the best optical glass was less than 1 p.c. Light passing through a thick piece of best optical glass lost practically nothing by absorption, though it lost considerably by reflection at every surface, generally from 4 to 5 p.c. at each surface.

In regard to what had been said as to the alteration in the tube-length upsetting the correction of the objective, the standard tube-length was when the eye-pieces were in their mean interocular position, and as the alteration in the interocular distance was produced very rapidly the error in the tube-length caused by setting this adjustment was not sufficient to interfere with the correction of the object-glass. If observers desired the amount could be exactly counterbalanced by an alteration in the length of the nose-piece. The ordinary monocular

Microscope when closed is about 140 mm. tube-length. How many observers were aware that to obtain the standard tube-length the draw-tube had to be pulled out. A small difference in the tube-length was inappreciable in the correction of the object-glass.

Mr. Barnard desired that a very hearty vote of thanks should be passed to Dr. Jentzsch for his paper, to Mr. Ogilvy for bringing it forward, and particularly to Mr. Beck for having gathered together such an admirable collection of instruments and for his own most interesting paper. He considered that it was one of the most successful Meetings the Society had held for a long time.

The vote was carried with acclamation.

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**Dr. Shillington Scales** read the list of nominations for the Council and Officers for the ensuing year.

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**The President** called upon the Meeting to appoint an Auditor on behalf of the Fellows.

Mr. A. W. Sheppard proposed the appointment of Mr. Maurice Blood, his appointment being seconded by Mr. Lees Curties, and the proposal having been put to the Meeting, was carried unanimously.

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It was announced that the next Meeting of the Society would be held on January 21, the business of which would in part consist of the Election of Officers and Council.

The next Meeting of the Biological Section would be held in the Society's rooms on January 7.

The Chairman announced that the Society's rooms would be closed for the Christmas vacation from Tuesday, December 23, till Monday, December 29.

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

Mr. Conrad Beck, F.R.M.S.:—Demonstration of Binocular Microscopes of various types.

Mr. W. Watson Baker, F.R.M.S.:—New Condenser Vertical Illuminator.

Mr. R. Finlayson:—A Circular 12-celled Slide for Opaque Objects.

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**New Fellows.**—The following were elected *Ordinary* Fellows of the Society:—Harry E. Hurrell, Hessay Mosey, Frederick Whitteron.

## MEETING

Held on the 21st of January, 1914, at 20 Hanover Square, W.: Professor G. Sims Woodhead, M.D., etc., President, in the Chair.

**The Minutes** of the Meeting of December 17, 1913, were read and confirmed, and were signed by the President.

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The thanks of the Society were accorded to Sir Frank Crisp for his donation of a copy of the Leeuwenhoek Microscope.

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**Mr. Watson Baker** proposed that Messrs. Maurice Blood and T. E. Freshwater be appointed Scrutineers of the Ballot for the election of Officers and Council for the ensuing year.

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The Annual Report of the Society for the year 1913 was then read by Dr. Shillington Scales.

### REPORT OF THE COUNCIL FOR 1913.

#### FELLOWS.

*Ordinary.*—During the year 1913, 25 new Fellows have been elected, whilst 9 have died, 15 have resigned, and 9 have been removed.

*Honorary.*—The following Honorary Fellow has been elected: Dr. Ludwig Rhümbler. The List of Fellows now contains the names of 413 Ordinary, 1 Corresponding, 34 Honorary and 81 Ex-officio Fellows, being a total of 529.

#### FINANCE.

The Council this year presents the accounts in a new form: a revenue account showing income and expenditure for the year 1913, and a balance sheet showing the exact financial position of the Society. The revenue account shows a surplus of income over expenditure of £122 5*s.* 2*d.*

The amount received from Members' subscriptions is £724 9*s.* 5*d.*, from Admission Fees, £44 2*s.*; the sales of the Journal, etc., realized £313 9*s.* 5*d.*

Considerable economies have taken place in the Journal without, it is believed, impairing its efficiency. In common with all other holders of Trustee securities, a depreciation of about $5\frac{1}{2}$ p.c. has taken place, during the year, on the Society's investments, and allowance has been made for this by writing down the investments to their market value on December 31, 1913. The furniture and show-cases have been valued at a low figure, and the instruments and books, which are of considerable value, have not been included in the balance sheet.

### JOURNAL.

There have been 18 original papers published in the Transactions of the Society during 1913 as against 10 in 1912, and the Summaries of Current Researches in Zoology, Botany, Microscopy and Metallography have continued on the same lines as heretofore.

The thanks of the Council are due to the Editorial Staff for their unremitting attention and excellent contributions.

### LIBRARY.

The Library is in better condition than it has previously been at any period during the past few years.

A large number of sets of Journals have been sold during the past year, and the money obtained has been carried to capital account, the interest on which will be used in binding.

The Library has been more used for reference purposes and the number of volumes lent out is considerably higher than in previous years, but the Hon. Librarian considers that still more use might be made of the Library, and wishes to call the attention of Fellows to the fact that the Library is open from 7 to 8 on the evenings when Meetings are held. The Society now subscribes to Lewis' Lending Library, and Fellows therefore have the privilege of borrowing works of reference on any scientific subject.

The most valuable books obtained during the year are three scarce works on optics and microscopy presented by Sir Frank Crisp. A second supplement to the Catalogue is in the Press.

### INSTRUMENTS AND APPARATUS.

During the year the main types of old Microscopes have been arranged in the new Show Case in historical and chronological order, thus giving a very much better idea of the contents of our Collection of old instruments.

The instruments and apparatus continue to be in good condition. The following additions have been made during the year :—

Feb. 15.—An Old Microscope, by Cauchoix, of Paris. Presented by Mr. Wynne Baxter.

June 18.—Two Grayson Rulings : 1 inch divided in 100ths and 1000ths, and 1 milimetre divided in 0·25, 0·1, and 0·01 mm. Presented by Mr. Conrad Beck.

Dec. 17.—An Old Culpeper-type Microscope, in brass, by J. Harris and Son, British Museum, London. Presented by Miss Sparks.

,, Portable Microscope by Bate, London. Presented by Messrs. Evershed and Son, Hove.

The Society hopes before long to be able to publish an illustrated descriptive catalogue of the unique collection of Microscopes in its possession. The matter is now being dealt with by Mr. Rousselet, Mr. Cheshire, and the Members of the Brass and Glass Section.

## SLIDES.

The following slides have been presented to the Society during the year :—

Prof. Sigmund's Histological Preparations, 36 slides and descriptive text. Presented by Messrs. Carl Zeiss, London.

Three slides of "Coumarin," a new preparation. Presented by Mr. G. M. Beaumont.

In addition to the above donations, the electric light installation was presented to the Society by Mr. F. E. L. Low.

## MEETINGS.

During the year 1913, eight Ordinary Meetings have been held—all of which have been well attended. The Conversazione which was so successful last year was repeated this year, and again held at King's College through the courtesy of the Principals. The attendance exceeded that of the previous year, and the exhibits were of unusual interest. The Conversazione appears likely to be a prominent feature and is unquestionably popular. All Fellows were invited to exhibit.

A sub-committee has been appointed to advise as to whether any changes should be made in the constitution of the Council.

The Sectional Meetings had a very successful year. The Biological Section, under the Secretaryship of Mr. Scourfield, held eight Meetings, with an average attendance of 19.

The Brass and Glass Section, under the Secretaryship of Mr. Cheshire, held five Meetings with an average attendance of 12.

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**Mr. Cyril F. Hill** (Hon. Treasurer) then read the Financial statement for the year 1913.

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**The President** remarked that the Society seemed to be in an exceedingly satisfactory condition. The Meetings during the past year had been characterized by great activity and interest, and now the Treasurer's report had just informed them that their finance was on a

## REVENUE ACCOUNT FOR THE YEAR ENDING 31st DECEMBER, 1913.

**Dr.**

| | | £ s. d. |
|---|---|---|
| To Journal | | 592 7 1 |
| ,, Rent and Insurance | | 159 3 0 |
| ,, Salaries | | 117 10 4 |
| ,, Stationery and Library, Books and Papers | | 140 4 0 |
| ,, Sundry Expenses, including Postages | | 59 14 9 |
| ,, Donation to Lister Memorial | | 5 5 0 |
| ,, Balance | | 122 5 2 |
| | | £1196 9 4 |

**Cr.**

| | | £ s. d. |
|---|---|---|
| By Subscriptions | | 724 9 5 |
| ,, Admission Fees | | 44 2 0 |
| ,, Sales of Journal | 294 13 11 | |
| ,, ,, of Sundry Papers | 18 15 6 | |
| | | 313 9 5 |
| ,, Interest on Investments | | 68 7 6 |
| ,, Advertisements | | 46 1 0 |
| | | £1196 9 4 |

## BALANCE SHEET, 1913.

**Dr.**

| Liabilities. | | £ s. d. |
|---|---|---|
| To Capital Funds Account | 1649 0 0 | |
| Add old Books and Papers sold during year | 173 0 0 | |
| | | 1822 0 0 |
| ,, Show Case Fund | | 20 9 3 |
| ,, Sundry Creditors | | 94 13 0 |
| ,, Reserve Account | 268 3 1 | |
| ,, Balance from Revenue Account | 122 5 2 | |
| | | 390 8 3 |
| | | £2327 10 6 |

**Cr.**

| Assets. | | £ s. d. |
|---|---|---|
| By Cash at Bank | 127 2 3 | |
| ,, ,, on Deposit | 350 0 0 | |
| ,, ,, in Hand | 2 14 5 | |
| | | 479 16 8 |
| ,, Investments (at Market Valuation, Dec. 31, 1913)— | | |
| £400 North British Railway 3 % Deb. | 296 0 0 | |
| £145 Nottingham Corporn. 3 % | 110 0 0 | |
| £400 New South Wales 3½ % | 392 0 0 | |
| £915 India 3 % | 660 0 0 | |
| £150 Metropolitan Water Board 3 % | 111 0 0 | |
| | | 1569 0 0 |
| ,, Sundry Properties, Office and Library Furniture | | 80 0 0 |
| ,, Sundry Debtors | | 198 13 10 |
| | | £2327 10 6 |

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

Cyril F. Hill, *Hon. Treasurer*.

Alfred N. Disney,
Maurice Blood, } *Auditors*.

sound and improving basis. The Society had been wonderfully active and vital in the past, and a great future still seemed to be assured to it.

Mr. Watson Baker, in moving the adoption of the Report, said that it had been a great pleasure to hear so satisfactory a statement of affairs. It had not been quite possible to grasp all the figures of the Financial Statement which had just been read, but full opportunity for doing so would be offered on the publication of the Report in their Journal. He considered that it was perhaps only very few who realized to the full extent what the activities of the Secretaries, Treasurer and Council had been during the last few years. The way in which economies in expenditure had been effected in the production of their Journal, without impairing its high level, and in fact the splendid way in which all the affairs of the Society generally had been conducted, reflected very great credit on their Officers. He had extreme pleasure in proposing that the Report of the Council and the Statement of Accounts should be adopted.

Mr. Tierney, seconded the proposal, which was carried unanimously

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**Mr. Rousselet** then said a few words in description of the Leeuwenhoek Microscope presented by Sir Frank Crisp to the Society, and which was handed round for examination by Members. Mr. Rousselet said that this apparatus was a copy of the simple Microscope invented and made by Leeuwenhoek before 1673, with which this "father of Microscopists" made his numerous and remarkable discoveries, which were nearly all published by the Royal Society of London between 1673 and 1722. Leeuwenhoek made his Microscopes, lenses and all, with his own hands, but gave no details of their construction to anyone, a secret which he jealously kept to himself all through his long life. Beyond the fact that his observations were made with "simple Microscopes" nothing was known about them by his contemporaries. At his death in 1723, at the age of 91, he bequeathed to the Royal Society a cabinet containing 26 of these Microscopes which unfortunately are now lost.

In 1886 Professor Hübrecht of Utrecht University brought to London one of Leeuwenhoek's Microscopes belonging to the Zoological Laboratory of his University, and from this original Sir Frank Crisp, then Secretary of this Society, had an exact copy made for his own collection. Last year, at the time of the International Congress of Medicine held in London, the Medical Society obtained the loan of this copy for their museum, and afterwards they joined the Royal Microscopical Society in a request for permission to have copies made of this interesting old Microscope, whereupon Sir Frank Crisp very kindly offered to supply a copy of it to each of these Societies. This has now been done, and the Society's best thanks are due to the donor for this generous gift, which, although only a copy, fills a great gap in the Society's collection, and is correspondingly appreciated.

The Microscope consists of a single biconvex lens of about $\frac{1}{4}$ in. focus, mounted in concavities between two thin plates of copper about 2 in. high by about 1 in. wide, riveted together in three places, and with a very small hole on each side; a very simple and primitive arrangement of screws for holding and focusing the object in front of the lens completes the apparatus.

For figures and further particulars see this Journal, 1886, p. 1047: also John Mayall, jun., Cantor Lectures before the Society of Arts, 1885, published in that Society's Journal for 1886: and for an account of the wonderful work done by Leeuwenhoek with these primitive means see Dr. Plimmer's Presidential Address in this Journal, 1913 pp. 121–135.

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**The President** announced that the Scrutineers having handed in their report as to the result of the Ballot, the following Fellows proposed by the Council had been duly elected as the Officers and Council for the ensuing year:—

*President* Prof. G. Sims Woodhead, M.A. M.D. LL.D. F.R.S.E., etc.

*Vice-Presidents*—J. E. Barnard; Wynne E. Baxter, J.P. D.L. F.G.S.; E. Heron-Allen, F.L.S. F.G.S. F.Z.S., etc.; David J. Scourfield, F.Z.S.

*Treasurer*—Cyril F. Hill.

*Secretaries*—J. W. H. Eyre, M.D. F.R.S.E.; F. Shillington Scales, M.A. M.D. B.C. (Cantab.).

*Ordinary Members of Council*—F. W. Watson Baker; Frederic J. Cheshire; A. N. Disney, M.A. B.Sc.; Arthur Earland; R. G. Hebb, M.A. M.D. F.R.C.P.; John Hopkinson, F.L.S. F.G.S. F.Z.S.; J. W. Ogilvy; Percy E. Radley; Julius Rheinberg; Charles F. Rousselet; A. W. Sheppard; 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*—Edward J. Sheppard.

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**The President** then delivered his annual address, entitled "The Microscope and Medicine."

Mr. Michael said he wished to propose the usual Resolution, that of returning thanks to their President for his Address, and to ask for his consent to print it in the Journal. It was not usually easy to find anything distinctive to say on the subject of a President's address, but of late years they had listened to a series of addresses from men who specialized in their own subjects and who had enabled the proposer to ask all present to join in the vote of thanks with genuine accord. The address they had heard that evening had not fallen behind the high level of its predecessors: it had brought to their notice the use of the Microscope as a working tool in one very important branch of science, and shown how improvement in the instrument brought in its train increase of the quality of the work done to the far-reaching benefit of races profiting by such improvement, and to the perfection and advance of science in general A most important and interesting subject had been dealt with by their P esident in a clear a d attractive way, and his address would form a record of the progress of the Microscope in that particular branch of which he had treated. He asked the Meeting to return their best thanks to their President for his very interesting address, and to beg his permission to print that address in the Journal.

Mr. A. W. Sheppard seconded the proposal, which was carried with acclamation by all present.

The President thanked Mr. Michael very heartily for his kind words, and accorded his consent for his address to be published in the Journal.

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**Mr. Disney** proposed that a hearty vote of thanks be accorded to the Honorary Officers—President, Secretaries, Treasurer and Council—of the Society. It was only necessary to ask those present to remember the successful meetings held during the past year, culminating in the satisfactory Report and Balance Sheet, to recognize the unceasing labours of their Officers. With these recollections in their minds he thought they would find no difficulty in supporting the motion he proposed.

Mr. Wilson seconded the vote to the Honorary Officers, which, having been put to the Meeting, was carried with acclamation.

Mr. Hill, the Honorary Treasurer, said it was always a pleasant duty to reply to the vote of thanks on behalf of the Honorary Officers, and he thanked all present for the vote accorded. There was a good deal of work to be done in connexion with the Society, and a fair amount of time was given to it, and it was gratifying to know that their labour was appreciated, and he hoped that they would still continue to merit that appreciation. The Conversazione was an innovation which had given a certain amount of extra work, but on behalf of the Officers he felt that he could say that they would only be too delighted to continue to give their services in promoting the welfare and success of the Society. One more thing he would like to say, and that was on the subject mentioned by Dr. Shillington Scales at the last meeting. It was a very easy thing for the Council to get out of touch with the Fellows of the Society, and they would always welcome very heartily any suggestion from Fellows, particularly as to nominations to the Council.

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**Mr. Waldron Griffiths** proposed that a hearty vote of thanks should be passed to the Auditors and Scrutineers of the Ballot for their work in connexion with the Society. The work of the Auditors could not be said to be very onerous, but it was none the less useful, and though the work of the Honorary Treasurer was excellently done, yet it was not likely to be less well done by having the sharp glance of the Auditors behind it.

Mr. E. J. Sheppard seconded the vote, which, having been put to the Meeting, was carried unanimously.

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**The President** called attention of Fellows to the Roll, and any present who had not signed were asked to do so.

**The President** announced that the next Ordinary Meeting would take place on Wednesday, February 18th.

The next Meeting of the Brass and Glass Section would be held on the 28th inst., at 7.30.

The Biological Section would meet in the Society's Rooms on the 4th February.

**The President** announced that a letter had been received from the Quekett Microscopical Club, cordially inviting the Fellows of the Royal Microscopical Society to be present at a Conversazione to be held on the 10th February next, by the kind permission of the authorities of King's College, Strand, W.C., in the Great Hall of that building.

The meeting was timed to commence at 7.30 p.m., and Microscopes would be in position soon after 7 o'clock. Tickets were to be obtained from the Hon. Secretary, James Burton, Esq., 8 St. Hilary Road, West Hampstead, N.W. Morning Dress.

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**New Fellows**:—The following were elected *Ordinary* Fellows of the Society:—Ernest Hermann Anthes, Major William Cooke Daniels, Theodore Crawford, Albert McCalla, M.A., Ph.D.

# JOURNAL

OF THE

# ROYAL MICROSCOPICAL SOCIETY.

APRIL, 1914.


## TRANSACTIONS OF THE SOCIETY.

### V.—*The President's Address.*


By G. Sims Woodhead.


(*Read January* 21, 1914.)

Through your kindness, gentlemen, it falls to my lot to occupy a position of which I feel I may justly be proud, but I recognize that, the latest, I am probably one of the least worthy of the series of men honoured by your choice. Former Presidents have, in return for the honour you have done them, conferred great distinction on our Society: many of them have contributed lavishly to the improvement of the Microscope, and much to the development of the science of Microscopy; and I cannot but be impressed by my inability to maintain the high standard set by my predecessors, and to prove myself worthy of the great traditions of this corporation. Only since I became a member of this Society have I realized how dependent upon others I have been for the apparatus with which to carry on investigations in the one department of study (Pathology, or the science of disease) to which I have devoted my professional life. As I have come to realize this, and as one branch of that study depends so largely for its successful prosecution on the use of all that pertains to the Microscope, I have decided, with your permission, to give some account of what Medicine, and therefore Humanity, owes to the Microscope.

My colleague, Sir Clifford Allbutt,* defending the thesis that medicine and surgery are but internal and external medicine, and that external medicine advanced by leaps and bounds at

* The Historical Relations of Medicine and Surgery to the End of the Sixteenth Century. London, 1905.

periods when internal medicine was lethargic and even stationary, attributes this to the fact that to the surgeon the application of scientific methods (observation together with close, repeated, and careful reasoning from ascertained facts as recommended by Hippocrates) was not only more necessary than to the Physician, but more readily achieved. The lesions he had to treat were patent to all, and the cause of them was so often known and so frequently of traumatic origin, that rational and effective treatment was more easy of application, and satisfactory results more readily obtained. Moreover, what was evident to the surgeon was also laid bare to the eye of the passer-by: it was not easy to hush up failures and hide mistakes. In internal medicine, on the other hand, excuse might be made by the physician that he could not expose the lesions with which he had to grapple, and that, in many cases, it was not possible to trace the causes or even the course of the disease. Hippocrates, indeed, insisted upon the need of careful observation and classification of symptoms, and the tracing and following out of the action of remedies; and from time to time there have been those who have come back to his first principles in carrying on the study of such diseases as are relegated to the domain of internal medicine; but for long—indeed, until the era of the Microscope—the physician remained the slave of convention, bound by the crude and ill-founded hypotheses of men, who, instead of studying nature, relied on the "authority" of those as ill-informed as themselves. They treated disease as an entity in itself and something apart from the patient. Custom, popular superstitions, religious susceptibilities, were, through the middle ages, all against the handling or dissection of the dead body, and although Vesalius and Eustachius and others, now and again, made careful dissections and thorough examination of the bodies of patients, no sustained and systematic account was kept of the condition of the organs and tissues of patients who had succumbed to disease, conditions that could be correlated with the symptoms manifested during life. Then a first step was taken, and post-mortem examinations were made on a considerable scale by Antonio Benivieni, who died in 1502, and whose work "De abditis causis morborum" was published posthumously in 1507. Allbutt says of him: "Before Vesalius, before Eustachius, he opened the bodies of the dead as deliberately and clear-sightedly as any pathologist in the spacious times of Baillie, Bright, and Addison." It was not, however, until Giovanni Battista Morgagni (1682–1771), as Professor in Padua, published his great work "De sedibus et causis morborum" (1761) that the way was opened up for the microscopist. There have been many great morbid anatomists since—Rokitansky, Lancereaux, Virchow, Wilks, Hamilton, Hebb, Shattock, and others—but morbid anatomy was but the basis of pathology, and not until the Microscope was called to the aid of the later of these workers and others in the field of pathology was it possible to reach our present advanced and advancing position. When such marked and extraordinary changes were found to have taken place in the organs of the body, physicians asked: "How can a patient with organs so diseased possibly remain alive?" and they came to be amongst the most pessimistic of men. On the post-mortem table they saw but the final lesions or products of disease, and whenever a physician was called to treat a patient suffering from one of the diseases the morbid anatomy of which had been studied, he recognized that he had seen the lesions on the post-mortem table, and assumed that the disease must necessarily follow the course of those of his previous cases that had proved mortal. Morbid anatomy could carry him no further; and it was only as it came to be realized that, with the aid of the Microscope, changes invisible to the uneducated and unaided eye could be demonstrated, that men gradually learned that lesions or damage to organs and tissues must have small beginnings which might easily be righted; but that, once begun, unless checked by treatment, natural or artificial, they must, after passing through various stages and phases, become like the lesions seen on the post-mortem table, the patient then being able to withstand their ravages no longer. The Microscope, then, came as a harbinger of hope to the physician.

Normal histology is still a growing science, and much remains to be done in this field of investigation; but with each step made, pathological histology has advanced—always a step behind, it may be, but seldom more than that step. The medical student of to-day knows more of the histology of the kidney, for example, normal and pathological, than did Malpighi, Henle or Bowman; and has a knowledge of other organs and tissues that was hidden from the teacher of thirty years ago. As a result of all this, internal medicine has gradually come to be studied on the same plan and plane as external medicine, and is, indeed, now making more rapid strides than surgery, which, however, it often calls upon to complete its work.

Our late distinguished President, Dr. Plimmer, in his interesting and illuminating address on the Dutch erstwhile linendraper's apprentice and Bedellus,* told us how his hero Leeuwenhoek, a non-medical man, opened up the way along which physicians and surgeons were in after years to toil so arduously, but in the long run, under the leadership of another brilliant layman, so successfully. In these days of biological chemistry and of theories of immunity, men are apt to forget or to lose sight of the path by which we have arrived at our present heights, though they realize clearly enough that no great advances have been made in our knowledge of the functions of the human body until accurate information has been gained as to their structure, first with the aid of the scalpel, and then

* See this Journal, 1913, p. 121.

of the Microscope; and that as these have gone hand-in-hand in the past, so in the future they can never be dissevered.

William Carruthers, in his Presidential address delivered in 1902,* notes that Cornelius Drebbel is said to have brought the first compound Microscope to England from Holland in 1619, and that the first application of the Microscope to the examination of the minute structure of plants was made by Robert Hooke, Secretary of the Royal Society in 1677, who constructed simple Microscopes and greatly improved the compound Microscope. Hooke's work is specially interesting to Cambridge men in that much of his histological work preceded that carried out by Nathaniel Grew, who acknowledges his indebtedness to Hooke, and who in all probability worked with the same Microscope. Grew's work was of extreme interest to all botanists, but especially to his fellow-alumni in Cambridge, and were it not that Carruthers has given such an admirable account of his training, life and work, I should be tempted to enlarge somewhat fully on Grew's contribution to histology. Even though I refrain from this, I cannot help drawing attention to the fact that Grew puts into very concise and convincing form a corroboration of Sir Wm. Roberts's contention referred to elsewhere. Grew was led to his studies by what he noted of the observations of others; for he says in the preface to his "Anatomy of Plants" (1682), "The first occasion of directing my thought this way was in the year 1664, upon reading some of the many and curious inventions of learned men, in the bodies of animals. For, considering that both of them (plants and animals) came at first out of the same Hand, and were, therefore, the contrivance of the same Wisdom, I thence fully assured myself that it could not be a vain design to seek it in both. And being then newly furnished with a good stock of seeds, in order to make a nursery of plants, I resolved, besides what I first aimed at, to make the utmost use of them for that purpose, that so I might put somewhat upon that side the leaf which the best botanics had left bare and empty."

We read Mr. Carruther's defence of Grew and his work with keen interest, especially as he attributes much to Grew without belittling Malpighi, on whose behalf Schleiden makes claims as against Grew's independence, which certainly cannot be upheld. He grants that Italy may well be proud of her son, but that England has no less reason for her pride in Grew.

Out of this controversy comes the comforting assurance that in all these controversies men's work is fitted into the great mosaic of scientific achievement, each receiving his meed of credit, if not in his own, in a subsequent, generation. To Hooke undoubtedly belongs the discovery of the vegetable cell, a discovery not at first recognized by Grew, but gradually accepted by him. Grew appears

* See this Journal, 1902, p. 129.

to have been Secretary of the Royal Society in 1677, when Hooke was also in office.

A great Dutch contemporary of van Leeuwenhoek, Jan Swammerdam (1637–1680), was the first, apparently, to give a description of red blood corpuscles (1658); whilst he laid all histologists under a great debt by introducing warm wax injections, by means of which a much more intimate knowledge of the relations of the blood-vessels to one another and to the surrounding tissues was obtained.

Leeuwenhoek, who is described as an inheritor of well-to-do brewers, is said to have "led an easy-going life"; it is allowed, however, that during that "easy-going life" he contributed no fewer than 375 scientific papers to the Royal Society of London, and 27 to the French Academy, which "contain, in addition to a vast amount of work on animalculæ and plant histology, many discoveries of capital importance to medicine," amongst these the histological characters of voluntary muscle, from which has arisen all our present knowledge of the mechanism of muscular contraction. They also contain an account of the structure of the crystalline lens, which has provided the modern physiologist and pathologist with a basis on which to build up the pathology of cataract.

I would refer those who wish to know something about the Microscope with which Leeuwenhoek did his work to Mr. Nelson's paper,* and it is interesting to note that he made out the transverse diameter of the red corpuscles in human blood to be $\frac{1}{1940}$th of an inch, a measurement that differs very considerably from that obtained by use of our present lenses, $\frac{1}{3390}$th of an inch.

Histology has ever been a bone for which the anatomist on the one hand, and the physiologist on the other, have contended Were we to consider merely the earlier microscopic researches on the structure of the tissues, we should undoubtedly have to cede this branch of research to the anatomist, as it is to Marcello Malpighi (1628–1694), to whom reference has already been made, that we owe much of the most fruitful and accurate of the early work on this subject. After professing anatomy in three Italian Universities, Malpighi died whilst acting as physician to Pope Innocent XII. Human anatomy was but a small part of the field tilled and cultivated by this indefatigable genius. As pointed out by Dr. Plimmer, the final demonstration of Harvey's almost-demonstrated theory of the circulation of the blood was given by Malpighi, who, with his Microscope, traced it in its course through the capillaries of the lungs from one chamber of the heart to the other, demonstrating not only the presence of these capillaries, but their structure. Insects, animals, plants, histology, embryology,

* See this Journal, 1910, p. 42, "What did our forefathers see in a Microscope?"

and physiology, all came within his ken, and to him, as modern nomenclature indicates, we owe much of our early knowledge of the structure of the skin, of the structure and functions of the organs of taste, of the lungs, liver, spleen, and kidney, whilst on his observations is founded our present knowledge of the developing ovum. So pregnant were his researches on the structure and relations of the capillary vessels, and on the lymphatic glands and spleen, that of the first it has been said that "Harvey made their existence a logical necessity; Malpighi made it a histological certainty."* Whilst in connexion with the second—observations of special interest to the pathologist—he described the enlarged lymphatic glands and the curious suet-like nodules in the spleen which were afterwards more fully described by two great English physicians of the nineteenth century, Hodgkin in 1832,† and later Samuel Wilks, who, attaching to this disease the name of the earlier observer, termed it Hodgkin's disease, lymphadenoma, or pseudo-leukæmia. By his indefatigable researches, Malpighi staked a claim for the anatomist in the field of histology, a claim that they cannot be asked to resign unless good cause can be adduced why they should do so. That cause now exists. For some time after the birth of physiology the Microscope could play but little part in the elucidation of the problems with which the physiologist had to deal; but, as the Microscope was improved and histology was advanced almost to the dignity of a separate branch of science, it soon became manifest that altered function is invariably associated with altered structure, and that it is possible to determine by careful histological examination of secretory cells whether they were resting, or whether they were functionally active at the time that their structures were "fixed." Moreover, it may be determined whether such cells as those of the brain were resting when fixed, were active after a period of rest, or whether they were fixed at the end of a long or strenuous period of activity. Accepting and verifying the observations of the normal histologist and physiologist, the pathologist has, by means of the Microscope, been able to trace the various stages of stimulation by morbid irritants of the cells of tissues and organs, to follow the processes by which these cells and tissues have become more or less permanently modified, and to observe the changes during their reversion to their original and normal condition; or, as they have gradually wasted or degenerated, until they reached a stage at which not only are they useless to the individual but are by their presence an actual menace. Living, they had a useful function to perform; dead, they are foreign bodies, which not only cumber the ground, but may harbour enemies to the organism that otherwise could find no foothold or coign of vantage from which to attack it.

* Fraser Harris, Nature, London, 1911, p. 584.
† Med. Chi. Trans. London, 1832, xvii, p. 68.

It is sometimes cast up as a reproach against the surgeon and physician that with all their microscopic examination of tumours they have, as yet, been unable to find the cause or to explain the origin of tumours. It must be remembered, however, that specific etiology is, after all, but of recent growth, and although the demonstration of the specific causes of a few diseases is still awanting, we have still been able, even in those in which we have failed to do this, to give guidance to the surgeon or physician as regards the prognosis of his case, to help him in carrying out treatment, and in many cases to relieve the suffering, both physical and mental, of the patient. Before the days of the Microscope the surgeon had little to guide him as to the probable course of the various tumours that he met with. He knew that they could be divided into benign and malignant, but he had few data on which to determine to which class a particular tumour might belong. With the advent of the Microscope all this was changed. Certain tumours, although growing independently, were found when examined histologically to depart little from the structure characterizing normal tissues, and did not give rise to any secondary growths; these proved to be benign, and, except mechanically, interfered little with the health of the patient. Other tumours were found to depart somewhat widely from normal adult tissues in arrangement, in their structure, rate of growth, and degree of development. These often gave rise to secondary growths at a distance, and so invaded and interfered with the tissues of the vital organs of the body that they came to be looked upon as malignant, in that the patient succumbed, sometimes very rapidly, in consequence of this invasion. A microscopic examination of all tumours is now carried on as a matter of routine by most surgeons at the time of operation, and the morbid histologist, by gradual improvement of methods, has succeeded in showing how these tumours spread, and even in marking the points to which the tumour has advanced. He has enabled the surgeon to become gradually more and more confident in effecting the complete removal of these tumours, and so prolonging, sometimes to the full span, the life of his patient. Again, dealing with a benign tumour, a microscopical examination enables him to assure his patient that it will not return, whilst, even in the case of malignant tumours, he is able to give some indication as to whether he has removed the whole of the ramifications of the tumour mass. Thus, though the microscopist has not been able to demonstrate the causes of tumour growth, his work has not been entirely in vain.

As one whose main interest in scientific work must necessarily have a bias in the direction of pathology, I might descant for hours on this aspect of the value of the Microscope in medicine, but I realize that, except generally, it can have but little attraction for those whose interest in the use of the Microscope is not so circumscribed. I wish to insist that were it not for the contributions made by the histologist, whether dealing with animal or vegetable tissues, modern biochemistry could have had no existence, and to indicate that those who are engaged in the study of chemical problems which now occupy some of the greatest minds might do worse than treat with greater sympathy the methods and work of the men who laid the foundation on which is built up one of the greatest branches of modern science, Biological Chemistry.

The late Sir William Roberts often gave expression to a fondly cherished idea of his that art, philosophy, and even literature might ebb and flow in tides, and that these might be brought to perfection by individuals, or groups of individuals, but that each individual must attain great heights for himself, often unaided by either his predecessors or his fellows, no body of knowledge or experience of past generations serving as a high ground from which new generations might rise still higher. With science, and where man turns to nature for his knowledge, how different are the conditions. "Natural" knowledge once gained and recorded is available for all time, and although but few may have the insight to interpret, and may pass by blindly and ignore pointers and landmarks which should guide their footsteps, these pointers and landmarks abide for ever and for the use of those who can read them aright. Roberts believed that the great nations of the past, with their philosophy, their literature, and their art, have degenerated as they have become conventional, and even with their high traditions have come to be of but little account, whilst those who have based their success on natural and physical science, and have trained their active workers in the school of observation, and only then in reasoning and argument, have taken a path that can but lead them to higher things and broader knowledge. That this holds good we have ample evidence in the history of the Microscope and microscopy. Each step forward has made further advance possible; the simple lens was succeeded by the compound Microscope, lenses have been corrected, the mirror, the parabolic reflector, the condenser, and all of that marvellous series of accessory illuminating apparatus, the increased magnification and definition, the opening up of the angle of aperture, and the wonderful apparatus for demonstrating structure and the use of monochromatic light, have placed in the hands, even of the tyro, powers of investigation far beyond those possessed by the most able and skilful workers of half a century ago, with the result that neither the anatomist nor the physiologist with his ever-widening field of observation and work can have time or energy to devote to the many histological problems that call for solution by the microscopist. Embryology, bacteriology, protozoology, each calls for its own devotees, but to each, skill in the use of the Microscope and the interpretation of microscopic observation is the foundation on which all new knowledge must be built up. The common feature of this as of all other results obtained by honest work in any field of science truly recorded, is that it always remains a coign of vantage from which fresh fields may be surveyed and explored new regions full of beauty and wealth and from these again still greater lands and more beautiful.

Although van Leeuwenhoek, through his close association with the Royal Society of London and the French Academy of Sciences, is, very rightly, most closely associated with the development of microscopy in relation to medicine, we have to go back to Athanasius Kircher of Fulda, a Jesuit priest, scholar and microscopist, for the first* of that long series of investigations into the microscopic causes of disease that shed such lustre on the seventeenth century. This work lay dormant for a period and bore little fruit, but it was again brought to light in the latter part of the eighteenth century with results as far reaching and important to men as were those obtained by Galileo (1609), whose "telescope had given a glimpse of the intimate vast in astronomy."† Although Kircher's "worms," which he found in decaying matter, were certainly not met with in the blood from plague patients which he examined, it is possible, as Loeffler ‡ points out, that he actually saw some of the larger bacteria met with in decaying matter, working as he did with a magnification of some 32 diameters. However this may be, such magnification and definition as he could obtain were not sufficient to enable him to discriminate between the pus cells or leucocytes and rouleaux of red blood corpuscles and these minute organisms. These observations, however, trained Kircher's mind on the subject of the causation of disease. He was convinced that disease was produced by something that could multiply, something that had the attributes of a living organism, and he stated very definitely his belief in a *contagium animatum* as to the cause of infective disease. It is interesting to find, as pointed out by Garrison, that the great Veronese virtuoso Girolamo Fracastoro (Fracastorius), who "shares with Leonardo de Vinci the honour of being the first geologist to see fossil remains in their true light (1530)," and "was also the first scientist to refer to the magnetic poles of the earth (1543)" in a treatise "*De contagione*" (1546), "states with wonderful clairvoyance the modern theory of infection by a micro-organism (*seminaria contagionum*)," thus anticipating Kircher by about 112 years. Garrison, in a footnote, adds: "It is to be remembered, however, that Fracastorius nowhere refers to the latter as living

* Ars magna lucis et umbræ, Romæ, 1646; Scrutinium . . . pestis, Romæ, 1658.

† An Introduction to the History of Medicine, by Fielding H. Garrison, A.B., M.D., 1913.

‡ Vorlesungen die Geschichtliche Entwickelung der Lehre von den Bacterien. Leipzig, 1887, p. 2.

organisms (*contagia animata*), but describes them (as if in terms of physical chemistry) as something very like our modern 'colloidal systems,' although he regards them as capable of reproduction in appropriate media. As between Fracastorius and Athanasius Kircher, the decision of priority in regard to the germ theory will depend upon whether the arbiter is a materialist or a vitalist." *

When Kircher, Swammerdam, Hooke, Leeuwenhoek demonstrated the presence of minute organisms in decomposing matter, in material taken from carious teeth and in the excreta of patients suffering from diarrhœa, they laid the foundation of our present knowledge of specific infective diseases, and, imperfect as that knowledge is, it has enabled those working at the cure and prevention of disease to initiate and carry out a plan of campaign that has reduced mortality and diminished suffering to an extent that could not have been anticipated even later than half a century ago. At the time they were obtained the findings of these observers were accepted as curious and interesting, no doubt, but as being of so little practical importance that few workers deemed it necessary to continue them or to make any special deductions from them. Later, however, Donné, finding vibrios in pus as well as in the secretions and excretions of the human subject, made a real attempt to connect the presence of microscopic organisms with the occurrence of an infective disease. In all probability Donné's observations were incorrect, or rather his deductions therefrom, for in 1837 he appears to have convinced himself that the presence of these organisms was purely accidental. His observations, however, suggested a new meaning and importance for the study of vibrios and monad-like organisms, and microscopists of all degrees of eminence took up their study, and there followed a time of preparation for the great advance that was made forty or fifty years later by Pasteur, Koch, and Lister. There had, of course, been preliminary tilling of the ground, but in 1837 Theodor Schwann,† a German anatomist and physiologist, and Cagniard Latour,‡ a French chemist, working independently, demonstrated that Leeuwenhoek's yeast globules present in fermenting beer and wine were really living organisms, probably plants, of a low order, which, multiplying by budding and by fission, might be regarded as setting up fermentation by their vital activities. With this observation in their minds, and studying the course of certain infective processes, they came to the conclusion that both fermentation and disease might be the result of the vital activity of similar, if not identical, organisms. Böhm, with his Microscope, looked for and found yeasts in the intestinal

* An Introduction to the History of Medicine, by Fielding H. Garrison, A.B., M.D., 1913.

† Mitth. a. d. Verhandl d. Gesellsch. Naturf., Berlin, Bd. ii. s. 9.

‡ Ann. d. Chim. et Phys., Paris, 1838, t. lxviii. p. 206.

contents of patients suffering from cholera, but, as he found them only when the patient had taken beer, and being a wise and observant man, he wrote them down as having no special significance in relation to the disease.

Then came the work of Bassi (1837),* who made a real advance for us by his careful study of silk-worm disease (muscardine), with which he found associated a vegetable organism or fungus, whose spores appeared to be exceedingly infective even for healthy caterpillars These spores were transferred by direct contact or by currents of air from the affected to the healthy larvæ, germinating on the skin, making their way inwards, and so producing the specific disease. Bassi thus was able to demonstrate that the lower plants are capable of living parasitically on animals as well as on plants. Others, also, seem to have been greatly occupied at this period with the question of parasitism, for we find that just about the same time the itch mite, *Acarus scabei*—which had been described by the Cordovan physician, Avenzoa (died 1164), and then forgotten until Bernard de Gordon, a Scottish physician who taught in Montpellier at the end of the thirteenth and beginning of the fourteenth century, re-discovered it, though it was again lost sight of for centuries—was again "re-discovered" and brought into prominence as the cause of itch.

All these important observations made in the thirties of the nineteenth century drew attention to the question of the existence of a living contagious agent, the *contagium animatum*, and Jacob Henle (1840), histologist and microscopist, summing up the evidence at his disposal,† concluded that the contagia of diseases carried by air currents, as well as of those resulting from direct contact with patients suffering from contagious disease, must be living organisms, capable of continued, and probably independent, existence, for some time at least, having the power of multiplying and able to produce special substances, poisons or ferments, that act upon animal tissues, altering their functions or bringing about their disintegration. He realized that it might not be the animal or vegetable organisms themselves, but their eggs or spores that constituted the infective agent. He pointed out, however, that the mere presence in the excretions or degenerated tissues of patients suffering from disease of either the organisms or their spores did not afford adequate proof that these organisms or spores were the infective factors in the "contagia" as he called them. How wide and, at the same time, intensive was his outlook is evident when we realize that he foreshadowed the postulates deemed necessary by Koch for the proof of the connexion between a possible contagium and a definite disease. He insists that the demonstration of the presence of an organism in the lesions or tissues

* Del mal del segno, calcinaccio o moscardino. Sec. ed. Milano, 1837.

† Pathologische Untersuchungen, Berlin, 1840.

of a diseased patient is essential, and that such organism must be so isolated from its surroundings, that its action may be tested by experiment, and must produce the same or similar results when allowed to act upon a healthy plant or animal. He could not complete the chain, as at that time no methods of growing these organisms in pure culture outside the body had been devised, and animal tests were impossible; but Koch, who succeeded in making these animal tests, insisted that it was necessary, for complete proof, to isolate the same organism from the experimental case.

Many of the earlier achievements in the history of bacteriology we owe to the great botanist Cohn, of Breslau, and for long the stimulus that he gave to those who were working under him or were inspired by his example was chiefly instrumental in advancing the study of this subject. From the time of Pasteur and Koch onwards, however, this work has been taken over almost entirely, not by the surgeon only, but by the physician also, who often, with little training in botanical methods, but confronted by practical problems of great significance to their art and to their patients, have built up a new study which has revolutionized medicine, has raised internal medicine from the position of a conventional art to that of a great and living science, and has removed the reproach that whilst surgery was scientific and progressive the physician remained empirical and unenterprising.

It is unnecessary to give an account of the numerous observations that were made, and controversies that were carried on during this period—a period of great activity in the physiological and pathological world. A few investigators were working away steadily and quietly at the minute structure of tissues, and at fungi and yeasts, and a still larger number were making suggestions, forming hypotheses, elaborating theories and analysing the work of this period, a vast mass of careful observation characterizing the years between 1849 and 1859, when Pasteur took up his famous work. The anthrax bacillus, the largest of the pathogenic bacteria, was observed by Pollender in anthrax blood in 1849, and again by Davaine and Rayer in 1850, and in the new search for the causes of disease this bacillus played a very prominent part, the study of its life-history helping men to crystallize their ideas as to the relation of micro-organisms to disease. Davaine held that the virulence of an attack of anthrax varied according to the number of the bacteria present in the blood and although he was unable to furnish all the proof that Koch later demanded, there can be little doubt that he was satisfied that the anthrax bacillus was the primary cause of splenic fever in animals. Edwin Klebs, a worker of great ingenuity and industry—who has recently passed from amongst us, full of years and held in honour by his fellows—devised a very striking experiment.* Taking fluid, diluted blood, in which the presence of the anthrax bacillus could be demonstrated by means of the Microscope and by experiments upon animals, he filtered it through earthenware, and found that, although the part kept back by the filter contained the bacilli, and was still capable of producing the disease, the filtrate, in which no bacilli could be found, was absolutely innocuous. It was left to Koch, however, to lay down the lines of research in connexion with the demonstration of the etiology of most of the infective diseases now recognized. By means of admirable technique he succeeded in studying the anthrax bacillus in great microscopical detail.† After demonstrating its presence in the blood of animals dying from anthrax, he succeeded, by the use of solidifying media—which had first been used by Klebs, whose work Koch seems to have studied with keen appreciation — in isolating and cultivating colonies arising from individual bacteria, colonies that could be watched under the Microscope as they grew, and their various phases of development noted. From these individual colonies pure cultures were obtained, and by transferring the organism from one lot of medium to another all possibility of anything but the growing organisms remaining was removed. With the organisms so separated and purified, organisms that had the same microscopical character as had those found in the blood of the original diseased animal, he produced definite anthrax by inoculating them into various animals; from these animals he isolated the original organism, with which he succeeded in repeating the whole series of experiments. Further, he showed that when the organism was allowed to grow outside the body under special conditions—conditions apparently unfavourable to the continuance of the species —it had the power of forming spores, bodies that he had never met with in the organism as it occurred in the fresh blood of animals dying from the disease, but which were afterwards found in old shed blood, i.e. when the bacillus came into contact with the air. He noted the resistance of these spores, and recognized their importance in maintaining the continuity of the species outside the animal body. He and his pupils now put to the test many of the observations that had been made by his brilliant predecessors, Henle and Edwin Klebs, observations on miasmata and contagia and on wound-infection that constituted epoch-making contributions to our knowledge of these conditions. He applied his methods to the bacteria of no fewer than six "infections," and showed that each bred true, each produced a definite form of disease, and that five at least could be again isolated and cultivated from the inoculated experimental animals.

Such revolutionary methods and observations were naturally

* Cor.-Bl. f. Schweiz. Aerzte, Bern, i. (1871) p. 279.

† Die Aetiologie der Milzbrand Krankheit, 1876.

distrusted alike by philosopher and pedant; but Pasteur—whose work on silk-worm diseases, flâcherie and pébrine, and whose studies in fermenting wine and beer even now had become classical, —stimulated by Lister's praise and Koch's work on the anthrax bacillus, took up the tale and fully confirmed Koch's results. He cultivated the anthrax bacillus through a hundred generations, and with the final culture series produced typical anthrax. Once started, this brilliant and pertinacious layman (non-medical) stormed position after position. He isolated and differentiated pathogenetic anaerobic micro-organisms; determined the effects of temperature upon bacteria; noted the fact that chicken-cholera virus gradually loses its virulence when left growing in an artificial medium over a long period; that this modification may persist for many successive culture generations; and that the modified culture serves as a protective vaccine against acute chicken-cholera virus much as Edward Jenner's vaccinia protects against smallpox. In the test-tube or in the flask he succeeded in producing vaccines against chicken-cholera, against anthrax, and against certain diseases of swine, and then gradually brought out the fact that a modification of a virus into a vaccine could also be obtained by passing these viruses through a succession of different animals—modification by passage—a method that later served him so well in his experiments on the production of a protective virus against hydrophobia. At every stage of his work, except in that dealing with rabies or hydrophobia, he checked his results by careful microscopical observation, and the confidence thus gained in his earlier studies enabled him to anticipate the results that he would obtain in his hydrophobia investigations, although he was not able to confirm them microscopically. It is sometimes said that the Microscope can no longer be called to our aid in the elucidation of the life-history of the minute ultra-microscopic organisms that are supposed to produce disease; but it may be adduced with justice that it has already provided so many analogies that men walk with great assurance in paths that they know must lead to the goal aimed at. Moreover, the Microscope in its perfected form now gives shadow-pictures which, like those imagined by Plato, indicate the presence of things unseen.

Medicine, then, has advanced just as fast and as far as the Microscope, and other instruments of precision have helped and allowed. All Ehrlich's earlier work in tissue-staining, and the affinity of certain colours for special structures, was based on observations made with the Microscope. Weigert carried on similar studies on the histo chemical reactions obtained in the staining of micro-organisms and of the central nervous system, and laid the foundation for Koch's special stain for the tubercle bacillus, without which, and the aid of powerful and well-corrected lenses, we should still be carrying on a blindly ineffective campaign against tuberculosis, but with the aid of which the white plague is gradually being driven back.

Without the Microscope we should still be making but feeble ineffective and ineffectual attempts to stem the death-rate from typhoid fever, cholera, diphtheria, pneumonia, the plague, pneumonic and bubonic, and many other disease of animals, plants, and man. Some of these have been scotched and others killed, and recent discoveries have led us to believe that others may, ere long, follow in their wake. It is not many years since Kitasato, Yersin, Lowson and others tracked down the *Bacillus pestis*, and in it the cause of plague. Our knowledge of the life-history of this organism has been acquired with great labour, slowly and intermittently, and at each stage the Microscope has been called in to provide the last scrap of evidence, to forge the last link in the chain.

The disease was known to be either contagious or infective. There must then be an infective agent. This was soon demonstrated in the buboes and blood of patients affected with the bubonic plague, and when the same organism was found in the lungs and blood of the patient affected with the pneumonic plague, a far more mortal disease than the bubonic form, evidence of the etiological identity of the two conditions was complete.

How is the disease carried from patient to patient? What relation has the increased mortality of rats, before and during the first stages of an outbreak, to the outbreak itself?

The plague bacillus was found in many dead rats. Then it was found that healthy rats might safely be placed near plague-stricken rats if an interchange of fleas could be prevented, but that if an interchange of fleas was allowed the healthy rats became plague-stricken. How the conveyance of the bacillus was effected by the flea still remained doubtful until C. J. Martin demonstrated under the Microscope the blocking of the alimentary canal of a proportion of the fleas that had been fed on mice infected with the *Bacillus pestis*.* In the beautiful specimens exhibited by him at our last conversazione could be seen viscid masses of plague bacilli, which were evidently the result of rapid multiplication of a number that had been ingested by the flea when it took its meal of blood from the infected mouse. This mass, blocking up the alimentary canal, renders the flea a more dangerous foe than an irritated cobra. Ingested blood can no longer pass through the canal, but after being mixed with a number of germs detached from the front portion of the bacillary bolus, it is regurgitated and driven into the next puncture made by the practically starving and irritated flea, operating whether on mouse or man. First and last, the Microscope, and the Microscope only, could provide the special and most important evidence required to make good the case against the plague

* See full account in Journ. Hygiene, xiii. (1914). Plague Suppl. iii., p. 423.

bacillus. With his knowledge thus acquired the plague officer goes forth to war against the disease with a confidence of success in his struggle that he has never known before, and in areas in which cleanliness and freedom from rats, mice and fleas can be ensured, we need never fear the ravages of a plague, which, in the epidemic described in Boccaccio's "Decameron" (1348), is said to have destroyed one quarter of the population of the whole world, whilst it is calculated that near home, in East Anglia, at least half the population succumbed to this disease.

Without the Microscope Pfeiffer's phenomenon, the solution of bacteria in the fluids of living immunized animals, could never have been observed, and our acquisition of knowledge concerning protection against disease would have been sadly cramped. Without the Microscope there could have been no Durham-Bordet or Widal reaction, and diagnosis in cases of typhoid fever could never have gained its present accuracy. Without the Microscope we could not have put our finger on the typhoid carrier—probably the cause of all endemic typhoid and of many epidemic outbreaks—and without its aid Wright could have devised no opsonic index, no knowledge of phagocytosis could have been acquired, and we should lack all that these mean in the study and treatment of microbic disease.

It would take me too long to give a history of the twentieth century development of protozoology, now the most important branch of microscopic parasitology; but as this subject is one that must occupy a great place in the history of medicine, it may be well again to insist that it could not have come into existence without the aid of the modern Microscope, and the Royal Microscopical Society has cause to congratulate itself that its members have continued to work and to improve the Microscope even beyond what appeared to be necessary to meet the immediate requirements of the botanist and the zoologist. Malaria, which has probably accounted for more illnesses and deaths than the bubonic plague and pneumonia together, is gradually being driven from its fastnesses. Time fails me to recount the stages by which a knowledge of the life-history of the infective agents in the different types of malarial disease has been acquired. Minute blood parasites were first found in the human blood, in the red blood corpuscle and in the plasma; then their development in shed blood was carefully studied. For long no solution of the problems: How do these parasites pass from man to man? and why is malaria specially associated with low-lying swampy ground? was obtained. Then similar parasites were found in birds, and Manson urged Ross to study the mosquito, infesting the regions inhabited by these birds, and to see whether he could find any stage of the bird parasite in the stomach or glands of the mosquito, and Ross did succeed in tracing certain phases of development of these parasites in the stomach wall of this mosquito. The

Italians, following up these observations, demonstrated a similar series of stages of the malarial parasite in the stomach wall of certain of the Anopheline mosquitoes, and gradually the complete life-history of the parasite was obtained; and now, given proper facilities, malaria has been or can be driven out of fever-stricken areas that once were regarded as uninhabitable by the white man. Yellow fever has given way to the researches of the Americans, who, though not finding the causal parasite, have found its mosquito host *Stegomyia fasciata*, and whole areas and islands once spoken of as "white men's graves" have been rendered comparatively healthy by raids on the mosquito host of the hypothetical parasite. Trypanosomes have also been traced from host to host, human, animal, and insect, and anyone who has seen the beautiful preparations and exquisite microscopical technique and management of monochromatic light utilized by Professor Minchin in his work cannot be surprised at the great progress that has been made in the study and description of the various phases of existence of the protozoal parasite and of the development of these parasites in their different hosts. We are told that Schaudinn was one of the most expert microscopists of his time, and that his discovery of the spirochætes or spironema of syphilis, against which Ehrlich has waged such successful war with his chemiotherapy, was due in no small measure to his incomparable skill in technique and staining methods. Once he had made the demonstration of this almost invisible parasite, however, the Microscope manufacturers soon provided optical combinations by means of which Schaudinn's and Metchnikoff's observations were readily confirmed by investigators all over the world.

It is generally recognized, even outside Great Britain, that some sixty years ago (old Pepys notes this at an earlier date) and onwards, the best Microscopes of a certain type were constructed in this country, and that nowhere have the results of the study of the mathematics of optics been applied with greater skill and intelligence; and we all look forward with keen interest to the appearance of Mr. Rousselet's and Mr. Cheshire's catalogue of Microscopes, the property of our Society. When we examine the dates of the various English Microscopes, note their special features, and compare them with the list of contemporary foreign Microscopes, when we make a survey of the work done by them at home and abroad, I think it will be found that we, at any rate, have been well supplied with instruments with which to pursue those branches of Medical Science involving the use of the Microscope. Individuals have used their great opportunities, but it must be admitted that until comparatively recently our Continental brethren, making use of their fewer opportunities more quickly and completely, forged ahead so rapidly and with such vigour that in this work we have not always held our own. Whilst it has always been the boast of English Medicine that it has been intensely practical, it seems at times almost to have lost sight of the value of practical microscopy, and to have ignored the necessity of co-operating with those engaged in developing the Microscope and in perfecting the means of studying pathogenetic germs and the minute structure of tissues and organs—matters of prime importance to those who have charge of patients and of the public health. British skill and brains in plenty have been worked into our Microscopes; the Royal Microscopical Society has contributed more to the evolution of the modern Microscope than any other single body of men; but how many who should be users of the Microscope have lagged behind! Is it possible to remedy this? Is there not at present far too little attention paid, especially in our Medical Schools, to the technical instruction of the histologist, normal and morbid, plant and animal, in the construction of the Microscope?

I well remember the sensation that was created by Hughes Bennett and by Rutherford when they introduced the less complicated Continental Microscope of Oberhauser and Hartnack into their histology classes in Edinburgh and London; and by Hamilton, when he opened classes of pathological histology similar to those that he had entered under Stricker in Vienna, Virchow in Berlin, and Cornil and Ranvier in Paris. As a medical student I had but little idea of the importance of a knowledge of the fundamental principles involved in the construction and use of objectives, oculars, condensers, mirrors, and the like. We were told to examine a specimen with a "high power" or a "low power" combination, by reflected light focused through a bullseye condenser, or by transmitted light reflected from a sub-stage mirror, with the stage diaphragm wide open or with it contracted. We were taught to stain specimens with the object of bringing out special cellular or nuclear structure, but beyond this nothing was expected of us. The thing that was most firmly impressed on my mind in those days, when we had practically no accessory apparatus, was that in screwing the objective into the removable tube of the old Hartnack Microscope, with which we were supplied, one must be careful "not to allow the eye-piece to fall out." Some of those ancient uncomplicated Hartnack Microscopes are still in use in the same laboratory after a lapse of thirty-eight or forty years. In spite of all this, the work done by some 300 students a year has played a great part in this one School in the development of modern methods of study and research in medicine; and one cannot but realize how much more might have been done even by a small fraction of these men had they been carefully instructed in matters then of common knowledge to the members of the Royal Microscopical Society. Indeed, since I have been privileged to take part in the proceedings of this Society, it has been borne in on me that if we could only turn some twenty or thirty of our members into the various Medical Schools of the kingdom, there to instruct first our junior students, and then those engaged in research, in the finer working and wonderful possibilities of the modern Microscope, the rate of advance of medical knowledge would be enormously speeded up. Pondering this matter, it has struck me that in Cambridge we have mercies for which we are not sufficiently thankful, and opportunities that we have failed to seize. Why, I put it to myself, should not our distinguished Secretary, with his knowledge of technique, be called upon to help us in providing for the men who are studying histology, normal and pathological, and bacteriology, sound teaching on the optical and mechanical principles on which are based the construction and use of the Microscope, in order that they may utilize to the full this wonderful instrument. My desire—and hope—is that ere long our best students, at any rate, may have some opportunity of acquiring facility in the use of the various types of sub-stage condenser, dark-ground illumination, monochromatic lighting, methods of measurement, ultra-microscopic work, micro-spectroscopy, polarization, and the like. Much of the rough work has been done with the simpler apparatus of the past, the blocking and hewing, in the domain of histology and cytology, bacteriology and protozoology. For further and finer work, every available adventitious aid, most of them coming to us through improvements in the structure and use of the Microscope, must be called upon. How much has been done in recent years only those can realize who have followed, in our Journal, the reports of what has been done in the great working centres of the microscopical world. Only they, too, can form any idea of the tremendous additional powers of investigation that might be placed in the hands of thousands of workers, were the facilities for microscopical work increased. I am afraid that we Britons are endowed with a natural repugnance to either giving or receiving State grants for furthering the development and utilization of brains. It may be that this repugnance is not so marked as it was, but it is still so great that one cannot hope that this Society, for example, may ever receive a grant for the encouragement of research, for the improvement of the optical and mechanical parts of the Microscope, or in aid of the diffusion of the knowledge acquired as the result of the encouragement of technical work. In the meantime, the researches of the brilliant and persevering investigators who have placed our Society in the honourable position it now holds in the scientific world, have helped to confer benefits on sick and sound alike such as could not have been realized fifty years ago, and the source of which is even now inadequately, very inadequately, recognized.

## VI.—*British Enchytræids.*

By The Rev. Hilderic Friend, F.R.M.S.

(*Read February* 18, 1914.)

Figs. 15 to 19.

### VI. *New Species and Revised List.*

During the past year my researches into this interesting group of microscopic Annelids have been diligently continued by the aid of a Government grant, and with the valued co-operation of Mr. H. Hillman, of Nottingham, who has, both in that county and in Jersey, discovered many interesting species, two of which I propose to name after him in recognition of his invaluable aid.

In the last paper which I had the honour to submit to this Society (*1*),* I gave a brief outline of Enchytræid characters, and it will suffice if the reader turns to page 255 (Vol. for 1913) for such details as he may require to enable him to follow the present descriptions. The progress made in this study renders it necessary to bring our knowledge of the group to a focus, and it is proposed in the present paper to deal in the first place with such new species as have been added to the family, or whose definition requires criticism, and then to tabulate results and give a revised catalogue of species known to Britain.

Since, however, the red-blooded Enchytræids (*Marionina* and *Lumbricillus*) still await careful revision, and the family is now so extensive, it will be necessary for the present to confine attention entirely to the genera with colourless blood. It must not, however, be thought that the colour of the blood is taken as a generic character, since we occasionally find red, pink, and yellow blood outside the range of the two genera (*Marionina* and *Lumbricillus*) in which red is the normal colour. Several of the genera possessing white blood have yielded good results during the year. I have personally explored some new localities as well as many old ones, and during my brief vacation spent some time in Germany and Belgium; but these countries did not yield much of special interest which was not already known to me at home. The truth is that Great Britain is peculiarly rich in Enchytræids, and though Bretscher, Issel, and others have found a goodly number in Switzerland and

* The figures in brackets refer to the Bibliography at the end of the paper.

Italy, England seems to be at present considerably ahead of other countries in the number of known species.

Owing to the uncertainty which still prevails in reference to the genus *Enchytræus*, it has been thought desirable to omit consideration of that group also for the present. This leaves us with eight genera for our present study, viz. *Achæta*, *Fridericia*, *Buchholzia*, *Henlea*, *Bryodrilus*, *Mesenchytræus*, *Grania*, and *Chamædrilus*. *Stercutus*, *Hydrenchytræus*, *Michaelseni*, *Distichopus*, *Hepatogaster*, and *Chirodrilus* are at present unknown in Great Britain.

## I.—SPECIES NEW TO SCIENCE.

### *a.* The Genus Buchholzia.

In the year 1900, when Michaelsen published his Oligochæta (*4*), two species only of *Buchholzia* were known to science, and these differed from each other so widely that one could hardly see how they could both be members of the same genus. The intervening years have brought other species to light which must for the present be spoken of as members of the genus *Buchholzia*; but they still further illustrate the difficulty of finding true generic characters. One of the new species about to be described is evidently a connecting link between this and other genera, and might well have been named *intermedia*, but that when a further revision is required such a name would be robbed of much of its significance.

#### 1. *Buchholzia focale* sp. n.

Length, 8–10 mm. Segments number about 45. While the chloragogen cells often give it a dark appearance, it is white and transparent. Setæ 2–3 in posterior region of body, 3 dorsal and 4 ventral as a rule in anterior bundles; not arranged as the setæ of *Fridericia* are, with the shortest in the middle of the bundle, but sigmoid and *fallax*-like, i.e. the shortest near the middle line. Setæ persisting on the girdle segment to a late period. Chloragogen cells very large, almost black under the lens, commencing in segment 6. Cœlomic corpuscles varying in size and shape, from round to oval or discoid, pointed, brownish, nucleated. Three pairs of septal glands normal in shape and position. Blood sometimes yellowish in colour. Body frequently glandular, and segments annulated. Nerve chord enlarged in front. Brain about $1\frac{1}{2} \times 1$, concave before and behind, Henlean in type. The origin of the dorsal vessel also in 12/13 is Henlean. Three specimens carefully examined all agreed in this peculiarity as in every other. Girdle normal on the 12th segment, extending over 12 and half 13, with fairly large cells. Sperm funnel about $2 \times 1$, with long slender duct arranged frequently like coils of vermicelli. Spermathecæ as usual, one pair opening in 4/5 with or without glands; duct about equal in length to ampulla, short, stout, gourd-like in outline (see fig. 15). The most striking peculiarity, however, is the presence of a pair of glands (possibly aborted salivaries) apparently issuing from the posterior of the pharynx, and looking like the two ends of a clergyman's bands or cravat. Hence the specific name *focale.* The nephridia were not studied.

It will be observed that the position of the girdle and sperm-funnel, the point of origin of the dorsal vessel, and the peculiar glands, differentiate it from *B. appendiculata* and *B. fallax,* while the spermathecæ show it to be unlike *B. parva*—a species not yet found in Britain. The brain, salivaries, spermathecæ, and origin

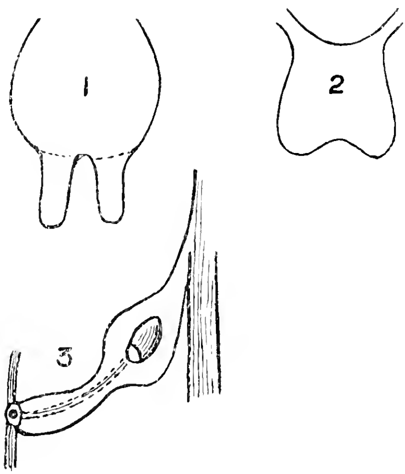


FIG. 15.—*Buchholzia focale* sp. n.
1. Cravat-like appendages. 2. Brain. 3. Spermatheca.

of the dorsal vessel also serve to make its dissimilarity from the next clear.

*Habitat.*—Alexandra Park, Hastings. Collected December 21, 1911; described from living material March 7, 1912; but the details now published for the first time, for reasons given under the next.

2. *Buchholzia tenuissima* sp. n.

Very slender. Length 8–10 mm. Segments 35–50. Setæ gradually decreasing in number posteriorly, from five in anterior to two in posterior segments; slightly sigmoid, wanting on segment 8. The most arresting external character is the girdle, which extends in the fully adult worm from the setæ of segment 7 to those of segment 9, and includes the whole of the 8th segment. Here the blind sac is situated internally from which the dorsal vessel takes its rise. The œsophagus suddenly emerges in this segment into the enlarged intestine. The brain is about as long as broad, varying somewhat under tension; slightly convex in front; straight, or slightly convex when strained; not incised, but nearly straight behind. Sperm-funnels rather large, about 2 × 1, somewhat mobile and variable, with fairly stout ducts, opening into a moderately large atrial gland-pore on segment 8. Large nephridia-like salivary glands in segment 4. Nephridia seen in 8/9 and later as in *Chamædrilus*, but not observed in the anterior segments. Duct a continuation of the postseptal. Cœlomic corpuscles of two kinds, larger and smaller. Very characteristic sperma-

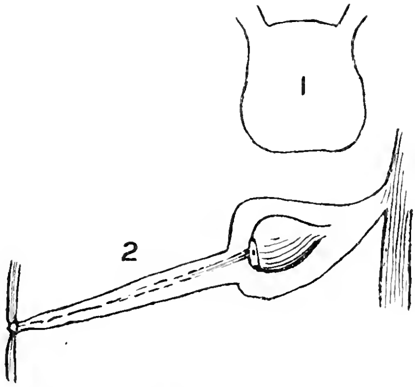


FIG. 16.—*Buchholzia tenuissima* sp. n.
1. Brain. 2. Spermatheca.

thecæ (fig. 16), with bulbous ampulla attached to œsophagus, and stout duct tapering to 4/5 opening without glands.

Five specimens were examined, of which three were adult and agreed in all particulars. The details respecting their length and number of segments may not be without interest.

| | Length | Segments |
|---|---|---|
| 1. Immature . . | 6 mm. | 35 |
| 2. ,, . . | 8 ,, | 35 |
| 3. Mature . . | 10 ,, | 50 |
| 4. ,, . . | 8 ,, | 45 |
| 5. ,, . . | 6 ,, | 36 |

There is thus a difference of fourteen segments and 4 mm. even in the adults. The length usually agrees with the number of segments.

The position of the girdle and other organs allies this species with *B. appendiculata*, from which it differs in the shape of the brain, diverticulum, spermathecæ, sperm-funnel, and other particulars. While *B. appendiculata* is stout, the new species is attenuated, whence its trivial name.

*Habitat.*—Under moss in the Alexandra Park, Hastings. Collected at the end of June 1912; described February 13, 1913, but the details now published for the first time. When *B. focale* was examined, I was daily expecting to be called to Hastings again on domestic business, and hoped to be able then to obtain new material. It was not till six months after my former visit, however, that I was able to examine the spot, and the results are noteworthy. In December I found *B. focale*, in June *B. tenuissima*. Such striking facts are continually coming under one's observation, and are of exceeding interest in the study of Enchytræid bionomics.

We now have four British species of *Buchholzia* on record, which may be distinguished thus:—

1. Girdle on segment 12.

   (i) Dorsal diverticulum present, from which dorsal vessel arises . . *B. fallax*

   (ii) Dorsal diverticulum absent; dorsal vessel arising in segment 12/13 . *B. focale*

2. Girdle on segment 8.

   (iii) Spermathecæ with pear-shaped ampulla, and two large glands . *B. appendiculata*

   (iv) Spermathecæ with bulbous ampulla, destitute of glands . . . *B. tenuissima*

The members of this genus are not, so far as our present knowledge goes, common in this country, and deserve a little further study. I first reported *B. fallax* Mich. as British in the Irish Naturalist for 1898, as having been taken on the shores of Lough Neagh in June 1896, and, about the same time, at Lodore and Lowther in Cumberland. My later records are Ledbury Churchyard, April 17, 1911; Eel-traps on Sutton Broad, August 19, 1911; Cauldwell, near Burton-on-Trent, June 11, 1912; Dundrum Road, Dublin, March 7, 1913; Blenheim Park, Oxon, April 14, 1913. The species seems liable to a good deal of variation. *B. appendiculata*, however, seems more fluid still, and presents many problems which I have not yet been able to solve. I first found and figured it April 21, 1892. It was first recorded as British, however, by Southern (*6*) in 1909. The type and varieties have been found by me at several places in Derbyshire between February 1911 and July 1912; at Hastings, June 1912; and Sedlescombe, Sussex, August 16, 1913.

### β. The Genus Achæta.

This interesting genus is characterized by the absence of setæ. In some instances setæ sacs still remain in the form of cœlomic processes slightly attached to the body-wall, while in others these vestiges have entirely disappeared. Michaelsen (*4*) has three species only, known to science in 1900, all of which are British. Bretscher (*8*) in 1902 added a fourth, which has not yet been found in these Islands. Southern (*5*) has described an Irish species, and to these I am now able to add two others.

#### 1. *Achæta spermatophora* Friend.

Length about 8 mm. Segments from 35–40. Setæ sacs present dorsally. Brain large, nearly oval, convex before and behind, about $1\frac{1}{2}$–$2 \times 1$. Characterized by a pair of bodies resembling spermatophores, whence the specific name. First described in Irish Naturalist for September 1912, p. 174.

#### 2. *Achæta incisa* Friend.

Length at rest about 5 mm., extending to 7 or 8 mm. when stretching eagerly, when it is very slender. Segments 35–40. Destitute of setæ, but possessing dorsal setæ sacs. Owing to the presence of large opaque cœlomic corpuscles and chloragogen cells, it resembles *Enchytræus nigrinus* under the Microscope. Sperm-funnels 2 or $2\frac{1}{2}$ times as long as broad, with long sperm duct, medium atrium and pores. Three pairs of septal glands, but no salivary glands observed. Dorsal vessel arises in segment 7 and pulsates in front, especially in segment 6. Nephridia in 6/7, 7/8 with very large postseptal. Behind the girdle the nephridia show the postseptal narrowing into a duct. Spermathecæ bottle-shaped, with neck opening into the œsophagus; not like those of *A. bohemica*. Brain about 2–3 times as long as broad, sometimes incised behind, suggesting the specific name. The brain (fig. 17) was found, after this specific name had been given, to be variable, but the name is retained as the other characters are sufficiently definite to ensure recognition.

*Habitat.*—Sandy soil, Mansfield, Notts, May 8, 1912. See Trans. Notts Nat. Soc., 1911–12, pp. 58–9. No figures were supplied, as it was intended at an early date to publish the diagnosis in one of the scientific journals.

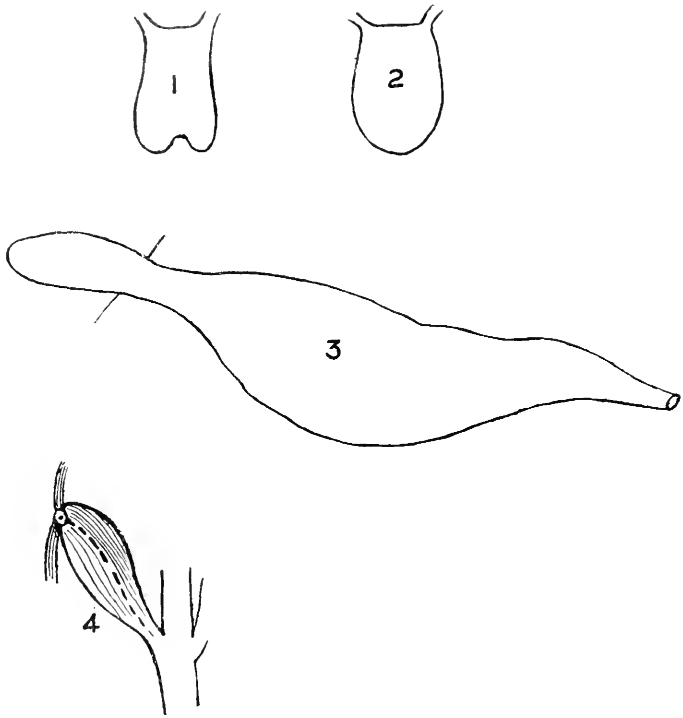


Fig. 17.—*Achæta incisa* sp. n.

1. Brain incised, typical. 2. Brain convex behind.
3. Nephridium. 4. Spermatheca.

The British species of *Achæta* now number six, and may be distinguished by the following characters :—

| | | |
|---|---|---|
| 1. | Setæ sacs absent . . . . . | *A. cameranoi* |
| 2. | Setæ sacs present . . . . . | 3 |
| 3. | Sacs present ventrally and dorsally . . | *A. eiseni* |
| | Sacs present dorsally only . . . | 4 |
| 4. | Brain concave behind . . . . . | *A. incisa* |
| | Brain convex or oval : | |
| | α. Spermathecæ with pear-shaped ampulla | *A. bohemica* |
| | β. Spermathecæ like spermatophores . | *A. spermatophora* |
| | γ. Spermathecæ simple ducts . . | *A. minima* |

## γ. The Genus Henlea.

On more than one occasion in the past this important genus has received attention in these pages. It is therefore unnecessary here to do more than describe those species which have been recently added to our indigenous Annelid fauna.

### 1. *Henlea glandulosa* Friend.

Resembles, in some respects, *H. marina*. First described in Irish Naturalist, January 1913, pp. 9–10; at the time when my paper on Henleas was in the hands of the Sec., R.M.S. (See Zoologist, March 1913).

### 2. *Henlea bisetosa* sp. n.

A very small transparent worm. Length 3–4 mm. Segments about 30. Setæ 2 throughout. Often a young one may be found growing beside the regular pair, but never three fully formed. Bulbous enlargement of intestine in segment 8, with dorsal vessel originating in 7/8. No œsophageal glands; but it might be possible to regard the bulb as an unpaired gland. Cœlomic corpuscles large, clear, not granular. Special glands (salivaries probably) between the second and third pair of septals (similar to *H. inusitata*). Septals of rather unusual form, three pairs in normal position. Intestine yellowish, chloragogen cells rare. Nephridia begin in 6/7, with long slender duct originating behind the septum.

Though not adult, this species is readily distinguished from all other British forms by the number of setæ and the shape of the septals. The position of the salivary glands is unusual, and allies it with *H. inusitata*.

*Habitat.*—Canal side, Dublin. Found by myself March 11, 1913, and recorded in Irish Naturalist, September 1913, p. 172; but now described for the first time. Also recorded for Nottingham, April 1913 (?)

### 3. *Henlea hillmani* sp. n.

Length 5–6 mm. Segments 30–36. Yellowish-white, rather a squatty form. Ventral setæ 2–4, usually two dorsally, largest in posterior end. When four are present the innermost pair is shortest. Three pairs of septals, the hind pair with globular processes behind; otherwise normal in position and shape. Dorsal vessel arising about thirteenth or fourteenth segment; in one traced to 12/13, in another to 14/15, pulsating forward to segment 5. Brain incised behind, somewhat longer than broad, of

Henlean type. Cœlomic corpuscles not horny, of two kinds, the larger granulated. No œsophageal glands or bulb; the œsophagus going gradually into the intestine. Strong gizzard extending from segment 2 to 4. Rather long, narrow salivaries, with tips slightly budding, or branching freely. First nephridia in 7/8; duct not always issuing from the same part of the postseptal. In the hindermost segments the duct tends to spring from the posterior portion.

*Habitat.*—Collected at Scarrington, Notts, June 10, 1913, by Mr. H. Hillman, after whom it is named in recognition of the splendid service he has rendered by his intelligent and indefatigable collecting.

### 4. *Henlea insulæ* Friend.

Collected in June 1913 by Mr. Hillman in Jersey, and first described in Zoologist, December 1913, p. 460.

### 5. *Henlea inusitata* Friend.

First regarded as a variety of *H. dicksoni*, but found to be a true species. Length variable (unless again two species are included); 5–15 mm. Segments 25–45. Setæ *Fridericia*-like; i.e. shortest in the middle of the bundle, three to six in posterior bundles, five to eight in front, rarely in the most adult reaching nine in a set. Brain typical, incised, concave or sometimes straight or convex behind, according to tension.

Nephridia begin in 5/6 or 6/7, duct as long as postseptal, from the middle of which it usually springs. Spermatheca usually a simple duct, occasionally with glands at the 4/5 opening. Bulb in segment 8, and dorsal vessel in 8/9. Salivary glands between the second and third pair of septals. First described in Zoologist, March 1913, p. 85.

*Habitat.*—Frequently found, and formerly recorded as *H. dicksoni* in part. Definite records for the new species are Rolleston Junction, Notts, March 26, 1912; Cauldwell near Burton-on-Trent, June 11, 1912, and again on April 7, 1913; Dundrum Road, Dublin, March 7, 1913; Oxford Botanic Garden, April 15, 1913.

### 6. *Henlea minima* Friend.

Length 5–6 mm. Segments 25. Brain slightly concave behind, converging forwards, of the usual Henlean type. Spermathecæ like an Indian club or champagne bottle, without ampulla or glands. Septals three pairs, small (in front), medium, and large. No œsophageal glands. Girdle 12 to half 13. Cœlomic corpuscles large, clear, oval to round. Setæ about six in front, shortest in the middle of each bundle, as in *Fridericia*, 4–5 behind, larger and nearly equal. Œsophagus merges suddenly into intestine in 7/8, dorsal vessel arises in 10/11. Four pairs of large nephridia in preclitellar segments (6/7–9/10). Duct of nephridia equalling postseptal in length, and usually arising from the middle portion. Sperm-duct in girdle segment very fine, coiled.

Related to *H. dicksoni*, but much smaller, and possessed of specific characters, such as origin of dorsal vessel, shape of spermathecæ, and size of brain.

*Habitat.*—Stream at Netherseal, near Ashby-de-la-Zouch, 1911. First described as a new species in Zoologist, March 1913, p 84.

### 7. *Henlea multispinosa* Friend.

Length 23 mm., fairly stout. Segments 40–50, transparent. Spermathecæ consisting of narrow ducts, sometimes varying in diameter, with small glands (apparently 2 to 4) at the 4/5 opening. Salivary glands present, slender, forked or branched (resembling those of certain species of *Fridericia*); three pairs of septals, normal in shape, size and position. First nephridia in 4/5 large; duct emerging from behind the septum, and exceeding postseptal in length. Bulb in 7, dorsal vessel arising in 8th segment. Setæ very numerous; 4–6 in posterior region, 8 in the middle, rising to 10–12 in front. Very few known Enchytræids ever exceed 10 setæ per set. *H. dicksoni*, which the new species resembles, may possess 8 setæ, and *H. puteana* may have 8–10.

*Habitat.*—Under moss, overflow from Canal, Nottingham City, December 16, 1912. Formerly regarded as a variety (*multispinus*) of *H. dicksoni*. See Trans. Notts Nat. Soc., 1911–12, p 55. Described for the first time as a distinct species in Zoologist, March 1913, p. 83.

### 8. *Henlea quadrupla* Friend.

Length 10–12 mm. Segments 45–50. Four pairs of septal glands, whence the specific name. One pair of œsophageal glands in segment 8, with dorsal vessel in 8/9. Large sac-like salivaries in front of first pair of septals. Setæ somewhat variable, 3–4 dorsally, 4–5 ventrally, but sometimes as few as two per set. Cœlomic corpuscles not of the horny type. Brain not much longer than broad; not rigidly outlined, but varying with tension. Postseptal about three times as large as anterior portion of nephridium; duct arising near posterior end, or as a continuation thereof, short.

Spermathecæ in the perfect adult with short duct, large ampulla and 4/5 glands, as shown in illustration (Fig. 18).

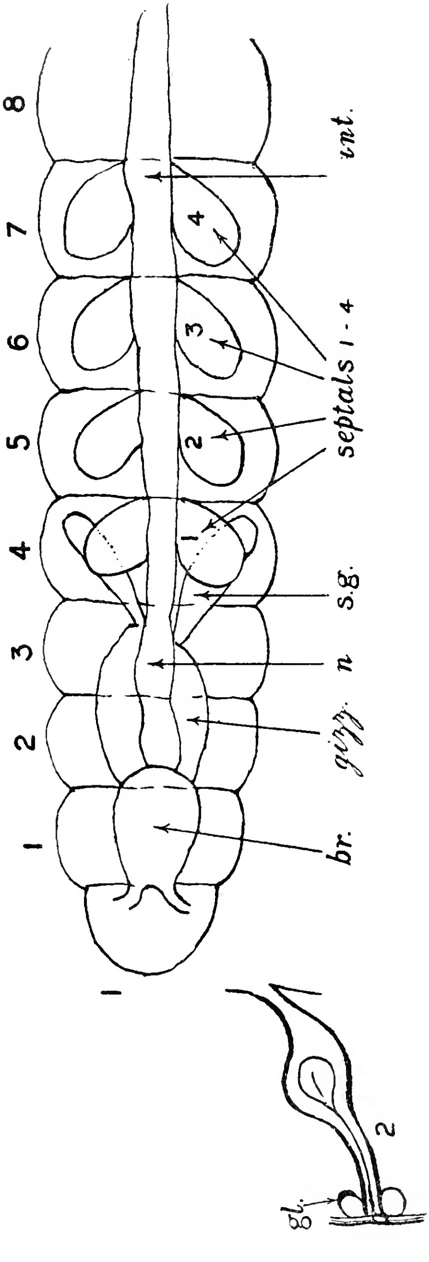


Fig. 18.—*Henlea quadrupla* sp. n.

1. Diagram showing brain, gizzard, nerve, salivary glands, four pairs of septals, and intestine.
2. Spermatheca, with glands.

*Habitats.*—Overseal, November 1911; Netherhall, November 22, 1912; Midway, January 30, 1913. These localities are all between Burton-on-Trent and Ashby-de-la-Zouch. First described in Zoologist, March 1913, p. 85.

9. *Henlea trisetosa* Friend.

Length 5–6 mm. Segments 35–40. Setæ sigmoid, three in each set throughout. Like the last, it has four pairs of septal glands, but no œsophageals, nor any salivaries. The dorsal vessel arises in 9/10. First described in Zoologist, March 1913, p. 86.

10. *Henlea tubula* sp. n.

Length 10–12 mm. Segments up to 45. The most striking feature is the bulb, which seems to be made up of tubes (whence the trivial name), and is capped with very dark cells. No œsophageal glands, three pairs of septals of normal type; setæ unequal in length, as if some had fallen out from one side of the *Fridericia*-like bundles. Usually 3–4 dorsal and 4–5 ventral; seldom, if ever, exceeding five. Bulb in segment 7 with dorsal vessel in intersegment 6/7 in front of the black cap and tubules. Sperm-funnel $1\frac{1}{2} \times 1$, the long coiled duct ending in an atrial gland half as large as the funnel. Cœlomic corpuscles not horny or clear, but granulated, in healthy worms embedded in a thick cœlomic fluid. Brain incised behind, rather longer than broad, Henlean in character. Large sac-like salivaries in front of first pair of septals. Spermathecæ with distinct duct and ampulla, with or without 4/5 glands. Posterior of nephridia merging in short duct. Large interspaces between the girdle cells.

*Habitat.*—Several localities in and around Dublin: Canal Side, Dundrum Road, Balls Bridge, and St. Doulough's, March 1913; now first described. See Irish Naturalist, September 1913, p. 172, for the first record.

10. *Henlea mariona* Friend.

Length 10 mm., stout. Segments about 50. Setæ up to eight in front and behind; those in anterior bundles *Fridericia*-like, i.e. shortest in the middle of each set. Only two pairs of septals; front pair very large, second pair smaller, with spermathecæ between them. No œsophageal glands. Sperm-funnel small, $1\frac{1}{2}$–$2 \times 1$, with fine irregularly coiled duct; large atrial glands and pores on segment 12. Bulb-like enlargement in 9 or 10, with the dorsal vessel arising in 10/11, pulsating forward. Girdle extending from setæ of segment 11 to setæ of 13. First pair of nephridia in 4/5; postseptal large, duct not proceeding from posterior extremity. Brain incised behind, length about $1\frac{1}{2}$ width. Spermathecæ very unusual, appearing to combine dorsally so as to form an unpaired ampulla. Cœlomic corpuscles oval, not horny.

. The characters are intermediate between those of *Marionina* and *Henlea*, on which account the specific name has been chosen. 1912, Friend, in Trans. Notts Nat. Soc., pp. 59–60. Found between Burton Joyce and Lowdham, December 16, 1912.

Owing to the large number of species of *Henlea* now found in Great Britain, I have found it desirable (*9*) to divide them into two groups, reserving the name *Henlea* for those which possess œsophageal glands, and calling the others, which are destitute of such glands, *Henleanella*.

### δ. The Genus Fridericia.

The members of this genus are very numerous, and in most instances can be readily distinguished from other genera by their setæ and spermathecæ. When the setæ number four or more per set, the innermost are the shortest. In many cases the spermathecæ are possessed of diverticula, and the brain is almost invariably convex behind. To differentiate the species, however, is by no means an easy task, since their number is now rapidly approaching a hundred. In Great Britain alone we have now some forty known species, and every year the number grows. I have already in this Journal (*1*) shown how they may be conveniently tabulated.

#### *Fridericia arborea* sp. n.

Length 6–8 mm. Segments 35–40. Front setæ two, rarely three dorsally, 3–4 ventrally, small; three stronger ones in the middle and two in the final segments. Brain of the typical shape, but in some cases tending to concave behind, with underlap. Salivary glands extending to 5/6 with long forked ends. First pair of nephridia in 6/7. Dorsal vessel arising about the 15th segment. Cœlomic corpuscles of two kinds, the larger oval. Three pairs of septal glands. Girdle on 12 to half 13. Spermathecæ with duct roughly covered with small cellular outgrowths. I found two forms. The first has the brain slightly concave behind, and the duct of the anterior nephridia short; while the second has the brain convex before and behind, and long ducts to the nephridia, opening by large glandular pores. The species belongs to the *bulbosa* group. The members of this section are numerous and not easy to distinguish on paper, though presenting very clear characteristics under the Microscope when alive. The first was found in a decaying tree trunk at Zouch Mills, Notts, April 2; the second form at Mapperley, May 14, 1913.

*Fridericia bretscheri* Southern.

When Southern created this species he assumed that it was already known as *F. parva* Bret.; and as the name *parva* had already been appropriated, he changed the name. But *F. parva* Bret. is quite distinct from *F. bretscheri* Southern, and both are British. I draw attention to the point here, and will refer to Southern's own works (*5*, *6*) for his definition. Bretscher's species will be discussed later.

*Fredericia bulbifera* sp. n.

Length 5–10 mm; slender. Segments 35–40. Setæ four unequal in segments 2–16 or thereabouts, and two equal thence to end. Brain egg-shaped, largest behind. Spermathecæ with duct about twice as long as bulbous ampulla and the posterior attachment; glands at 4/5 present or absent. Salivaries long, often extending back to 5/6 unbranched. Nephridia in anterior segments, with bulbous anteseptal and distinct duct; those behind with pointed anteseptal and postseptal merging into a duct. Girdle 12 to half 13, with large gland-cells. Sperm-funnels small. Dorsal vessel arising in or near segment 16. Three pairs of septals, the posterior pair sometimes having forward processes, so that at first sight there appear to be four pairs of glands. Another member of the *bulbosa* group.

First taken at Portobello, Dublin, March 10, 1913. Oxford Botanic Garden and Blenheim Palace in April, and frequently in Notts in May to July 1913.

*Fridericia coronata* sp. n.

Length 15, stretching to 20 mm. Segments 50, opaque, yellowish, and resembling *Henlea dicksoni* in appearance. A stout worm, difficult to study alive. Setæ never exceed four in front; in the middle and posterior usually one dorsal, and one, two, or three ventral setæ present. The larger setæ strongly curved within, and tending to a central bulb or bulging. Brain convex before and behind, with underlap. Salivary glands much branched behind. Spermathecæ very characteristic; with long, somewhat slender duct, and a coronet of small glands around the ampulla (fig. 19). Girdle in normal position, with large male pores. Funnel about 4 × 1, rather long and narrow, with long irregularly-coiled duct. Dorsal vessel arising in or behind segment 16. Characteristic nephridia, with medium anteseptal, large postseptal with a lobe or indentation behind, and duct much exceeding postseptal in length. Duct springs from just behind the septum. Cœlomic corpuscles of two kinds, the larger oval, nucleated and granular. Large dorsal pores and conspicuous guard cells. Altogether a well-defined species. The crown of glands on the spermathecæ recalls *hegemon* and *microcara*, but the differences are well marked.

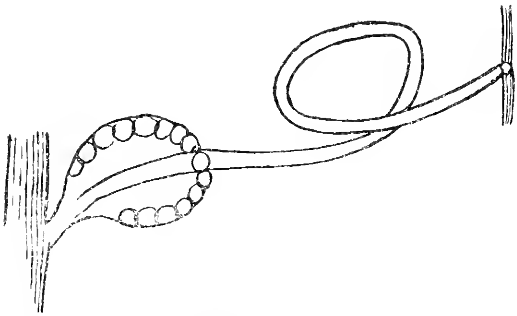

FIG. 19.—*Fridericia coronata* sp. n. Spermatheca.

*Habitat.*—Blenheim Park, April 14, 1913. Examined in June, after keeping the material nearly three months; worms were then fully adult.

### *Fridericia parva* Bret.

Some of Bretscher's descriptions are very imperfect, but of this he distinctly says that it has two setæ in each bundle; hence it cannot be the same as *F. bretscheri* Southern. The *F. parva* of Moore has been referred to *F. bulbosa* Rosa. I am not so sure that they are one and the same, but my record in Naturalist, August 1898, was made before we dreamed that the genus was so extensive, and later research has not cleared the matter up.

### *Fridericia hillmani* Friend.

Described in Zoologist, December 1913, p. 462.

### *Fridericia rotunda* sp. n.

Length 15–20 mm. Segments 55–60. Dense, opaque; dirty white or yellowish in colour. Setæ usually 4–6 dorsal, and up to eight ventral in anterior bundles, and, as a rule, four or three behind, very stout. Brain almost spherical, whence the name. Spermathecæ with short stout duct, two glands at 4/5 opening, and five or perhaps six sessile diverticula. The whole organ quite the stoutest I have seen in the genus. Girdle thick, including half 11 to half 13, or perhaps the whole of the latter segment when perfectly developed; gland cells small. Three pairs of very large septals. Slender sperm-ducts, with large atrial glands and male pores. Ampullæ 3–4 × 1, with collar absent or small. Dorsal vessel about the 19th segment. Though seven distinct specimens were examined, no nephridia could be seen. Salivary glands branched. The brain and spermathecæ serve to separate this from every other known British species.

*Habitat.*—Rough place by the wall of Woodboro' Hall Gardens, Notts, December 18, 1912.

I have notes of other species which it is impossible at present to determine.

## II.—A REVISED LIST.

So great has been the increase in the number of Enchytræids known to Britain since the Government aided me in my researches, that the time has come when a complete list should be prepared for the guidance of zoologists. The present contribution to that revised list contains the names of all known British genera and species, except *Enchytræus* and the red-blooded group which consists of the two genera *Lumbricillus* and *Marionina.* These will form the subject of a later communication.

For facility of reference, the genera and species will be alphabetically arranged, and the references will, as far as possible, relate to the original memoirs or principal monographs. Wherever possible the first British record will be cited, and any additional information given which may be deemed necessary for purposes of identification or further research. The *Oligochæta* volume (Das Tierreich) of Michaelsen is indispensable.

### ACHÆTA Vejd.

Setæ wanting; setæ sacs sometimes wanting. Salivary glands unpaired, dorsal. Spermathecæ free, not attached to the œsophagus.

1. *A. bohemica* Vejd. 1879, *Anachæta bohemica* Vejdovsky, in Zool. Anzeig., ii. p. 183. Michaelsen, Das Tierreich, p. 103. August 28, 1911, Kew Gardens; See Bulletin of Mis. Inf., xii. p. 374. November 7, 1911 and March 2, 1912, Nottingham, Trans. Notts Nat. Soc., 1910–11, p. 38. March 11, 1913, Dublin, Irish Nat., 1913, p. 171.

2. *A. cameranoi* Cognetti. 1889, *Anachæta camerani* Cogn. in Boll. Mus. Torino, xiv. No. 354, p. 2; Michaelsen, Das Tierreich, p. 103; July 2, 1911, Acresford near Ashby-de-le-Zouch; Friend, in The Naturalist, December 1911, p. 413.

3. *A. eiseni* Vejd. 1877, *Achæta eisenii* Vejdovsky, in SB.

Böhm. Ges., p. 300; Michaelsen, Das Tierreich, p. 103. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 165. Limerick, Ireland.

4. *A. incisa* Friend. 1912, Friend, in Trans. Notts Nat. Soc., p. 58; Mansfield, Notts, May 8, 1912. Vide supra, p. 133.

5. *A. minima* Southern. 1907, Southern, in Irish Naturalist, xvi. p. 77. Lambay, Ireland.

6. *A. spermatophora* Friend. 1912, Friend, in Irish Naturalist, xxi. p. 174. Poyntzpass, Armagh, Ireland.

### Bryodrilus Ude.

Setæ present, sigmoid. Blind sacs on œsophagus in segment 6. Spermathecæ simple, destitute of diverticula, communicating with œsophagus.

7. *Bryodrilus ehlersi* Ude. 1892, Ude, in Zool. Anzeig., xv. p. 344; Michaelsen, Das Tierreich, p. 71. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 147. *B. ehlersi* Ude. var. ? Powerscourt, Wicklow, Ireland. 1911, Netherhall, near Burton-on-Trent, Derbyshire.

### Buchholzia Michaelsen.

Setæ present, sigmoid [œsophagus widens suddenly in segment 7. Dorsal vessel arises in diverticulum]. Spermathecæ communicating with œsophagus.

8. *B. appendiculata* Buch. 1863, *Enchytræus appendiculatus* Buchholz, in Schr. Ges. Könisb., iii. Abh. p. 96; Michaelsen, Das Tierreich, p. 72. 1892, April 21, Suburbs of Bradford, Yorkshire. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 148. Co. Dublin, Ireland. 1911, February 10, Woodville. July 11, Cauldwell, Derbyshire. 1912, Hastings and Sedlescombe, Sussex.

9. *B. fallax* Mchln. 1887, Michaelsen, in Arch. Mikr. Anat., xxx. p. 374. 1896, June 4, Antrim, Ireland; Friend, in Irish Naturalist, vii. 1898. 1911, April 17, Ledbury, Herefordshire; Sutton Broad, Norfolk. 1913, Dublin, Ireland, Irish Naturalist, xxii. p. 171; Blenheim Park, Oxfordshire, April 14.

10. *B. focale* sp. n. Supra, p. 129. Hastings, Sussex, December, 1911.

11. *B. tenuissima* sp. n. Supra, p. 130. Hastings, Sussex, June, 1912.

### Chamædrilus Friend.

Setæ present, sigmoid. No preclitellian nephridia or salivary glands; girdle on segment 9. Spermathecæ with large 4/5 gland but without diverticula, not free in cœlom. Origin of dorsal vessel postclitellian.

12. *C. chlorophilus* Friend. 1913, Friend in J.R.M.S., p. 257 et seq. 1912, November 23, Netherhall, Derbyshire; December 3, Hastings, Sussex; Smisby, Newhall, Hathern, Oxford and elsewhere. Jersey, June. Zoologist, December, 1913, p. 457.

### Chirodrilus Verril.

Not yet known as British.

### Distichopus Leidy.

Not yet known as British.

### Hepatogaster Cejka.

Not yet known as British.

### Enchytræus Henle.

Reserved for later treatment.

### Fridericia Michaelsen.

Setæ present, not sigmoid, innermost shortest. Dorsal pores present, also salivary glands. Spermathecæ frequently with diverticula and glands. (N.B. The order is alphabetical.)

13. *F. agricola* Moore. 1895, Moore, in Proc. Ac. Phil., p. 342. Michaelsen, Das Tierreich, p. 97. Carlisle, January 1898, and frequently since. My large accumulation of notes and specimens suggests the need of revision and clear definition. 1899, Friend in Zoologist, p. 264. Gardeners' Chronicle, June 1899.

14. *F. alba* Moore. 1895, Moore, in Proc. Ac. Phil., p. 344. 1898, Friend in The Naturalist. p. 20. Carlisle, January 1898. A record which needs confirmation, owing to the great advances in our knowledge of the genus.

15. *F. anglica* Friend. 1912, Friend in J.R.M.S., p. 24. Near Ashby-de-la-Zouch in March, and Swadlincote, Derbyshire, April 1911.

16. *F. arborea* sp. n. Supra, p. 140. Notts, April and May, 1913. A similar Annelid from St. Doulough's, Dublin, March 12, and near Blenheim Palace (Kiddington, Oxon), April, 1913.

17. *F. aurita* Issel. 1905, Issel, in Zool. Jahrb., xxii. p. 468–70. 1907, Southern, in Irish Naturalist, xvi. p. 74. Bray Head, Wicklow, and Lambay, Dublin. New records are Dublin Canal side, collected by myself March 11; Stretton-en-le-field, May 12; Isle of May, collected by Mr. Evans, June 6, 1913. In most instances they varied somewhat from Issel's description, but could be referred to no other species.

18. *F. beddardi* Bret. 1900, Bretscher, in Rev. Suisse Zool., viii. p. 29; 1904, ibid., xii. p. 265; 1909, Southern, Proc. Roy. Ir. Acad., xxvii. p. 164. Newton Moss, near Penrith, Cumberland; collected March, kept alive and examined August 11, 1911. See *F. ratzeli* infra.

19. *F. bisetosa* Lev. 1884, Levinsen, in Vid. Meddel. 1883, Michaelsen, Das Tierreich, pp. 96–7. I have a large collection of bisetose material which shows that the group must be carefully revised. Bretscher (1900, Rev. Suisse Zool., viii. p. 27) erroneously places here a form with four setæ. I simply record the species as British, and await an opportunity to sift and edit.

19A. *F. bretscheri* Southern. 1907, Southern, in Irish Naturalist, xvi. p. 73. 1909, Proc. Roy. Ir. Acad., xxvii. p. 160. Not to be confused with *F. parva* Bret. or *F. parva* Moore. Dublin, Edinburgh, frequent in Notts and elsewhere, 1913.

20. *F. bulbifera* sp. n. Supra, p. 141. To be compared with *bulbosa*, *glandifera*, and others.

21. *F. bulbosa* Rosa. 1887, *Neoenchytræus bulbosus* Rosa, in Boll. Mus. Torino, ii. No. 29, p. 2. Michaelsen, Das Tierreich, p. 96, places *F. parva* Moore here. One of the most widely distributed of British species. Already I have divided my material and made two or three new species, but more remains to be done. Friend, in J.R.M S., 1912, pp. 14–15. Trans. Notts Nat. Soc., 1910–11, p. 40.

22. *F. callosa* Eisen. 1878, *Neoenchytræus callosus* Eisen in Ofv. Ak. Förh., xxxv. No. 3, p. 76. Michaelsen, Das Tierreich, p. 99; Friend, in J.R.M.S., 1912, p. 19. In April 1913 I found in the gardens at Blenheim Palace, along with specimens of *F. michaelseni* and *F. leydigi*, a worm which approaches this species most nearly, though there are differences between my own notes and Eisen's description. Trans. Notts Nat. Soc., 1911–12, p. 62.

23. *F. clara* Friend. 1913, Friend, in J.R.M.S., p. 267. I have nothing to add to the description and record there given.

24. *F. connata* Bret. 1902, Bretscher, in Rev. Suisse Zool., x. p. 20. 1907, Southern, in Irish Nat., xvi. p. 75. 1909, Proc. Roy. Ir. Acad., xxvii. p. 161. 1912, Friend, in J.R.M.S., p. 17. Belongs to the bisetose group, and often needs careful study to distinguish it from *diachæta*, *bisetosa*, and related forms. More accurate diagnosis is needed in this large and interesting section, in the light of my recent gleanings. Trans. Notts Nat. Soc., 1910–11, pp. 34, 40; ib., 1911–12, p. 56.

25. *F. coronata* sp. n. Supra, p. 141. A clearly-defined species. 1913, Blenheim Palace.

26. *F. densa* Friend. 1912, Friend, in Trans. Notts Nat. Soc., p. 61. Collected in Notts December 16, 1912, and stated in a footnote to be possibly a variety only of *F. michaelseni*. But

Mr. Hillman collected a form at Rolleston, Notts, on May 14, 1913, which leads to the suspicion that *densa* may be a true species. It has not yet been carefully described.

27. *F. diachæta* Bret. 1900, Bretscher, in Rev. Suisse Zool., viii. p. 451. 1902, ib., x. pp. 23–4. See No. 24 above. First British record in Trans. Notts Nat. Soc., 1910–11, p. 41. Frequently found in Notts since. 1913, Pocklington, Yorkshire, December 1.

28. *F. galba* Hoffm. 1843, Hoffmeister, in Arch. Natur., xci. p. 194; Michaelsen, Das Tierreich, p. 101; Friend, in J.R.M.S. 1912, pp. 12–13. Recently found in Notts and elsewhere. See Southern, Proc. Roy. Irish Acad., xxvii. p. 163.

29. *F. glandifera* Friend. 1913, Friend, in J.R.M.S., pp. 263–5. Separated from *bulbosa* and *bulbifera*; characters permanent. Trans. Notts Nat. Soc., 1910–11, p. 40.

30. *F. glandulosa* Southern. 1907, Southern, in Irish Nat., xvi. p. 76. 1909, Proc. Roy. Ir. Acad., xxvii. p. 162; Dublin and Edinburgh. 1911, Friend, in Trans. Notts Nat. Soc., 1910–11, p. 41.

31. *F. hegemon* Vejd. 1887, *Enchytræus hegemon* Vejdovsky, in SB. Böhm. Ges., p. 303; Michaelsen, Das Tierreich, p. 101. The earliest British record is doubtful. See Friend, in J.R.M.S. (1912) p. 15. 1909, Southern, in Proc. Roy. Irish Acad., xxvii. pp. 164–5.

32. *F. helvetica* Bret. 1896, Bretscher, in Rev. Suisse Zool., iii. p. 516. 1899. ib., vi. p. 407; Michaelsen, Das Tierreich, p. 98. 1911, Friend, in Naturalist, p. 291. Frequent records during the past three years awaiting revision.

32A. *F. hillmani* Friend. 1913, Zoologist, December, p. 462. Jersey.

33. *F. humilis* Friend. 1911, Friend, in Naturalist, August, p. 291. 1912, J.R.M.S., pp. 20–1. Smisby, near Ashby-de-la-Zouch, January 31, 1913.

34. *F. leydigi* Vejd. 1877, *Enchytræus leydigii*, Vejdovsky, in SB. Böhm. Ges., p. 303; Michaelsen, Das Tierreich, p. 97. 1912, Friend, in J.R.M.S., comp. 1907, Southern, in Proc. Roy. Ir. Acad., xxvii. pp. 161–2. Several gleanings from various parts of England and Jersey show the need of further revision here.

35. *F. lobifera* Vejd. 1879, *Enchytræus lobifer* Vejdovsky, Enchytræidæ, p. 57. Michaelsen, Das Tierreich, p. 98. 1907, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 163. 1911, Friend, in Trans. Notts Nat. Soc., p. 41. 1912, J.R.M.S., p. 12; ib., 1913, p. 268, for var. *minor*. So fluid are some of the forms that it seems at times absolutely impossible to fix the species.

36. *F. maculata* Issel. 1905, Issel, in Zool. Jahrb., xxii. pp. 466–8. Fields between Swadlincote and Overseal, Derbyshire, April 12, 1912.

37. *F. magna* Friend. 1889, Friend, in Zoologist, ser. 4, iii p. 262; Michaelsen, Das Tierreich, p. 97. 1907, Southern, in. Proc. Roy. Ir. Acad., xxvii. p. 165, footnote; Friend, in J.R.M.S., 1912, pp. 15–16. After losing sight of the species for nearly a quarter of a century, I rediscovered it, May 13, 1913, in a shrubbery at Stretton-en-le-Field.

38. *F. michælseni* Bret. 1899, Bretscher, in Rev. Suisse Zool., vi. p. 410; Michaelsen, Das Tierreich, p. 100. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 163. 1912, Friend, in J.R.M.S., p. 18. Quite distinct from *F. galba*. Widespread and very variable. Here again my large collection of material needs careful revision.

39. *F. microcara* Friend. 1912, Friend, in J.R.M.S., p. 23. Sutton Broad, August 22, 1911. I brought away from the Broads a quantity of the Enchytræid soil, and, in June 1912, re-examined the material. This species was again present, and my diagnosis was confirmed.

40. *F. minuta* Bret. 1900, Bretscher, in Rev. Suisse Zool., vii. p. 33. 1907, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 162. 1912, Friend, in J.R.M.S., p. 17.

41. *F. nigrina* Friend. 1913, Friend, in J.R.M.S., p. 266. Hastings, Sussex; and Stretton-en-le-Field, near Ashby-de-la-Zouch.

42. *F. obtusa* Friend. 1913, Friend, in J.R.M.S., p. 267; Trans. Notts Nat. Soc., 1911–12, p. 61.

43. *F. oligosetosa* Nusb. 1895, Nusbaum, in Biol. Centrabl., xv. p. 27; Michaelsen, Das Tierreich, p. 99. Collected Hastings, June 1912.

44. *F. paroniana* Issel. 1904, Issel, in Atti Soc. Lig., xv. p. 3. 1905, Zool. Jahrb., xxii. p. 416. 1907, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 161. 1912, Friend, in J.R.M.S., p. 18. Dublin, in Ireland; Acresford, near Ashby-de-la-Zouch, July 1911. Naturalist, December 1911, p. 413.

45. *F. parva* Bret. and *F. parva* Moore are named here because they have been recorded in earlier days as British. The growth of our knowledge, however, makes those records doubtful, and the material must be re-examined.

46. *F. perrieri* Vejd. 1877, *Enchytræus perrieri* Vejdovsky in SB. Böhm. Ges., p. 302; Michaelsen, Das Tierreich, p. 98. 1898, Friend, in Irish Nat., p. 196. 1912, Friend, in J.R.M.S., p. 15. Earliest record somewhat doubtful; frequently found of late years, resulting in large masses of notes and material awaiting careful analysis.

47. *F. peruviana* Friend. 1911, Friend, in J.R.M.S., xxviii. p. 734. Kew Gardens, May 12, 1911.

48. *F. polychæta* Bret. 1900, Bretscher, in Rev. Suisse Zool., viii. p. 450. 1907, Southern, in Irish Nat., xvi. p. 75. 1912,

Friend, in J.R.M.S., p. 17. Kerry, Dublin, and Donegal in Ireland; Derbyshire, Notts, Jersey, and elsewhere.

49. *F. pulchra* Friend. 1912, Friend, in J.R.M.S., pp. 21–2. Kew Gardens, 1911. Naturalist, December 1911, p. 415.

50. *F. ratzeli* Eisen. 1872, *Enchytræus ratzeli* Eisen, in Öfv. Ak. Förh. xxx. No. 1, p. 123; Michaelsen, Das Tierreich, p. 100. 1897, Friend, in Irish Nat., vi. p. 206. 1907, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 164. 1912, Friend, in J.R.M.S., p. 14. A difficult species, concerning which I have much material for future study.

51. *F. reversa* Friend. 1911, Friend, in Trans. Notts Nat. Soc., p. 41. 1913, J.R.M.S., p. 265. Since found in several new localities.

51. *F. rotunda* Friend. 1912, Friend, in Trans. Notts Nat. Soc., p. 62. Supra, p. 142. Found at Woodboro' Hall, Notts, December 17, 1912. In looking over my notes I find that this species has been taken by me elsewhere, but entered under other names. An accurate account of its distribution as at present known can only be written when the genus has been carefully brought up to date.

52. *F. striata* Lev. 1884, *Enchytræus striatus* Levinsen, in Vid. Meddel., 1883, p. 236; Michaelsen, Das Tierreich, p. 96. 1898, Friend, in Zoologist, p. 121. 1907, Southern, in Irish Nat., xvi. p. 73. 1909, Proc. Roy. Ir. Acad., xxvii. pp. 159–60. 1912, Friend, in J.R.M.S., p. 13. A well defined species, widely distributed in England.

53. *F. ulmicola* Friend. 1898, Friend, in Irish Nat., p. 195. 1912, J.R.M.S., p. 13. Ireland, Malvern, Jersey. Cf. Zoologist, December 1913, p. 460.

54. *F. variata* Bret. 1902, Bretscher, in Rev. Suisse Zool., x. pp. 19–20. 1907, Southern, in Irish Nat., xvi. p. 73. 1912, Friend, in J.R.M.S., p. 22. Very nearly related to *F. bulbosa*, as are also *F. bulbifera*, *F. glandifera*, etc. Sometimes, however, they appear to be quite distinct. Here again much remains to be done.

It will be clear from the foregoing notes that even yet our knowledge of this genus is far from satisfactory. In spite of careful study, accurate diagnoses and diagrams, and constant reference to authorities and types, I find it frequently impossible to satisfy myself. The number of setæ, shape of the spermathecæ, presence of glands, and arrangement of diverticula, the point of origin of dorsal vessel and duct of nephridia, to mention no more of the specific characters, are often very variable and uncertain. Only by the examination in detail of large numbers of specimens, and most careful diagnosis and description, can we hope eventually to place the subject on a satisfactory and scientific basis. Towards that end I am devoting almost all my leisure time.

### Grania Southern.

Setæ present, straight and thick, but absent from anterior region; habitat marine. 1913, Southern, in Proc. Roy. Ir. Acad., xxxi. No. 48, pp. 8–12.

55. *G. maricola* Southern. 1913, Southern, as above. Clew Bay, Blacksod Bay, and Dingle Bay, Ireland. Regarded by the author as related to *Enchytræus monochætus* Mich.

### Henlea Michaelsen, em. Friend.

Setæ straight or sigmoid. No dorsal pores. Œsophagus frequently enters the intestine by a bulbous enlargement in segments 7, 8, or 9. Spermathecæ simple, devoid of diverticula.

N.B.—The discovery of many new species which do not agree with the old generic definition makes revision necessary. As a first step towards this the genus is divided for the present into two sections. § 1. *Henlea*, possessing œsophageal glands. § 2. *Henleanella*, destitute of such glands. It would be advisable to make a third group for those species which show a gradual emergence of the œsophagus into the bulbous enlargement. These will in due course probably constitute a new genus. Many details will be found in my previous contributions to this Journal, as well as to the pages of the Zoologist and other scientific magazines or the records of various Natural History Societies.

### § 1. Henlea Mich. Œsophageal glands present.

56. *H. attenuata* Friend. 1912, Friend, in J.R.M.S., p. 592; Southwell, Notts, March 26; Overseal, Derbyshire, April 12, 1913. Friend, in Trans. Notts Nat. Soc., 1910–11, p. 39.

57. *H. fragilis* Friend. 1912, Friend, in J.R.M.S., pp. 588–9. Hastings, Sussex, December 21, 1911.

58. *H. fridericioides* Friend. 1912, Friend, in J.R.M.S., p. 587. Hastings with the foregoing, December 21, 1911.

59. *H. heterotropa* Friend. 1912, Friend, in J.R.M.S., p. 589. Hastings, as before.

60. *H. hibernica* Southern. 1907, Southern, in Irish Nat., xvi. p. 70. 1909, Proc. Roy. Ir. Acad., xxvii. p. 146. Lambay, Ireland. Also counties Kerry and Meath. 1913, Notts (first English record, April 25, received from Mr. H. Hillman, who also collected it for me in Jersey); Sedlescombe, Sussex, August 16, 1913.

61. *H. nasuta* Eisen (= *H. leptodera*). 1878, *Archienchytræus nasutus* Eisen, in Ofv. Ak. Förh., xxxv. No. 3, p. 72. Michaelsen, Das Tierreich, p. 69. *Schandinella henleæ* Nusbaum, in Zool. Anzeig., ix. pp. 46, 57. 1896, Friend, in Naturalist, p. 298. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 146. Yorkshire, Co. Dublin, and elsewhere. Friend, in Naturalist, Sept 1, 1911, p. 319. J.R.M.S., 1912, p. 580.

62. *H. pusilla* Friend. 1913, Friend, in J.R.M.S., p. 270. Notts, September 1912. A similar worm found in Derbyshire, November 22.

63. *H. quadrupla* Friend. 1913, Friend, in Zoologist, No. 861, p. 85. Separated from *H. tenella*: see ib. 1911, p. 468. Acresford, near Ashby-de-la-Zouch, November 28, 1911, and later at Netherhall, Bretby, and Overseal, Derbyshire. Supra, p. 137.

64. *H. triloba* Friend. 1912, Friend, in J.R.M.S., p. 596. Hastings, December 21, 1911.

65. *H. ventriculosa* Udek. ? 1837. *Enchytræus albidus* (part). See for synonymy Michaelsen, Das Tierreich 69. 1896, Friend, in Naturalist, p. 298. 1907, Southern, in Irish Nat. xvi., p, 70. 1909, Southern, in Proc. Roy. Ir. Acad. xxvii., p. 147. 1911, Friend, in Zoologist, December, p. 464. The first record (Essex Naturalist, 1896, p. 298) is open to doubt. In those early days it was not suspected that so many new species awaited discovery.

§ 2. *Henleanella* Friend. Œsophageal glands absent.

66. *H. alba* Friend. 1913, Friend, in Zoologist, March 15, No. 861, p. 83. Netherhall, Derbyshire, November 22, 1912.

67. *H. arenicola* Friend. 1912, Friend, in J.R.M.S., p. 586. Hastings, December 21, 1911.

68. *H. bisetosa* Friend. 1913, Friend, in Irish Nat., xxii. p. 172. Supra, p. 135. Dublin, March 11, 1913, and Nottingham the following month.

69. *H. curiosa* Friend. 1912, Friend, in J.R.M.S., p. 588. Hastings, December 21, 1911.

70. *H. dicksoni* Eisen. 1878, *Archienchytræus dicksonii* Eisen in Ofv. Ak. Förh., xxxv. p. 70. Michaelsen, Das Tierreich, p. 68. 1907, Southern, in Irish Nat., xvi. p. 70; Proc. Roy. Ir. Acad., xxvii. p. 146. 1912, Friend, in J.R.M.S., p. 581. Ireland, Hastings, Nottingham.

71. *H. glandulosa* Friend. 1913, Friend, in Irish Nat., xxii. p. 9; J.R.M.S., July 1913, p. 270. Poyntzpass, Ireland, May 1912. Cauldwell, Derbyshire, June 1913.

72. *H. hillmani* sp. n. 1913, supra p. 135. Collected by Mr. Hillman, June 10, 1913, in Notts. Trans. Notts Nat. Soc. 1912–13.

73. *H. insulæ* sp. n. 1913, supra p. 136. Collected by Mr. Hillman, June 1913, in Jersey. Friend, in Zoologist, December 1913.

74. *H. inusitata* Friend. 1913, Friend, in Zoologist, March 15, No. 861, p. 83–4; see supra, p. 136. Rolleston Junction, Notts, March 26, and Cauldwell, Derbyshire, June 11, 1912.

75. *H. lampas* Eisen, enlarged by Friend. 1911, Friend, in Zoologist, December 15, p. 465; J.R.M.S. 1912, p. 584. St. Anne's-on-Sea, 1898. The species as enlarged has since been found at Hastings, Dublin, Notts, and elsewhere.

76. *H. marina* Friend. 1912, Friend, in J.R.M.S., pp. 589 *seq.* Hastings, Sussex, December 21, 1911.

77. *H. mariona* Friend. 1912, Friend, in Trans. Notts Nat. Soc. 1911–12, p. 59–60; supra, p. 139. Between Burton Joyce and Lowdham. Notts, December 16, 1912.

78. *H. minima* Friend. 1913, Friend, in Zoologist, No. 861, p. 84. See supra, p. 136. With *H. alba* at Netherhall, near Burton-on-Trent, autumn, 1911.

79. *H. minuta* Friend. 1913, Friend, in J.R.M.S., p. 268. Sutton Broad, by the landing stage, August 25, 1911.

80. *H. multispinosa* Friend. 1913, Friend, in Zoologist, No. 861, p. 80. See supra, p. 137. Canal, Notts, December 16, 1912. Reported as *H. dicksoni* var *multispinus,* in Trans. Notts Nat. Soc., 1911–12, p. 55 (cp. p. 59).

81. *H. perpusilla* Friend. 1911, Friend in Zoologist, pp. 466–7; also Naturalist, pp. 320-21: Cauldwell, Derbyshire, July 9, 1911; Worcester, October 23, 1912; St. Doulough's, Dublin, March 12, 1913, Irish Nat., xxii. p. 172. Careful revision of my material and notes leads to the conclusion that *H. parva* Friend may be identical with, or only a variety of *H. perpusilla.* But cf. Zoologist, December 1913, p. 461.

82. *H. puteana* Vejd. 1887, *Enchytræus puteanus* Vejdovsky, in SB. Böhm. Ges., p, 301. Michaelsen, Das Tierreich, p. 68. 1911, Friend, in Zoologist, p. 465. 1912, J.R.M.S., p. 583; Ledbury Churchyard, April 17, 1911.

83. *H. rhætica* Bret. 1903, Bretscher, in Rev. Suisse Zool., xi. p. 115. 1912, Friend, in J.R.M.S., pp. 593–5; Trans. Notts Nat. Soc., 1911–12, p. 59; Hastings, December 21, 1911; Notts, April 15, 1912; Dublin, March 1913; Irish Nat., xxii. p. 172. Widely distributed and very variable. For the present I include *H. variata* Friend (J.R.M S., 1912, p. 592), but the material is not very homogeneous, and needs further revision.

84. *H. rosai* Bret. 1899, Bretscher, in Rev. Suisse Zool., vi. p. 412; Michaelsen, Das Tierreich, pp. 68–9. 1911, Friend, in Zoologist, pp. 465–6; Naturalist, p. 320. 1912, J.R.M.S., p. 583–4. Buxton, May 27, 1911; Eel-traps on Sutton Broad, August 19, 1911; Cauldwell, Derbyshire, June 11, 1912.

85. *H. tenella* Eisen. 1878, *Archienchytræus tenellus* Eisen in Ofv. Ak. Förh., xxxv. No. 3, p. 70; Michaelsen, Das Tierreich, p. 70. 1911, Friend, in Zoologist, pp. 467–8. 1912, J.R.M.S., pp. 585–6. Acresford, near Ashby-de-la-Zouch, November 28, 1911. 1913, Irish Nat., xxii. p. 172, a form found in Dublin at present referred to this species provisionally.

86. *H. trisetosa* Friend. 1913, Friend, in Zoologist, No. 861, p. 86. See supra, p. 139. In tree-stump with *H. quadrupla* Friend at Midway, between Ashby and Burton, January 30, 1913.

87. *H. tubula* Friend. 1913, Friend, in Irish Nat., xxii. p. 172. First described supra, p. 139. Balls Bridge, Canal Side, Dundrum Road, Dublin, and St. Doulough's, March 6 to 12, 1913.

It will be seen that the British Annelid fauna is peculiarly rich in *Henleas* and *Fridericias*. There are doubtless many more species yet to be discovered.

## Mesenchytræus Eisen.

Setæ present, sigmoid, fewer in lateral than in ventral bundles. No salivary glands, no dorsal pores. Nephridia with small anteseptal.

88. *M. beumeri* Mich. 1896, *Pachydrilus* (*M.*) *beumeri*, Michaelsen. See Das Tierreich, p. 86. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. p. 155. County Kerry, Ireland.

89. *M. celticus* Southern. 1909, Southern, in Proc. Roy. Ir. Acad., xxvii. pp. 155–6; Montpelier, Dublin, December 1907; Edinburgh, February 1908.

90. *M. fenestratus* Eisen. 1878, *Neoenchytræus fenestratus*, Eisen, in Ofv. Ak. Förh. xxxv. No. 3, p. 74; Michaelsen, Das Tierreich, 85; see Ditlevsen, in Zeit. wiss. Zool., Bd. 77, 1904, p. 439. 1897, Friend, in Irish Nat., as having probably been found by Dr. Trumbull at Powerscourt, Wicklow. In poor condition; record not confirmed.

91. *M. flavidus* Mich. 1887, Michaelsen, in Arch. Mikr. Anat. xxx., p. 372. Das Tierreich, p. 35. Found June 11, 1912, at Swain's Park, Swadlincote, Derbyshire, and now recorded for the first time as British. Varies a little from Michaelsen's type.

92. *M. oligosetosus* Friend. 1913, Friend, in Zoologist, December, p. 462. Jersey, Collected by Mr. Hillman.

93. *M. setosus* Mich. 1888, Michaelsen, in Arch. Mikr. Anat. xxxi., p. 494; Das Tierreich, p. 85. 1907, Southern, in Irish Nat. xvi., p. 71. 1909, Proc. Roy. Ir. Acad. xxvii., p. 155. Cauldwell, Derbyshire, June 11, 1912. On August 8, 1913, I found it with other Enchytræids between Oberlieber and Braunsberg, Neuwied-am-Rhein.

### Michaelseni Ude.

Not known in Great Britain.

### Stercutus Mich.

Not reported as British hitherto.

### Bibliography.


1. Friend—J.R.M.S., 1912–13.
2. „ Trans. Notts Nat. Soc., 1911–13.
3. „ Irish Nat., xxi. (1912); xxii. (1913).
4. Michaelsen—Das Tierreich, 1900.
5. Southern—Irish Nat., xvi. (1907) pp. 68–82.
6. „ Proc. Roy. Ir. Acad., xxvii. (1909) pp. 119–82.
7. „ Proc. Roy. Ir. Acad., xxxi. (1913) pt. 48.
8. Bretscher—Rev. Suisse Zool., x. (1902) p. 27.
9. Friend—Zoologist, 1913.

# SUMMARY OF CURRENT RESEARCHES

RELATING TO

# ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

# MICROSCOPY, ETC.*

## ZOOLOGY.

### VERTEBRATA.

#### *a.* Embryology.†

**Development of Rabbit's Embryo in Vitro.**‡—A. Brachet has been able to secure for 24–48 hours the development of "explanted" blastodermic vesicles of the rabbit (from the sixth or seventh day) in plasmic media, formed from the rabbit's blood. They not only remained in life: they exhibited progressive development. The noteworthy result is that in the artificial plasmic medium the development was not appreciably altered. Thus the placenta, whose formation might have been supposed to require the direct action of the uterine mucosa, not only made its appearance but had its foundations laid just as if the blastodermic vesicle had remained in the mother. A blastodermic vesicle with a didermic embryonic disk, but otherwise undifferentiated, is explanted into a blood clot and submitted, therefore, to uniform influences all over its surface, yet its development for the short term of its survival is quite normal; it forms an embryo, an ectoplacenta, and a papilliferous zone. There are only slight differences in detail. It follows from this important conclusion that the influence of the immediate normal environment within the mother is not so rigorously indispensable as some have supposed. Plasma formed from the blood of the male rabbit is just as suitable as that from the blood of the female. The general conclusion is that the internal causes of organogenesis are of paramount importance.

**Artificial Parthenogenesis in Amphibians.**§—E. Bataillon distinguishes between the activation of the egg and its karyocatalysis (an

* 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., xxviii. (1913) pp. 449–503 (2 pls.).

§ Ann. Sci. Nat. (Zool.) xvi. (1912) pp. 257–307.

acceleration induced by the introduction of a foreign nuclear element). After electric shocks the eggs become non-fertilizable, but they will develop abnormally and form larvæ if they are inoculated with a catalysing nucleus. Mere pricking them is not efficacious. The efficacy of the second faction (the introduction of a foreign nuclear element) seems to be limited to the first hour after activation. The change of state produced by activation is independent of the afflux of water. Internal movements may be seen going on in the ova in a moist chamber just as in those in immersed ova.

Eggs of *Rana fusca*, exposed to vapour of chloroform in a moist chamber for three minutes, are activated as others are by electricity. They are non-fertilizable. They give off their second polar body and divide. If they are moistened with blood and then pricked they develop into larvæ. The same result may be obtained by using vapour of ether, benzol, and toluol. After the activation there has to be an introduction of some organic apparently nuclear matter, which Bataillon regards as having a catalytic influence.

Various physical and chemical excitations (electric discharges, changes of osmotic pressure, exposure to vapours, etc.) affect the ovum, and are followed by a reaction which opposes a barrier to fertilizing elements. The addition of a catalysing nucleus to the ovum in its new state of equilibrium is followed by embryogenesis.

**Artificial Parthenogenesis in Frog.***—Fritz Levy has reared not only tadpoles, but three young frogs from artifically stimulated eggs. His method was to prick the eggs with a platinum needle, which was sometimes first dipped in salt or in the blood of the mother. He finds that the nuclei of the results of this aspermic development are smaller than the normal, and he believes that they are haploid, i.e. with half the normal number of chromosomes.

**Artificial Parthenogenesis in Frog and Toad.†**—Günther Hertwig finds that eggs of *Rana esculenta* and *Bufo vulgaris* fertilized by sperms of *Rana fusca* segment normally, but die before gastrulation. But if the sperm of *R. fusca* be first exposed to intense radium rays, and then used for fertilization, the eggs go through gastrulation and become larvæ, which survive for several weeks. The explanation suggested of this paradox is that the sperm of *R. fusca* contains some chromatin element which is not in harmony with the idioplasm of the ova of *R. esculenta* or *Bufo vulgaris*; therefore the developing ova soon die. But if this element be destroyed by the radium, the sperm may act simply as a stimulus to development—which is really parthenogenetic. In various organs, it is noticed, the surface or the volume of the nuclei is half the normal.

**Hermaphroditism in Toad.‡**—O. Fuhrmann describes a number of cases of hermaphroditism in *Bufo vulgaris*—several of rudimentary hermaphroditism affecting the gonads and their ducts, two of potential

* Arch. Mikr. Anat., lxxxii. (1913) 2te Abt. , pp. 65–77 (8 figs.).
† Arch. Mikr. Anat., lxxxi. (1913) 2te Abt., pp. 87–127 (2 pls. and 6 figs.).
‡ Rev. Suisse Zool., xxi. (1913) pp. 331–45 (6 figs.).

hermaphroditism with testes and ovaries (with unpigmented ova), and oviducts well formed, and two of effective hermaphroditism, able to produce both eggs and sperms. There does not seem to be any direct correlation between the state of the ovary and the degree of development of the oviduct. Bidder's organ has doubtless come to have a secondary physiological significance, but it is morphologically a rudimentary ovary.

**Eggs of Skates.***—A. Chas. Williamson has done a useful piece of work in preparing drawings of the egg-cases or mermaid's purses of seven species of skate, showing that these have in some cases a marked specificity.

**Spermatozoon of Guillemot.**†—E. Ballowitz describes the mature spermatozoon of *Uria lomvia*, which shows (*a*) an elongated cylindrical curved head with an apical piece; (*b*) a middle piece with a spiral filament coiled around the axis; and (*c*) the tail ending in a short fine terminal portion.

**Larval Phases of Nemichthydæ.**‡—Louis Roule finds evidence that the forms described as *Tilurella* are larval stages of *Nemichthys*, the principal genus in the family Nemichthydæ. In this family, therefore, as in other Apoda, the occurrence of Leptocephalid or Leptocephalid-like larvæ is characteristic.

### *b*. Histology.

**Active Movements of Epithelial Cells.**§—A. Oppel describes the active movements of the epithelial cells at the wound-surface of a tail excised from a tadpole. Apart from a passive shifting of cells as the result of pressure, there is independent movement. This is to be seen also when half of an excised cornea has the epithelium stripped off it. The epithelial cells on the uninjured half elongate, and some of them move on to the stripped half.

**Müller's Epithelium.**‖—S. E. Wichmann maintains the homology of the Müllerian duct in mammals, reptiles and amphibians, and describes its origin from a flat stretch of blastema, which is phylogenetically derivable from the nephrostomial epithelium of the pronephros. He gives the name "Müller's epithelium" to the various components of this blastema and to the epithelium of structures which arise from it, such as Müller's duct and the fimbria ovarica.

**Muscle-bands in Middle Coat of Arteries.**¶—A. H. MacCordick finds that when the course of an artery is straight, and it is not subjected to bending, the muscle-fibres of its media are circularly disposed.

* Sci. Invest. Fisheries Scotland, 1912 (published 1913) No. 1, pp. 1–6 (5 pls.).
† Anat. Anzeig., xliv. (1913) pp. 305–9 (9 figs.).
‡ Comptes Rendus, clviii. (1914) pp. 352–4.
§ Anat. Anzeig., xlv. (1913) pp. 173–85 (7 figs.).
‖ Verh. Anat. Ges., 1913, in Anat. Anzeig., xliv. (1913) Ergänzung., pp. 139–54 (19 figs.).
¶ Anat. Anzeig., xliv. (1913) pp. 225–61 (3 figs.).

When the course of an artery is not straight, and when it is subjected to bending of various grades, the circularly disposed fibres of its media are reinforced by oblique or longitudinal bundles, the oblique fibres occurring much more frequently than the longitudinal. These oblique and longitudinal fibres are to be found in the middle coat in all periods of life. It does not appear that these occur in any particular site of development within the media.

**Spongiosa of Cetacean Pelvis.***—Willy Augustin took Röntgen photographs of several specimens of rudimentary pelvic bones. They showed the characteristic trajectories in the spongiosa. This is interesting, since these rudimentary bones are connected only with muscles (the tail-muscle, the genital muscles, and trunk muscles).

**Structure of Preen Gland.**†—Hugo Granvik describes the structure of the glandula uropygii in a number of types. He shows, for instance, the presence of Herbst's corpuscles (modifications of Paccinian corpuscles) in the fowl and some other birds, the secondary canals of the efferent duct in the flamingo, the septum in *Passer montanus*, which is absent in the house-sparrow, the very well-developed state of the gland in the snow-bunting, and many other points.

**Structure of Preen Gland.**‡—P. Paris gives a detailed account of the state of the preen gland in different orders of birds, and discusses its vascularization, innervation, development, and use. He describes the gland, which is present in most birds, and probably in all their embryos, as a subcutaneous mass of variable but clearly-defined form, made up of two equal lobes entirely or partly separate, but united at the apex in an excretory nipple projecting on the integument, by which it is closely invested. Each of the constituent lobes is autonomous—that is, each has its own vascularization and innervation, and can secrete independently of the other. Each lobe is surrounded by a capsule of connective-tissue without smooth muscular fibres. It contains a great many glandular tubules, separated from each other by thin partitions, of the same nature as the enveloping capsule, which enclose the glandular epithelium. The glandular tubes form a mass, sometimes single, sometimes sub-divided into glandules within each lobe. The tubes are of varying length, and they unite to form secondary ducts, which in their turn form the primary ducts. These ducts may be wholly or partly absent, in which case the secretion is collected in a cavity at the apex of each lobe and is discharged to the exterior by an excretory canal through the nipple. Each lobe has thus at least one excretory canal, except in a few cases (*Caprimulgus europæus*, *Upupa epops*), which have only a single duct for the whole gland. The glandular epithelium is formed by several—at least three—layers of secretory cells, which increase progressively in size from the periphery to the axis of the tube. Primitively triangular, they become polyhedral, then globular in form. These secretory cells are very similar

* Zool. Jahrb., xxxv. (1913) pp. 533-80 (2 pls.).
† Arkiv Zool., viii. (1913) No. 4, pp. 1-19 (2 pls. and 10 figs.).
‡ Arch. Zool. Expér., liii. (1913) pp. 139-274 (4 pls.).

throughout the whole length of the tube, except in *Rhyncotus rufescens*, and perhaps in other Tinamiformes where the tubes are divided into two zones of cells of quite different aspect. The excretory nipple, invested by the fine integument, encloses the excretory canals of the lobes with the terminal portions of their enveloping capsules. Its extremity may be naked or furnished with plumules or exceptionally with feathers. Within it, as within the capsules, there are often very large capsules of Herbst and abundant adipose tissue. There may be bundles of smooth muscular fibres forming two constricting groups, one at the apex, the other at the base of the nipple, the two connected by sparse longitudinal fibres. The arteries which supply the gland arise from two trunks issuing from the caudal artery. After a variable course, at some point of which they anastomose with vessels from the next interapophysary spaces, these arterial trunks break up into two or three branches, which are distributed throughout the gland. The two coccygeal veins arise directly from anastomosis of the hypogastric veins, or from a trunk rapidly dichotomized. They follow the same course as the arteries. The nerves arise from branches, issuing between the first and second caudal vertebræ, which after dividing anastomose with sympathetic nerves.

The investigator gives a detailed account of the development of the gland (in *Anas boscas*), as well as of the chemical composition of its secretion, and of physiological experiments undertaken to prove its function. The general result of these experiments is that the gland is of no use for increasing the impermeability of the feathers, has no toxic action—at least in this country—and that its removal or hypertrophy has no effect whatever on the health of the bird. In origin, development, anatomy, etc., the uropygium of birds presents marked analogies with the odoriferous glands of other Amniota, especially with those of reptiles, and it must therefore be regarded as an odoriferous gland.

The paper includes a synoptic table of the state of the gland in different groups.

**Plastosomes of Visual Cells.***—G. Leplat has studied the differentiation of the plastosomes in the rods and cones of the bird's eye. Definite plastosomes seen in the embryonic cells and in the visual cells undergo chemical change and differentiation in the primordia of the rods and cones. Some granulations persist in the internal segment; others, in the external segment, form a homogeneous sheath on the centrosomic filament.

**Minute Structure of Amnion of Chick.**†—Tiberius Péterfi has studied the epithelial cells of the chick's amnion. The young cells become vacuolated. The fibrils appear as a haptogen-membranous boundary between the vacuoles. Lamellæ become reduced to a reticulum of fibrils which extend continuously over the whole amnion, without it being possible to define beginnings or ends. The stronger lines become cell-boundaries, the finer form intracellular fibrils.

* Anat. Anzeig., xlv. (1213) pp. 215–21 (5 figs.).
† Anat. Anzeig., xlv. (1913) pp. 161–73 (8 figs.).

Phenomena of surface-tension and absorption play an important part in the differentiation.

**Histological Peculiarities of Turtle.***—K. Ogushi describes the vascularization in the villi of the buccal, pharyngeal, and œsophageal epithelium in *Trionyx japonicus*, which have a respiratory function. As Agassiz pointed out, there is also a very abundant ramification of blood-vessels on the skin of the lower surface, and this is also of respiratory significance. The author also describes a nerve-ending beneath a papilla on the lip, and the peculiar structure of the epithelium of the epididymis.

**Development of Cartilage of Notochord in Lizards.**†—J. Pusanow goes back to the stage when the notochord consists of a vacuolated syncytium without even a chorda-epithelium. There is active amitotic division of the nuclei ; no penetration of ectochordal cells was seen ; there is a chondro-mucoid metaplasis of the "chorda-membranes" which are formed between the vacuoles ; a differentiation of a ground-substance or exoplasma and an active endoplasma occurs ; the nuclei increase in size as the ground-substance increases, and thereafter they get smaller again ; a hyaline cartilage is formed which very soon undergoes degeneration till only a vestige remains. The spot where the chorda cartilage appears is the spot where the vertebra afterwards breaks across in autotomy.

**Leucocytes of Amblystoma.**‡—Hal Downey finds that the polymorphonuclear leucocytes of this Amphibian contain granules with the general character and staining reactions of azurophil granules. They are quite variable in size, number, and distribution. In this respect they resemble the azurophil granules of the mammalian lymphoid cells, but their radial grouping around the centrosphere, their constant appearance in the polymorphonuclears, and their great number in any one cell, place them nearer the "special" granules of the higher animals.

The lymphocytes of most Amphibia (frog, *Cryptobranchus*, etc.) lose their azurophil granules when they differentiate into polymorphonuclears, and their cytoplasm becomes oxyphilic. In *Amblystoma* the cytoplasm of the polymorphonuclears remains "lymphoid" in character, while the azurophil granules remain and their number is increased. This may be regarded as an attempt towards the differentiation of a "special" granulation.

In *Amblystoma* all possible intermediate stages between larger lymphocytes and polymorphonuclears are found in the circulating blood. The "parachromatin canals" of Werzberg are optical appearances due to deep furrows on the surface of the nuclei. The erythrocyte nuclei of *Amblystoma* are more pyknotic and more degenerative in character than those of the erythrocytes of the garter snake, and Minot's distinction of ichthyoid and sauroid types of erythrocytes will not hold in this case.

* Anat. Anzeig., xlv. (1913) pp. 193–215 (1 pl. and 5 figs.).
† Anat. Anzeig., xliv. (1913) pp. 262–9 (2 figs.).
‡ Anat. Anzeig., xliv. (1913) pp. 339–22 (8 figs.).

### c. General.

**Relation between Diameter of Nerve-fibres and their Rapidity of Action.***—L. Lapique and R. Legendre find that the nerves of the greatest functional rapidity, innervating the most rapidly contracting muscles, have fibres with the largest diameter. The rapidity of transmission is in proportion to the diameter of the fibres. Thus the nerve-fibres to the white muscles of the rabbit, which contract quickly, have a diameter of 13 $\mu$, while those to the red muscles, which contract slowly, have a diameter of 8 $\mu$.

**Pigmentation of Skin in Primates.**†—K. Toldt, jun. has found that in thick-haired Primates there is considerable marking of the skin hidden by the hair. It is due to pigmentation in the epidermis and corium. There seems to be no constant relation in position or intensity between pigmentation in the hair, in the epidermis, and in the corium. There is often a marked symmetry in the integumentary pigmentation, and it appears to be characteristic for genera at least. Numerous points of interest are discussed, such as the occurrence of blue birth-marks in man, which are due to a vestigial pigmentation of the corium.

**Ontogeny and Phylogeny of Pancreas.**‡—Ivar Broman calls attention to cases where there are accessory pancreatic glands, to the frequent development of the pancreas from three primordia, to Oppel's observation that the pancreas of *Proteus anguineus* has nineteen to forty-four ducts, and to other facts, which lead him to the view that in the primitive condition of the vertebrate gut there were numerous small pancreatic glands in the vicinity of the opening of the bile-duct.

**Ciliary Mechanisms in Amphioxus, Ascidians, and Solenomya.**§ J. H. Orton has made a study of the function of cilia in connexion with feeding. He finds that feeding in *Amphioxus* is effected in three main ways. (1) By the maintenance of a stream of water through the pharynx by rows of lateral cilia on the gill-bars; (2) the throwing out of mucus from the endostyle on to the gill-bars to serve for entrapping food-particles; (3) the collection of food-particles by rows of cilia on the pharyngeal surface of the gill-bars; these cilia work up the food-particles with mucus into cylindrical masses, and transport these dorsally into the dorsal groove, which carries the collected masses backwards into the digestive tract. Thus the ciliary mechanisms on a gill-bar of *Amphioxus* are exactly the same as those on the gill-filaments of some Lamellibranchs, as *Pecten*, and some Gastropods, as *Crepidula*. The ciliated tract known as the wheel-organ also effects food-collection, and Hatschek's pit supplies mucus for entrapping food-particles. The gill of *Amphioxus* functions mainly as a feeding-organ and a water-pump, and probably not at all as an organ for aerating the blood. The mode of feeding in Ascidians is almost exactly the same as in *Amphioxus*, but

* Comptes Rendus, clvii. (1913) pp. 1163–6 (2 figs.).
† Zool Jahrb., xxxv. (1913) pp. 271–350 (4 pls. and 3 figs.).
‡ Verh. Anat. Ges., 1913, in Anat. Anzeig., xliv. (1913) Ergänzung., pp. 14–20 (3 figs.).
§ Journ. Mar. Biol. Assoc., x. (1913) pp. 19–49 (11 figs.).

food-collecting is effected by cilia on the papillæ and on the gills, and is helped in some forms by transverse waving of the longitudinal bars. The investigator's observations lend support to the view that the neural gland in Ascidians is an organ for secreting mucus, which aids in the collection of food-particles, and that the dorsal tubercle of Ascidians is an organ for passing mucus on to the pharynx. The ciliation of the gill-bars of *Balanoglossus* is essentially the same as that of *Amphioxus*. Hence the current of water through the body is doubtless produced by the lateral cilia, and food-collecting is effected by the frontal cilia.

The ciliation of the gill of *Solenomya* closely resembles that of *Nucula*; the lateral cilia produce the main current; the latero-frontal and the frontal cilia collect food-particles, which the frontal cilia carry to the ventral surface of the gill, whence they are conveyed to the mouth by special transporting cilia. Numerous small ciliated knobs occur on the ab-frontal face of the gill-lamellæ, and serve to interlock with their fellows on opposite leaflets. These ciliated knobs correspond to the ciliated disks of the gill-filaments of other Lamellibranchs, such as the mussel. Interlocking cilia occur on the edges of the upper and lower leaflets of the gill, and serve to lock the gill to the inner wall of the mantle, and thus to partition the mantle-cavity. The function of the Lamellibranch gill is probably mainly that of a food-collecting organ and water-pump, and except in Protobranchs it is probably not an organ in which aeration of blood occurs.

## Tunicata.

**Protostigmata in Ascidians.***—A. G. Huntsman describes the development of the primitive stigmata or gill-slits, which are elongated dorso-ventrally and occur in a longitudinal series on each side of the pharynx. The stigmata of the adult differ from these in being usually very numerous, indefinite in number, and elongated antero-posteriorly.

In *Ciona* there are to begin with two protostigmata of the first order, arising from a division of the stigmatic primordium. The two primaries produce four secondaries by division, and the first pair divide into four tertiaries. The protostigmata are formed either by simple sub-division or by modified sub-division, resulting in the intercalation of new stigmata. Or there may be an intermediate method of sub-division. In various ways, which are described, the protostigmata are converted into the rows of definitive stigmata of the adult. The genesis of the stigmata affords a proper basis for an understanding of the adult pharynx and a serviceable aid in classification.

**Localization of Plastosomes in Ascidian Ovum.**†—J. Duesberg describes the unequal distribution of the fundamental substance, the yolk-granules, and the plastosomes in the egg of *Ciona intestinalis*, and regards the plastosomes in particular as the organ-forming substances. He gives good figures and refers to other intances of localization described by Conklin and others.

* Proc. Roy. Soc., Series B, lxxxvi. (1913) pp. 440–53 (2 figs.).

† Verh. Anat. Ges., 1913, in Anat. Anzeig., xliv. (1913) Ergänzung., pp. 3–13 (12 figs.).

**Origin of Ascidian Mouth.***—A. G. Huntsman has studied this in *Clavelina*, *Dendrodoa* (*Styelopsis*), and *Cæsira* (*Molgula*), and has reached the unexpected result that a large part of the epithelium of the wall of the oral cavity is derived from the primitive neural tube of the embryo.

**New Type of Compound Ascidian.**†—A. Oka describes a remarkable compound Ascidian from Japan, *Cyathocormus mirabilis* sp. n., for which a new family will be required. The colony is fixed and stalked; the portion composed of zooids is like a beautiful open cup. The mouth of the cup is the common cloacal opening, the cavity of the cup the common cloaca. The wall of the cup consists of a single layer of zooids, with their anterior ends external and their posterior ends internal. The body of each is divided into a thorax and an abdomen, the latter with a long vascular appendage. The peribranchial wall is imperfectly developed; the stigmata of the branchial sac open directly into the central common cloaca.

The test is soft, gelatinous, and transparent; there are no calcareous spicules; the bladder-cells are very numerous. There are four rows of stigmata on the well-developed branchial sac. No internal longitudinal vessels are present. The stigmata are very long and narrow. The tentacles are simple. The dorsal lamina is represented by a series of languets. The gut forms a simple loop posteriorly to the branchial sac The gonads are not conspicuous. An incubatory pouch is present. There is a tailed larva.

Oka considers this interesting form as representative of a new family, somewhere in the neighbourhood of Distomidæ, e.g. near *Colella*, but leading in the direction of Pyrosomidæ. In many ways it agrees with *Pyrosoma* and serves to link that type nearer to other Ascidiæ compositæ.

## INVERTEBRATA.

### Mollusca.

#### δ. Lamellibranchiata.

**Development of Anadonta cellensis.**‡—Karl Herbers has reared the young stages artificially to a length of 3·13 mm.; from 5·7 mm. in length onwards the stages were found in natural conditions. The primary mesoblasts form two bilaterally symmetrical mesoderm-bands, which can be traced into the glochidium, and do not break up into loose mesenchyme. The young shell of *Anodonta* differs in shape and colour from that of the adult; it has a typical wavy sculpture, and carries the glochidial shell for a considerable time. The labial palps arise from two epithelial folds; the gills from rows of papillæ.

A saccular invagination, homologous with a byssus cavity, arises from the pedal epithelium and moves inwards to near the pedal ganglion. Besides the paired statocysts, there are the osphradia and the adoral

* Proc. Roy. Soc., Series B, lxxxvi. (1913) pp. 454–9 (2 figs.).
† Journ. Coll. Sci. Univ. Tokyo, xxxii. (1913) Art. 12, pp. 1–30 (3 pls.).
‡ Zeitschr, wiss. Zool., cviii. (1913) pp. 1–174 (104 figs.).

integumentary sense-organs, the lateral and oral sensory ridges, and a lateral sensory organ between the openings of ureter and gonoduct. The kidneys, heart, pericardium, and gonads arise from paired primordia, associated with the mesoderm-bands. The gonads appear to arise as paired invaginations from the anterior pericardium. The development of the remarkable relation between the heart and the gut is described.

**Vascular System of Anodonta cellensis.***—G. Schwanecke gives a detailed and effectively illustrated account of the arterial and venous systems. He deals with the heart, the valves, the circulation in the gills, the kidneys, the mantle, the foot, and so on. The main circulation is from heart to body, from body to gills, from gills to heart. A minor stream is from heart to mantle, and back to the heart. Another stream passes from the body through the kidney to the heart, and an accessory stream through the parenchymatous tissue of the branchial septum instead of through the gills themselves.

## Arthropoda.

### α. Insecta.

**Structure of Ovary in Insects.**†—Paul Govaerts distinguishes, like previous investigators, between panoistic ovaries that have no nutritive cells, but only ova and follicular cells, and meroistic ovaries that have nutritive cells either connected with each ovum or located in the terminal chamber of the ovarian tube (and with or without uniting filaments). He is chiefly concerned with the history of the follicle cells and the ovocytes, as seen particularly in *Trichiosoma*, *Carabus*, and *Cicindella*. In *Carabus* (and probably in *Trichiosoma*) the nutritive cell and the ovum has a quite similar nucleus and a similar stage of synapsis. Both have a mitochondrial apparatus, but that of the ovum is a regular crescent; that of the nutritive cells is diffuse. The nucleus of the nutritive cells becomes much larger than the germinal vesicle. Both show an elimination of nucleolar matter into the cytoplasm, but the details differ. The nutritive cell degenerates, the ovocyte proceeds to vitellogenesis. In short, they have much in common, but they have quite distinct histories, and the nutritive cells cannot be called abortive ova.

**Chromatoid Body in Spermatogenesis of Pentatoma.**‡—Edmund B. Wilson discusses a chromatoid body simulating an accessory chromosome in *Pentatoma* (*Rhytodolomia*) *senilis* Sav. It is of large size, invariably present, and almost always single. A study of the entire spermatogenesis shows that it is neither an accessory nor any other kind of chromosome. It is in fact of protoplasmic origin, first appearing early in the growth period outside the nucleus, whence it may be followed uninterruptedly through all the succeeding stages until it is finally cast out of the spermatozoon. Its nature is problematical, but it is important to note its deceptive resemblance to an accessory chromo-

* Zeitschr. wiss. Zool., cvii. (1913) pp. 1–77 (39 figs.).
† Arch. Biol., xxviii. (1913) pp. 347–445 (3 pls.).
‡ Biol. Bulletin, xxiv. (1913) pp. 392–410 (3 pls.).

some. Decisive evidence as to sex-chromosomes can only be obtained by tracing their individual history and by accurate correlation of the chromosome-numbers in the spermatogonial and spermatocyte divisions.

**Comparison of Nervous Systems of Insects.***—K. F. Kühnle gives an account of the brain, cerebral nerves, and head-glands of the common earwig (*Forficula auricularia*) and compares these with what he finds in a bug (*Tomocerus flavescens*), a termite (*Eutermes peruanus*), and a walking-stick insect (*Dixippus morosus*). He gives a careful analysis of the proto-, deutero-, and trito-cerebrum, and the nerves arising from these parts.

**New Order of Insects.†**—F. Silvestri describes three species of an interesting new genus, *Zorotypus*, from the Gold Coast, Ceylon, and Java, and proposes a new order Zoraptera for their reception. The insects are minute, terrestrial, wingless, and agile; they live among rotting vegetable debris, and seem to catch mites and the like. The mandibles are strong biting organs; the antennæ are short and moniliform; there are conical single-jointed cerci; the thorax is relatively long; the abdomen has 10 segments, 8 stigmata, and 2 ganglia.

**Tracheal Capillaries among Fibres of Wing-muscles.‡**—J. Athanasiu and J. Dragoiu describe the tracheoles or fine capillary branches of the tracheæ among the fibres of the wing-muscles in *Hydrophilus*. Penetrating below the sarcolemma the branches divide into a large number of capillaries which lie between the columns, some longitudinally, some transversely. In a longitudinal section it is seen that the space between two muscle columns is occupied by a tracheal capillary with an approximate diameter of 0·001 mm. The transverse capillaries are seen as minute dark circles. The ramification is extraordinarily rich, and it is a very interesting point that it is not seen at all in the muscles of the legs.

**Skin and Glands of Dytiscus marginalis.§**—Alois Casper describes the cuticle, hypodermis (single-layered), and the basal membrane. The cuticle is formed in part by secretion, in part by a direct change of the cell-plasma of the hypodermic cells. The cuticle is made up of many lamellæ and beams, and has a complex structure. The insertion of muscles is effected by an epithelial tendon (modified cells of the hypodermis).

There are varnishing unicellular glands, modified epidermic cells. Packets of such cells occur which have a specialized function, e.g. at the genital apparatus. Or a more compact packet is formed, and the chitinous tubules open on a common cribellum. This occurs on the jaws. A third type of packet occurs, with looser vesicular cells.

Invagination and the differentiation of a canal lead on to more complicated glands—offensive, pseudoacinous, and pygidial. These are

* Jen. Zeitschr. Naturw., l. (1913) pp. 147–276 (5 pls. and 39 figs.).
† Boll. Lab. Zool. Scuola Agricoltura Portici, vii. (1913) pp. 193–209 (13 figs.).
‡ Comptes Rendus, clvii. (1913) pp. 1168–71 (2 figs.).
§ Zeitschr. wiss. Zool., cvii. (1913) pp. 387–508 (44 figs.).

described in detail. The offensive glands repel larger enemies. The secretion of the other two types serves to close up the air-chambers under the elytra and between pro- and mesothorax. The imago shows a distinctly segmental arrangement of its larger glands. The glandular cells have a vesicular nucleus, a reticulate plasma, an internal vesicle, and a chitinous tubule. Secretion is preceded by an increase of chromatin by the nucleolus; the secreted product appears in the plasma, collects around the vesicle, passes along fine plasmic threads through the membrane of the internal vesicle, and thence osmotically through the wall of the chitinous tubule. During each secretory period the chromatin of the nucleus is temporarily exhausted.

**Odoriferous Organs of Female Lepidoptera.***—Ernst Urbahn has made a detailed study of these organs, which may occur in the vicinity of the external genitalia or elsewhere. Illig and Freiling have distinguished (*a*) protrusible scent-areas (*Phalera*, *Pygæra*); (*b*) evaginated scent-rings (*Pterostoma*, *Cucullia*, *Colocasia*); (*c*) the dorsal scent-fold of Lymantriidæ; (*d*) intersegmental scent-sacs (*Hypocrita*, *Callimorpha*, *Saturnia*, *Aglia*, *Argynnis*); (*e*) the glandulæ odoriferæ of species of *Argynnis*; and (*f*) the ventral tufts of *Agrotis fimbria*. All scent-organs that are restricted to the females are abdominal. They always lie at the end of the abdomen and are either tufts or intersegmental folds, sacs, and the like. The folds and sacs arise from an intersegmental fold, usually between 8 and 9, which has become glandular. There are large glandular cells with large nuclei, and a plasma with numerous secretion-vacuoles.

**Trophi of Leaf-Miners.**†—Ivar Trägardh describes the larvæ of a series of Lepidopterous leaf-miners. He has been able to follow the whole of the interesting transformation from the so-called "flattened type" to the cylindrical type. A pronounced dimorphism in the mouth-parts of the younger and the later instars occurs in those forms where there are two well-defined, and in some respects entirely different periods in the life-history of the larva. The difference depends on the two methods of feeding and mining. The one method is to cut a thin horizontal slice in the parenchyma and suck the sap; the other method is to eat mouthful after mouthful of the parenchyma, excavating a mine without wounding the epidermis. The relation of the mouth-parts to the sap-feeding and tissue-feeding is illustrated in detail.

**Larva of Egle spreta.**‡—Ivar Trägårdh describes the eggs and larvæ of *Egle* (*Anthomyia*) *spreta*, which he found on *Epichloë typhina*, a fungus attacking grasses (*Phleum pratense* and *Dactylis glomerata*). Three instars which, differ greatly, are described. When they hatch the larvæ use the egg-shell as a cover, but soon form a thin oblong-oval tube of fæcal or fungoid matter. From this cover the larva makes excursions into the fungus, devouring it, and "leaving broad winding streets." As it grows it adds to its tube, which becomes as broad as the

* Jen. Zeitschr. Naturw., l. (1913) pp. 277–358 (2 pls. and 26 figs.).
† Arkiv Zool., viii. (1913) No. 9, pp. 1–48 (67 figs.).
‡ Arkiv Zool., viii. (1913) No. 5, pp. 1–16 (1 pl.).

grass blade. At the same time the greater part of the fungus disappears. At last the larva attacks the grass itself.

**Development of Wings in a Caddis-fly.***—W. S. Marshall has studied the development of the wings in *Platyphylax designatus* Walk. The wing-rudiments of *Platyphylax* appear in the larva soon after hatching, probably in the second instar, and are noticed as small disk-like thickenings of the hypodermis, lying each under a small dark marking of the cuticular layer. Each disk invaginates, and, insinking below the surface, forms a peripodial cavity which communicates with the outside by a peripodial pore. The disk is at first circular, but soon elongates and then lies obliquely to the longitudinal axis of the body of the larva. The cuticular layer just over the rudiment differs from the surrounding part in being darker, and free from small setæ. The cuticular layer is secreted at all stages by the cells of the rudiment. The disk evaginates and soon grows so large that a folding of the rudiment within the peripodial cavity is necessary. The peripodial pore becomes a long narrow slit, through which the wing rudiment leaves the peripodial cavity and becomes external. While still within the peripodial cavity dark markings appear on each rudiment; these form alternating light and dark areas upon the wing; the former become the wing veins, and the latter the areas between them. Tracheæ do not enter the developing wings until they have become external, and the wing veins have been formed. The wings become external soon after the larva has closed its case for pupation. Each wing rudiment is situated under the dorsal plate a little above its lateral margin.

**Eyes of Termites.**†—Kurt von Rosen finds that in the youngest larvæ of Termites the primordia of the eyes are all alike. This changes as the larvæ differentiate into big-headed and small-headed forms—apparently in response to different nurture. In the big-headed forms the development of the eye soon stops. In the lowest Termites, the workers and soldiers have complex eyes, and this is probably primitive. Many degrees of rudimentariness occur. In the sexual forms the eyes and the optic ganglia soon degenerate. The various conditions of the eyes in different types and in different castes are discussed.

**Spermatophores of Gryllidæ and Locustidæ.**‡—Ulrich Gerhardt describes the various kinds of spermatophores—simple and compound—which are formed in Locustidæ and Gryllidæ. The spermatophore is always fastened by a longer or shorter hollow stalk in the vulva of the female, and the spermatozoa pass from the reservoir or reservoirs of the spermatophore into the receptaculum seminis of the female. In all Locustidæ, but not in Gryllidæ, the reservoir portion is surrounded by a large envelope formed from the accessory glands. This is almost always eaten by the female after the pairing is accomplished. The most primitive spermatophores and mode of pairing may be found probably in the Locustid family Stenopelmatidæ.

* Zeitschr. wiss. Zool., cv. (1913) pp. 574–97 (3 pls. and 6 figs.).
† Zool. Jahrb., xxxv. (1913) pp. 625–64 (3 pls. and 10 figs.).
‡ Zool. Jahrb., xxxv. (1913) pp. 415–532 (2 pls. and 22 figs.).

**Study of Lomechusa and Atemeles.***—Karl Jordan has studied these and some related myrmecophilous beetles. The secretions which the ants lick come from numerous unicellular glands situated on the sides of the abdomen and opening among the setæ. Wasmann's so-called exsudation tissue is simply fatty tissue.

The beetles have numerous offensive glands and a large dorsal reservoir which opens between the third and fourth abdominal segments. These glands occur in all members of the sub-family Aleocharinæ. They are used by the myrmecophilous beetles against strange ants, or against their hosts when these go too far. The secretion has a stupefying effect on ants. Its odour is like amyl-acetate or methyl-heptenon, which have a similar effect on ants.

The symphilous state depends on adaptations on the part of the guests. The offensive glands give the beetles a standing, but they are much older than the partnership. A new adaptation, however, is the acquisition of the myrmecophilous glands. The males of *Lomechusa* are much excited at the breeding season; the sexual act is several times repeated: only a few eggs are laid in the recesses of the nest.

### γ. Prototracheata.

**Integument of Peripatus.**†—D. H. Webster, who has specialized on the detection of chitin, finds secure evidence of its presence in *Peripatus* as a thin covering of the skin. This shows, he says, that *Peripatus* is nearer to Arthropods than to Annelids. In *Aphrodite*, *Lepidonotus*, *Lumbricus*, *Echiurus*, *Hirudo*, etc., he found no trace of chitin.

**New Peripatus from India.**‡—Stanley Kemp gives a preliminary account of *Typhloperipatus williamsoni* g. et sp. n. from the Abor country. No external trace of eyes could be seen; the ocular lobe is well developed, but has a rudimentary nerve. A non-cellular structure in the lobe may be remains of the rods and cones. The male has nineteen legs, the female twenty. The legs have four spinous pads and two distal papillæ; in the fourth and fifth legs the nephridial openings are on the third pad. A description is given of the teeth on the jaws and of the gonads. The ova are large, heavily charged with yolk. The uterine embryos are of all ages and do not possess a trophic vesicle. The spermatophore is very long and has a horny cap. Living specimens are pale ventrally, deep raw umber brown above, with the ends of the antennæ and the tips of some of the primary tubercles pale buff. They were found on the banks of the Dihang River, under stones at altitudes varying from 1200–2500 ft.

### δ. Arachnida.

**Dimorphic Males.**§—Theophilus S. Painter discusses the dimorphism which occurs in the males of *Mævia vittata*, a North American Jumping

* Zeitschr. wiss. Zool., cvii. (1913) pp. 346–86 (20 figs.).
† Zool. Jahrb., xxxv. (1913) pp. 640–1.
‡ Records Indian Museum, ix. (1913) pp. 241–2.
§ Zool. Jahrb., xxxv. (1913) pp. 624–6 (1 fig.).

Spider. The two forms—known as the tufted and the grey—appear to be approximately equal in numbers, and the total number of males collected (70) was not far short of the total number of females collected (80). The tufted males differ from the others in the colour of the legs, the colour of the palps, and in the possession of three tufts of hair on the cephalothorax. They also differ in the method of their love dance, but the females show no preference. The dimorphism is probably due to a discontinuous variation. It was found that the grey males carried a pair of small chromosomes, called "ctetosomes" by the author, while the nuclei of the tufted males lacked these elements.

**Food-canal of Limulus.***—D. H. Wester finds that in the œsophagus, stomach, and a small hind-gut portion of *Limulus* there is a chitinous lining; there is none in the long mid-gut; the same is true in *Mygale avicularia* and *Epeira diadema*. No chitin was found in the gut of *Scorpio* and *Buthus*, nor in *Tegeneria domestica* and another spider. In *Astacus*, *Hyas*, *Carcinus*, the whole alimentary canal shows, according to the author, a chitinous lining. (This is difficult to credit in regard to the mesenteron; and of *Eupagurus bernhardus* the author says that he is not sure if "the portion of the gut immediately behind the stomach" is chitinous.) The conclusion drawn is that *Limulus* is related to Arachnoids rather than to Crustaceans.

**Regeneration in Pantopoda.**†—W. Schimkewitsch and V. Dogiel have studied the regeneration of appendages in species of *Nymphon*, *Anoplodactylus*, *Chætonymphon*, *Pycnogonum*, and other forms. There is evidence of the regeneration of the cheliferæ, probably of the palps and ovigerous limbs, of the posterior limbs, and of the abdomen. The re-grown appendage may be like the original or after a primitive type. The regeneration of the cheliferæ may be quite abnormal. Sometimes the regenerating part shows some duplication.

**Development of Pantopoda.**‡—V. Dogiel has made an important contribution to the embryology of the Pantopoda. He distinguishes three types of development, as exemplified: (1) by *Anoplodactylus Phoxichilidium* and *Pycnogonum*; (2) by *Nymphon strömii*; and (3) by *Chætonymphon spinosum*. The post-embryonic development and metamorphosis is described in six types, and the organogenesis of the larva. Some general results may be noted.

The segmentation is total, and, to begin with, equal. It afterwards becomes unequal. The result is a cœloblastula or a sterroblastula. Gastrulation occurs by typical epibole or by a process intermediate between epibole and invagination. The development is definitely determinate, particular cells forming particular layers, but the yolk in some types tends to disguise this. There is a strong resemblance between the early development of Pantopoda and that of some Entomostraca. This is well illustrated by the history of the endoderm.

* Zool. Jahrb., xxxv. (1913) pp. 637–9.
† Bull. Acad. Imp. Sci. St. Petersbourg (1913) No. 18, pp. 1147–56 (10 figs.).
‡ Zeitschr. wiss. Zool., cvii. (1913) pp. 575–741 (6 pls. and 109 figs.).

The six-footed larva is the primary larval type. Pantopods have little to do with Arachnoids, but may be held to have arisen, along with Crustaceans but on a different line, from a common Annelid stock.

### ε. Crustacea.

**Effect of Sacculina on Host.***—Geoffrey Smith has enquired into the precise action of *Sacculina* and *Peltogaster* on their hosts. They feminize the males, converting them externally, and in part internally, towards the female condition. They leave the female unchanged, or hasten on the adult female characters, despite the partial destruction of the starved ovary. The roots of the parasite affect the metabolism of the crab just as an ovary does, by taking up fat and stimulating the liver to make more. The glycogenic function is depressed, for there is an absence of demand for glycogen, there being no growing or moulting after the *Sacculina* has protruded. In the normal female the blood becomes progressively charged with lutein and fat; in the parasitized crab this is not demonstrated, but the liver is always coloured with lutein, and so are the *Sacculina* roots, showing that a transference of these materials has occurred, perhaps so rapidly that their presence in the blood cannot be detected. Smith's view is, in general, that the parasite alters the composition of the blood to or towards a female condition, and that this is naturally followed by the development of female secondary characters or by the regeneration of an ovary instead of a testis from the indifferent germ-cells that remain at the end of infection. It is not the mere presence of fat in the blood that is the cause of the transformation; the fat is but the sign of more deep-seated changes in the metabolism. In this case at least the author claims that his theory of metabolic stimulation is superior to any hormone theory.

**Adaptations in Galatheidea.**†—K. Zimmermann compares three types—*Galathea squamifera*, *Porcellana platycheles*, and *Munida rugosa*—and indicates in an interesting way their special adaptations. A description of the details of the structure of the branchial and other organs serves to show how the animals secure steadiness in progression or at rest within the wave-washed region of the shore, or are able to guard against the choking of the branchial cavity and clogging of the branchial organs by the mud of the low shore.

**Integument and Glands of Terrestrial Isopods.**‡—Werner Herold describes the minute structure of the integument in *Oniscus*, *Porcellio*, etc. He deals with the five strata, with the sculpturing, and with the moulting. Particular attention is paid to the "white plates," which are best seen on the first four thoracic segments, and the various kinds of glands. He agrees with previous investigators that the "white plates" represent secondarily acquired respiratory organs. A plate shows an

* Quart. Journ. Micr. Sci., lix. (1913) pp. 267–95.
† Journ. Marine Biol. Assoc., x. (1913) pp. 84–97 (4 pls. and 1 fig.).
‡ Zool. Jahrb., xxxv. (1913) pp. 457–526 (3 pls. and 15 figs.).

external coloured cuticle, a layer of lens-like white calcareous bodies, which enclose numerous branched passages containing air. They are auxiliary to "gills," where these are present in terrestrial forms.

**Development of Summer Eggs of Polyphemus.***—Alfred Kühn gives a full account of the segmentation and gastrulation of *Polyphemus pediculus*, and a survey of later embryonic stages. He makes a comparison between the development of *Polyphemus* and that of other Crustaceans, and discusses the question of the determination of the blastomeres. The development is definitely determinate. Particular blastomeres represent definite primordia, as in Annelids and Molluscs. The first two blastomeres get different kinds of plasma, because the ovum shows polar differentiation and the cleavage plane is inclined to an angle to the main axis. A quantum of substance lying at the vegetative pole comes into a quadrant which is henceforth marked by a special developmental history. Plasmic differentiation in the primary axis of the egg has a far-reaching influence.

**Crustaceans on Alcyonarians.**†—Ch. Gravier describes a small Crustacean that forms galls on *Primnoisis formosa* and *Mopsea gracilis* from Antarctic waters. Males and females and young forms were found. The males are smaller, but there is no dimorphism. The systematic position is among Lamippidæ, and the name *Isidicola antarctica* sp. n. is proposed. The differences between the new form and the genera *Lamippe* and *Linaresia* are indicated.

## Annulata.

**Structure of Branchiura sowerbyi.**‡—Fr. Keyl gives an account of this East Indian Oligochæt, which Beddard first found in the Victoria Regia tank in the Royal Botanical Society's garden in Regent's Park. Keyl's specimens were found in a similar situation in Göttingen and Frankfurt. It lives in tubes in the mud, and eats the mud. It is prejudical to the rooting of young plants. The author describes the nervous system, comparing it with that of other Oligochæts, and shows that in spite of apparent unity the two halves are very distinct and form a rope ladder system. The neurochords are discussed in great detail, and Keyl inclines to the view that they were nervous to begin with, but have undergone degeneration. The gills are diverticula of the epithelium of the body and a portion of the circular musculature. An account is also given of nephridia, gonads, and germ-cells.

**Food of Sipunculids.**§—Marcel A. Herubel finds that the intestine of *Sipunculus nudus*, *Phascolosoma vulgare*, and *P. elongatum* contains besides sand and shell fragments almost nothing but Diatoms—of which a list is given.

* Zool. Jahrb., xxxv. (1913) pp. 243–340 (7 pls. and 14 figs.).
† Comptes Rendus, clviii. (1914) pp. 354–6.
‡ Zeitschr. wiss. Zool., cvii. (1913) pp. 199–308 (3 pls. and 56 figs.).
§ Bull. Soc. Zool. France, xxxviii. (1914) pp. 317–18.

### Nematohelminthes.

**Development of Nematodes.***—André Martin has made an interesting study of the conditions of development in parasitic Nematodes. His experiments show that the development, hatching and survival of the egg and embryo of the parasitic Nematodes of mammals and birds, are dependent on physical and chemical factors of the environment, and on the physical and chemical properties of the ovular envelopes. Temperature exerts a preponderating influence. Development is accelerated in proportion as the temperature rises, up to a limit beyond which it does not take place. This limit varies for the different parasites. The embryo of some Nematodes (*Ascaris equorum*, *Ascaris canis*, *Trichocephalus depressiusculus*, Sclerostomes, Ankylostomes) develop rapidly in the temperature of their host or one approximating to it. The embryos of *Ascaris vitulorum*, *Ascaris suis*, and *Heterakis columbæ* are never formed at 38°, but if the temperature be lowered to 33° development becomes possible, and the embryo is built up in a few days. The ova of these last three parasites show a remarkable sensitiveness to a temperature of 38°. Segmentation begins, but is arrested at the stage of a morula with large blastomeres (*Ascaris* of the calf), with two blastomeres (*Ascaris* of the pig), or with small blastomeres (*Heterakis*). This degree of temperature exercises an inhibitory influence on the ovum and the capacity for development disappears, not returning even when the ova are transferred to a temperature of 33°. Conversely, if ova in process of development in a temperature of 33° be transferred to 38°, segmentation is at once arrested and embryos are not formed. This sensitiveness to a temperature of 38° is a physiological character of these forms. At moderate temperatures of the external environment development is always possible, but it is very slow. The formation of the embryo in certain parasites requires several months even in the most favourable environment. At low temperatures the ovum is indifferent to the substances in solution in the medium, with the exception of gas. When the temperature rises to 33° and 38° the segmentation presents peculiarities due to the substances in solution in the medium; it is sometimes accelerated, sometimes retarded, both acceleration and retardation being due to metallic ions in the solutions. Hydrochloric acid, chloride of sodium, bicarbonate and carbonate of sodium, chloride of potassium, hasten development; chloride of calcium and chloride of magnesium retard it. Acceleration and retardation vary according to the parasites. They are greater for the *Ascaris* of the calf than for that of the horse. The salts show an antagonism to one another, as can be seen from the variations in the duration of the development, and of the survival of the embryo. The degree of concentration is of little importance; effects are only shown when there is a degree much greater than the ova are apt to encounter in the conditions of natural development. The eggs of *Ascaris vitulorum* and of *Ascaris equorum* develop in water, the temperature of the laboratory and at 33°. Free oxygen is indispensable to the development of the embryo of most oviparous Nematodes; without it, segmentation does not take place. But this need for free oxygen must diminish

* Ann. Sci. Nat., xviii. (1913) pp. 1–151.

and disappear in the case of those Nematodes that attach themselves to organs in which it is awanting. A certain amount of moisture, too, is necessary; and most of the eggs are destroyed by desiccation, and full development is rarely reached in dry conditions. The shell of the egg is not dissolved by the digestive juices, and hatching is not due to the action of their diastases. Hatching does not take place in the stomach but in the small intestine, and particularly in the last third of it.

The conditions necessary to the liberation of the embryo of Ascarids, Heterakids, and Trichocephalids are three: (1) an alkaline or neutral reaction of the medium: (2) a temperature equal to that of the host; (3) complete development of the embryo. Liberation is rare at a temperature below 33°. The survival of the ovum depends on the presence of the shell, on its physical and chemical properties, and on the temperature. The shell is composed of chitin, and is therefore resistant to the most diverse chemical agents, and to the digestive juices. At low temperatures the substances dissolved in the medium penetrate so slowly that the shell was long believed to be impermeable, but gases pass through it relatively easily. At a high temperature (33–38°) both dissolved substances and gases penetrate the shell more easily, and the fate of the embryo then depends on the degree of their toxicity. Among the substances studied in the course of Martin's work, chloride of sodium, bicarbonate of sodium, chloride of lime, and chloride of magnesium are most favourable to the survival of the embryo at a temperature of 33°. Independently of the modifications it produces in the properties of the shell, temperature exercises a direct influence on the embryo itself, and, generally speaking, the higher the temperature the shorter the duration of the life of the embryo. The most complete adaptation is exhibited by viviparous Nematodes, the embryos of which develop at the temperature of the host, within the maternal uterus, during the parasitic life of the worm. In oviparous forms the indifference of the ovum to the chemical nature of the environment and the quasi-impermeability of its shell at an ordinary external temperature enable it to survive for a long time, and to develop slowly in water, soil, etc. When ingested by a Vertebrate it is protected by its chitinous shell from the action of the digestive juices, and the embryo emerges in the small intestine, where the necessary conditions of temperature and alkaline reaction are found. Eggs deposited in the intestine do not develop there, because (1) the temperature of the host prevents the development of the embryo in some cases, and destroys it at an early stage in others; (2) there is an insufficiency of free oxygen; and (3) the gases arising from intestinal fermentation are rapidly fatal to the embryo. Outside of the body the chief causes of the destruction of the ova are desiccation, the permeability of the shell to toxic gases, the presence of saprophytic fungi, which often attack the shell and destroy the vitellus.

**Fresh-water Mermithidæ.***—Eugen von Daday gives an account of the external features, the fine structure of the integument, the longitudinal bands which divide the musculature into bundles and afford insertion to internal organs such as gonads, the muscular system,

* Math. Nat. Ber. Ungarn., xxvii. (1913) pp. 214–72 (4 pls.).

the nervous system, the gut, and the gonads in fresh-water Mermithidæ. In systematic distinctions importance must be attached to the fine structure of the integument, the number of longitudinal bands (eight or six), the spicules, and the structure of the vagina. He deals with species of *Mermis*, *Neomermis*, *Mesomermis*, *Limnomermis*, *Pseudomermis*, *Bathymermis*, *Paramermis*, and *Eumermis*.

**Reproductive Ducts of Cestodes.***—Robert Schaefer has studied these, with especial reference to the conditions of the epithelium. He traces their development. For *Bothridium pythonis* he finds, as Schmidt did for *Bothriocephalus latus*, that the testes and yolk-glands arise, in the parenchyma of the medullary and cortical layers, quite apart from the primordia of the other reproductive organs. In *Tænia* the testes only have this independent origin. In the young stages of both there is an epithelium lining the genital ducts. In parts which communicate with the surface the epithelium degenerates and a cuticle is differentiated from without inwards, a process associated with an insinking of epithelial nuclei. The cuticle of Cestodes is ectodermic, not mesodermic.

**New British Trematodes.**—W. Nicoll † describes *Ancylocœlium typicum* g. et sp. n., a small Trematode from the horse-mackerel (*Trachurus trachurus*), and *Zoonogenus viridus* g. et sp. n. from the sea-bream (*Sparus centrodontus*). The first of these stands very much by itself, as is shown by the accessory genital sac, the unique configuration of the intestinal diverticula, and the peculiar condition of the yolk-glands. The second resembles *Zoogonoides*, but has an unarmed cirrus, a very highly-developed vagina, and much smaller egg-capsules.

In another paper ‡ the author describes *Hemipera ovocaudata* g. et sp. n. from *Lepadogaster gouanii*, *Derogenoides ovacutus* g. et sp. n. from *Trachinus draco*, *Lepidauchen stenostoma* g. et sp. n. from *Labrus bergylta*, and *Podocotyle syngnathi* sp. n. from pipe-fishes.

**Reproduction in Fresh-water Triclads.**§—Adolf Burr has studied species of *Planaria*, *Dendrocœlum*, and other forms. Fertilization is mutual. There is no receptaculum seminis in the strict sense. The spermatozoa accumulate in a part of the oviduct—the tuba. The so-called "uterus" is rather a bursa copulatrix. The egg-capsule is formed in the atrium, not in the so-called uterus. The erythrophilous shell-glands form the secretion that becomes the matrix of the shell. The rest of the shell of the egg-capsules is formed from spherules contributed by the yolk-cells. It appears that the muscular glandular organ is of the nature of a weapon.

**Peculiar Association of Two Species of Convoluta.**‖—Marcel A. Herubel reports from Roscoff the occurrence of the widely-distributed

* Zool. Jahrb., xxxv. (1913) pp. 583–624 (6 pls. and 2 figs.).
† Parasitology, v. (1913) pp. 197–202 (1 pl.).
‡ Parasitology, v. (1913) pp. 238–46 (1 pl.).
§ Zool. Jahrb., xxxiii. (1912) pp. 595–636 (1 pl. and 11 figs.).
‖ Bull. Soc. Zool., xxxviii. (1914) pp. 319–20.

*Convoluta flavibacillum*, which has not been previously noticed from this locality. About forty were found in a collection of *C. roscoffensis*, and the peculiar fact was observed that on the ventral surface of each of them there was a young *C. roscoffensis*, clinging on by its dorsal surface. When they were separated in an aquarium, they were re-united in half an hour. The one species has chlorophyll, the other has not. But the meaning of the association is quite obscure.

### Incertæ Sedis.

**Nervous System of Cristatella mucedo.***—A. Gerwertzhagen describes the central nervous system, the innervation of tentacles, the epistomal and oral nerve-rings, the sensory cells of the tentacle-crown, the innervation of epistome and tentacular sheath, the colonial nervous system, and the sympathetic system. The so-called œsophageal ring of Gymnolæmata is homologous with the oral nerve-ring of *Cristatella*; the ganglion of *Cristatella* is probably supra-œsophageal, but the definite developmental proof of this is lacking. The author compares the nervous system of *Cristatella* with that of *Phoronis*, Brachiopods, Chætognaths, and Pterobranchia, but does not discover any close affinities.

### Echinoderma.

**Echinoderm Hybridization.†**—David H. Tennant calls attention to the apparent confusion that exists among observations on hybrid Echinoid larvæ, as to whether plutei of a maternal type, a paternal type, or of mixed form are derived from certain crosses. Different results have been obtained by different investigators, and by the same investigators working in different regions, or in the same region in different seasons. He points out that the results differ according to the conditions. Under some conditions we may obtain larvæ of a maternal type with respect to certain characters; under other conditions larvæ of a paternal type; and under still other conditions larvæ of a blended type. The real problem in Echinoderm hybridization is the determination of the conditions under which these different types appear. Another point to which Tennant directs attention is the importance of determining the extent and nature of the variations in the skeleton before using skeletal characters as indices of inheritance in crosses. Moreover, in proper material, parental influence may be demonstrated in stages even younger than the pluteus. In fertilizations of *Cidaris* ova with sperms of *Toxopneustes* or of *Hipponoe*, the influence of the foreign sperm was clearly seen, in the early gastrula stage, in the changed site and earlier appearance of the primary mesenchyme.

* Zeitschr. wiss. Zool., cvii. (1913) pp. 309–45 (3 pls. and 3 figs.).
† Science, xxxvii. (1913) pp. 535–7.

## Cœlentera.

**Fat in Sea-anemones.***—W. Arndt finds, in *Heliactis bellis*, that the endoderm-cells, some of the ectoderm-cells, and the zooxanthellæ include a lipoid substance. It is absent from the mesoglœa. Fresh specimens show it more abundantly than those that have been kept in captivity for a considerable time. The fat probably comes from the food, not from the symbiotic algæ. It may be said that *H. bellis* exhibits Steatosis physiologica.

**Structure of Sea-anemones.**†—Chas. L. Walton and Olwen M. Rees communicate some details as to the muscle characters and the like in their discussion of some rare and interesting sea-anemones from Plymouth —*Edwardsia timida* Quatrefages, *E. claparedi* Panceri, *Halcampa chrysanthellum* Peach, *H. arenaria* Haddon, and *Eloactis mazeli* Jourdan. Of the last a detailed account is given by Rees.‡ It is an elongated anemone, with twenty highly-specialized tentacles (to which the nematocysts are restricted), ten pairs of perfect and fully-developed mesenteries, and a deep well-defined siphonoglyph. It is probably intermediate between *Halcurias* and *Peachia*.

**Axis of Alcyonarians.**§—K. Kinoshita corroborates the view of Koch that the axis of Gorgonacea arises as a secretion product of an axis-epithelium, and not in the interior of the cœnenchyma as Kölliker concluded. The polyps are all of the same order, and the Gorgonid type is not derivable from a Telestid type. The Gorgonids should rather be derived from the stock of the Stolonifera. In Scleraxonia three main types may be recognized—*Briareum*, *Melitodes*, and *Suberogorgia*, and these may be derived from a *Briareum-Paragorgia* stock in which there has been a thickening of the cœnenchyma in the direction of the main axis. Some valuable figures of the internal structure of the different types are given.

**Incubation in Antarctic Alcyonarians** ‖—Ch. Gravier describes in *Mopsea gracilis* Gravier a kind of zooid, apparently without tentacles, containing one large egg. There is marked dimorphism. In *Mopsea elongata* Roule there are nodosities on some of the branches, each of which lodges a large egg or occasionally two eggs. In *Rhopalonella pendulina* Roule many of the branches show swellings containing yellow bodies, each of which is an ovum surrounded by vitelline cells. Gravier recalls the incubation among Antarctic Actinians, Echinoderms, and Polychæts. It appears that special protection has been evolved for a relatively small number of large ova.

* Zool. Jahrb., xxxiv. (1913) pp. 27–42 (1 pl.).
† Journ. Marine Biol. Assoc., x. (1913) pp. 60–9 (2 figs.).
‡ Journ. Marine Biol. Assoc., x. (1913) pp. 70–80 (4 figs.).
§ Journ. Coll. Sci. Tokyo, xxxii. (1913) pp. 1–50 (13 figs.).
‖ Comptes Rendus, clvii. (1913) pp. 1470–3.

## Protozoa.

**Antarctic Foraminifera.***—E. Fauré-Fremiet describes a collection made on the second voyage of the 'Pourquoi Pas.' All the species are ubiquitous, and known from all latitudes. Some are cold water forms; others are hardy forms that occur at all depths. There is no special Antarctic Foraminifer fauna, nor Arctic either (Awerinzew).

**Tertian Malarial Parasites.**†—J. G. Thomson and D. Thomson have studied the growth and sporulation of the benign and malignant tertian malarial parasites in the culture-tube and in the human host. The cultures of the benign tertian (*Plasmodium vivax*) differ from those of malignant tertian (*P. falciparum*) in that there is no tendency to clumping of the parasites in the former, either before or during sporulation. The malignant tertian is capable of producing, in maximum segmentation, thirty-two spores: the benign tertian usually produces sixteen, never thirty-two, spores. The pigment collects in *P. falciparum* into a definite circular and very compact mass, which is formed early in the growth of the parasite. In *P. vivax* the pigment remains scattered in definite granules till just before segmentation, when it collects in a loose central mass.

**Trypanosome of Dourine.**‡—R. Blacklock and Warrington Yorke have found along with typical forms of *Trypanosoma equiperdum*, short forms sometimes with a posterior displacement of the nucleus. It seems that the symptom-complex of the disease clinically known as Dourine can be produced by more than one species of Trypanosome. The new form, for which the name *T. equi* is proposed, has very little free prolongation of the flagellum, and approaches *T. rhodiense*, whereas *T. equiperdum* is a monomorphic parasite in which all the forms are furnished with a free flagellum.

**Life-history of Karyolysus lacertæ.**§—E. Reichenow has followed the life-history of this Hæmogregarine, which occurs in *Lacerta muralis* and in its ectoparasitic mite, *Liponyssus saurarum*. He describes the gametocytes in the intestine of the mite, the fertilization of the macrogametes, their conversion into ookinetes, the sporogony of these, and the asexual multiplication. The parasites may destroy the whole nuclear material of the infected blood-corpuscles, but even badly infected lizards do not appear to be much the worse. The internal body or karyosome of Coccidia is discussed, and regarded as physiologically comparable to the nucleolus of Metazoa.

**Nematocysts and Trichocysts of Polykrikos auricularia.**‖—E. Fauré-Fremiet has studied this curious Peridinian, and finds both trichocysts and nematocysts. The trichocysts are very abundant in the

* Bull. Soc. Zool., xxxviii. (1913) pp. 260–71 (9 figs.).
† Proc. Roy. Soc., Series B, lxxxvii. (1913) pp. 77–87 (1 pl.).
‡ Proc. Roy. Soc., Series B, lxxxvii. (1913) pp. 89–96 (1 pl.).
§ Arb. k. Ges. Berlin, xlv. (1913) pp. 317–63 (3 pls. and 7 figs.).
‖ Bull. Soc. Zool. France, xxxviii. (1914) pp. 289–90 (1 fig.).

ectoplasm ; they burst the surface and project as sinuous filaments. The nematocysts have an ovoid capsule, an anterior hyaline collaret, an invaginated biconical invagination of considerable complexity, bearing the spirally coiled lasso. A nematocyst begins as an intra-cytoplasmic vacuole, which shows gradually increasing internal differentiation.

**Coccidia of the Rabbit.***—Adrien Lucet finds that the coccidian of the liver (*Eimeria stidæ* Lindemann = *Coccidium oviforme* Leuckart = *Psorospermium cuniculi* Rivolta) is distinct from the coccidian of the intestine (*Eimeria perforans* Leuckart = *Coccidium perforans* Leuckart). The oocysts of the two species are distinguishable. Those of the first are on an average larger and have a slight brownish colour ; those of the second show a constant and well defined residual body.

**Development of Adelina dimidiata.**†—C. Schellack has studied the life-history of this parasite of the centipede, *Scolopendra cingulata*. He describes the sporozoites and the schizonts to which they give rise, the merozoites and their schizonts, the nuclear divisions in the schizonts, the sporogony, the maturation phenomena in macrogametes, the formation of microgametes, and so on.

* Comptes Rendus, clvii. (1913) pp. 1091–2.
† Arb. k. Gesundheit. Berlin, xlv. (1913) pp. 269–316 (3 pls. and 9 figs.).

# BOTANY.

## GENERAL,

### Including the Anatomy and Physiology of Seed Plants.

### Cytology,

#### Including Cell-Contents.

**Function of Yellow Pigment in Chlorophyll.***—D. Iwanowski has conducted a series of experiments in order to ascertain the function of the yellow pigment in chloroplasts, and the results obtained seem to show that it plays an important part in protecting chlorophyll against the destructive influence of light. Both carotin and xanthophyll share the power, but the latter exhibits it in a more marked degree. The protective influence appears to rest upon the capacity of these pigments for absorbing the blue and violet rays of the spectrum.

### Structure and Development.

#### Vegetative.

**Anatomy of Tubers of Tropical Orchids and other Plants.†** L. Moreau has studied the anatomy of the pseudo-bulbs of tropical orchids and of the tubercles of a few other tropical genera, and finds that in the orchids the stem-tubercle is formed from the conjunctive tissues of the stele, while the root-tubercle is formed from the cortical parenchyma. The tubercles of the Asclepiadaceæ and also of seedlings of *Adansonia* are usually formed at the expense of the secondary wood. The different reserve-substances found in the tubercles bear no relation to the volume of the latter, for small root-tubercles like those of *Disa sagittalis* and *D. micrantha* contain starch, sugar, gums, and oxalate of lime, while the tubers of *Adansonia za* contain only starch; although the latter may be regarded as a rather unusual case, the same thing is true in the large pseudo-bulbs of certain orchids.

**Structure of Leaf-sheaths of Grasses.‡** — H. Brockmann-Jerosch has studied the leaf-sheaths of grasses, and is led to the conclusion that those authors who regard them as an adaptation to a dry environment are only partially correct. The author agrees that the formation of a "straw-tunic" is characteristic of grasses found in unfavourable environment, but points out that in some cases this structure is below the surface of the soil where there is no risk of excessive evaporation, and that there are indications that its function is rather that of a water-reservoir. In all grasses having this kind of sheath, the extreme basal portion has

* Ber. Deutsch. Bot. Gesell., xxxi. (1913) pp. 613-17.
† Rev. Gén. Bot., xxv. (1913) pp. 503-48 (24 figs.).
‡ Ber. Deutsch. Bot. Gesell., xxxi. (1913) pp. 590-4 (1 pl.).

a velvety texture owing to a thick growth of delicate downwardly directed hairs. These trichomes arise as outgrowths from the outer walls of the young epidermal cells: at a later stage they assume an outward and downward course, and have a well developed basal attachment. The outer side of each hair is covered with a ribbed cuticle and usually has no pore, although a single pore is sometimes found in the angle of the bend. The adjacent cell-membrane is strongly thickened when fresh and has a complex of pores towards the interior of the leaf. When dead, the hair-membrane breaks and assumes an alveolar structure. It appears as if the old leaf-sheaths forming the tunic act as a reservoir from which the living sheaths adjoining it take up water, and so render the plant less dependent upon the water in the soil. The author considers that further work in this direction will furnish interesting and useful results

### Reproductive.

**Fruit-wall of the Papilionaceæ.***—M. Fucsko has studied the structure and development of the fruit-wall of the Papilionaceæ, and distinguishes two chief types, viz. the older and simpler type of pod found in such genera as *Trifolium*, *Galega*, *Coronilla*, etc., and the legume of *Pisum*, *Vicia*, *Genista*, etc. The development shows that the outer part of the double hard layer belongs to the mesocarp, while the inner part, and also the entire layer when the latter is simple, is derived from the inner epidermis. The growth of the pericarp and the seed is not equally rapid; during the early stages the pericarp grows more quickly, but subsequently the seeds grow at a greater rate. The distribution of the forces governing the torsion of the valves is as follows: The transverse swelling-force of the fibres increases until it reaches a maximum in the middle of the layer and gradually decreases towards the inner surface: the longitudinal force is least in the centre and greatest in the outer part of the hard layer. Thus, each hygroscopic bend is the resultant of these two factors, but is more evident in the outer part, since the greatest torsion is there. The resulting displacement is gradual and symmetrical on both sides of the pericarp. The torsion of the fibres themselves plays an active part in the general torsion: the inner and outer fibres twist in opposite directions, but neither in direction nor amount is their torsion symmetrical in the two halves of the pericarp. The torsion of the inner fibres decreases the general torsion, since it is of greater strength than that of the outer fibres. Thus, the movement of the valves is not a simple transverse twisting, but a bending and torsion resulting from the swelling of the hard layer and torsion of the individual fibres, the latter being sometimes a retarding force and at others an increasing force.

**Embryo-formation in Balanophora.**†—A. Ernst has studied the formation of the embryo in different species of *Balanophora*, and finds that the embryo-sac is derived directly from the embryo-sac-mother-cell, or arises, after a single division, from the upper daughter-cell; the

* Flora, vi. (1913) pp. 160–215 (24 figs.).
† Flora, vi. (1913) pp. 129–59 (2 pls.).

nucleus has the somatic number of chromosomes. The endosperm is formed entirely from the upper polar nucleus, and after the first division of the latter into a small upper endosperm-cell and a large basal haustorial cell, the cavity of the embryo-sac develops. These results agree with those of Treub and Lotsy, but their subsequent observations and conclusions appear to be incorrect, for the present investigations show that while the endosperm-cell regularly develops into an eight-celled mass of endosperm, the egg-apparatus does not degenerate as supposed, but persists as a small shrunken cell, which after several divisions gives rise to a small undifferentiated embryo. Thus *Balanophora* agrees with such saprophytes as *Burmannia*, *Sciaphila*, and *Cotylanthera* in exhibiting somatic parthenogenesis. The investigations of Van Tieghem and Hofmeister, taken in conjunction with the present work, show that the embryo of the Balanophoraceæ usually arises from the egg-cell, but that in exceptional cases another cell of the egg-apparatus may take part in its formation; in the majority of the genera embryo-formation takes place after fertilization, but that in *B. elongata* and *B. globosa*, and also in *Rhopalocnemis phalloides* and *Helosis guyanensis*, it is of a parthenogenetic character.

## CRYPTOGAMS.

### Pteridophyta.

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

**Dichotomy and Lateral Branching in Pteropsidæ.***—J. C. Schoute has studied modes of branching in Ferns, and comes to the conclusion that the formation of a dichotomy does not differ in principle from a lateral branching. As a result of disease, the usual dichotomy may appear with a normal angle-leaf, or one branch may be much larger than the other and may take the place of the main shoot. The author argues therefore that all branching of ferns is homologous, and the lateral buds are not to be regarded as adventive-formations. Also it is very probable that axillary branching of Gymnosperms and Angiosperms depends on the same process, the only differences between the lateral branching of ferns and that of the other Pteropsidæ being, that in the former the bud is not always above the leaf insertion, and by no means all leaves produce buds. If that view be correct, the rare normal dichotomy of Angiosperms must be regarded as a new process, similar to a dichotomy of the second rank.

**Lepidostrobus mintöensis.**†—W. J. Wilson describes and figures a new species of *Lepidostrobus*, fragments which he found in shale at the Minto Coal Mines in New Brunswick. He compares it with other fossil species.

* Versl. k. Akad. Wet. Amsterdam, xv. 1 (1912) pp. 710–11. See also Bot. Centralbl., cxxiii. (1913) p. 444.
† Canada, Victoria Memorial Museum, Bull. No. 1 (1913) pp. 89–94 (1 pl.).

**Spore-development in Equisetum.***—R. Beer publishes an account of the premeiotic and meiotic nuclear divisions of the spores in *Equisetum arvense*, illustrated with many highly magnified figures of the phases observed. He describes the formation of the spireme, the chromosomes, and the separation of their longitudinal segments towards the poles of the spindle in the premeiotic divisions; also the synapsis, segmentation of the spireme into heterotype chromosomes, and the stages of the first and second meiotic divisions.

**Synopsis Hymenophyllacearum.**†—R. B. Van den Bosch published in 1858 a Synopsis Hymenophyllacearum.‡ A new edition is now issued, prepared by W. A. Goddijn; and in it are included numerous additions and unpublished drawings. The original short diagnoses are retained and amplified by all the notes and citations of literature, exsiccatæ, etc., synonyms, collected by Van den Bosch before his death.

**North American Ferns.**—T. C. Frye and M. M. Jackson,§ in continuing their account of the ferns of Washington, give diagnoses and figures of the Ophioglossaceæ and some of the Polypodiaceæ. The general keys to the Polypodiaceæ are two: one based on the leaves, the other on the sori.

W. R. Maxon‖ discusses a collection of rare ferns made by L. N. Goodding in Cochise County, Arizona. Five of them, described as new by Goodding, are shown to be species already known.

L. S. Hopkins¶ describes and figures *Polystichum Andersoni*, a new fern collected on Vancouver Island by J. M. Macoun, and points out the characters by which it is distinguished from allied species.

## Bryophyta.

(By A. Gepp.)

**Filamentous Formations in Moss-cells.****—K. Boresch describes his experiments on certain filamentous and net-like formations in the leaf-cells of certain mosses. *Funaria hygrometrica* and *Fontinalis antipyretica* were the species chosen. The formations occur markedly in the auricles of the older leaves of the latter species. They probably are composed largely of fatty material, and are either homogeneous or studded with small strongly refractive drops. They are continually changing their form, position, and visibility. All the filamentous growths drop to pieces under the action of certain reagents, going through a distinct series of stages. If the reagent is removed by water the growths are re-formed, passing through the same stages in reverse order. The same effect can be produced by lighting a hitherto dark

* Ann. of Bot., xxvii. (1913) pp. 643–59 (3 pls.).
† Mededeelingen van 's Rijks Herbarium. Leiden, No. 17 (1913) pp. 1–36.
‡ Nederl. Kruidk. Archief, iv. (1859) pp. 341–419.
§ American Fern. Journ., iii. (1913) pp. 97–108 (figs.).
‖ American Fern. Journ., iii. (1913) pp. 109–16.
¶ American Fern. Journ., iii. (1913) pp. 116–18 (1 pl.).
** Zeitschr. Bot., vi. (1914) pp. 97–156 (1 pl.).

cell. Most of the structures in *Funaria* lie on the side of the inner protoplasmic membrane nearest the cell-sap. Experiments were made to test whether the formations stand in a causative connexion with the movement of the chloroplasts. The conclusions were against this theory, and another is put forward. Other groups of plants were examined.

**Sterile Moss-cultures.***—G. v. Ubisch describes his experiments in the culture of mosses in light and darkness, and compares his results with those of Servettaz on the same subject. His work was principally carried out on *Funaria hygrometrica*. The spores germinated at about the same time on whatever nutritive soil they were sown, in light or darkness, but the resulting protonema varied greatly. Von Ubisch found starch reaction in all cultures; Servettaz failed to find it in his cultures grown in the dark. The various cultures are figured at different stages of growth. Ripe capsules were never obtained. Seven species were germinated in the dark cultures, eight in the light.

**Fresh-water Mosses.**†—C. Warnstorf, W. Mönkemeyer, and V. Schiffner have collaborated in producing Section 14 of A. Pascher's Fresh-water Flora of Germany, Austria, and Switzerland. They are responsible for Sphagnales, Bryales, and Hepaticæ respectively. Only those plants which thrive in fresh water or can tolerate an aquatic life are admitted. The number of species included in the three groups are Sphagnales 48; Bryales 140; Hepaticæ 60. Each genus, species, variety and form is carefully described, and keys are given for facilitating identification. Numerous text-figures are supplied, many of them original.

**Nuclear Division in Preissia.**‡—M. Graham publishes some studies in nuclear division of *Preissia commutata*, describing first the stages observed during mitosis in the vegetable cells, and secondly the nuclear changes during sporogenesis. Numerous figures, highly magnified, are provided.

**New Hyophila from Tripoli.**§—G. Zodda, in giving a list of mosses collected by R. Pampanini in Tripoli, describes *Hyophila Pampaninii*, a new species, and figures the structure of its leaves. Thirty-seven mosses and five hepatics are now known from Tripoli; they are almost all xerophilous; and not a single pleurocarpous moss has been recorded.

**Triquetrella in Europe.**‖—A. Luisier records the discovery near Salamanca of *Triquetrella arapilensis*, a new species of a genus known hitherto only from the Southern hemisphere. He describes and figures the distinguishing characters of the plant, and points out its affinities to *T. papillata*, a species found in Tasmania and New Zealand. He records other novelties for the Iberian Peninsula.

* Ber. Deutsch. Bot. Gesell., xxxi. (1913) pp. 543–52 (figs. in text).
† Die Süsswasser-Flora Deutschlands. Heft 14: Bryophyta. Jena: G. Fischer (1914) 222 pp. (figs.).
‡ Ann. of Bot., xxvii. (1913) pp. 661–79 (2 pls.).
§ Bull. Soc. Bot. Ital., 1913, pp. 174–8 (figs.).
‖ Broteria, Bot., xi. (1913) pp. 135–43.

**New Brachythecium.***—O. E. Jennings describes and figures the structure of *Brachythecium pacificum*, a new species collected by W. Spreadborough on the Queen Charlotte Islands off the north coast of British Columbia. He indicates the characters by which it differs from *B. subasperrimum* Card. & Thér.

**Bryological Notes.**†—V. Schiffner continues his series of notes upon questions of bryology. Inter alia, he describes and figures the gemmæ of *Hydrogonium Ehrenbergii*; records new stations for *Scapania intermedia* in North Bohemia and Ireland; declares that *Jungermannia confervoides* Hampe is not an independent species but the slender small-leaved off-shoots of the leaves of *Plagiochila dichotoma*; records new stations in Hungary for *Riccia Frostii*; and adds remarks on some interesting Swedish hepatics.

**Siberian Bryophyta.**‡—H. W. Arnell, in an account of the bryophyta collected in the valley of the Lena by H. Nilsson-Ehle in 1898, gives descriptions of 15 new species and varieties, illustrated by some figures showing leaf-structure, etc. Altogether 241 mosses, 14 sphagna, and 61 hepatics are enumerated.

**Mosses of East and South Africa.**§—V. F. Brotherus, in an account of the moss-collections made by J. Brunnthaler in German East Africa and in Cape Colony, Natal, and Rhodesia, publishes descriptions of 14 new species. In all 92 species were collected, and these belong to 61 genera.

## Thallophyta.

### Algæ.

(By Mrs. E. S. Gepp.)

**Plankton of the Adriatic.**‖—J. Schiller gives a preliminary report on the Coccolithophoridæ collected by S.M.S. 'Najade' in the Adriatic in 1911–12. After describing the new genera and species, he deals with the biological aspect and summarizes shortly his results. No region of the Adriatic was found to be devoid of these organisms. The littoral forms were more numerous than the pelagic, the proportion being five to two. They resemble the diatoms in being purely surface forms, reaching their maximum development in 2–5 metres depth and in some cases to 20 metres. The author attributes this to a strong need of light. Finally, he states that the Coccolithophoridæ reach their maximum in summer, at a time when net-phytoplankton is very poor, and thus provide compensation in the food supply.

The same author¶ gives a preliminary report of the Flagellates and

* Bryologist, xvi. (1913) pp. 95–6.
† Oesterr. Bot. Zeitschr., lxiii. (1913) pp. 453–6 (figs.).
‡ Archiv f. Botanik., xiii. No. 2 (1913) 94 pp. (3 pls.).
§ Denkschr. Math.-Nat. k. Akad. wiss. Wien, lxxxviii. (1913) pp. 734–43.
‖ SB. k. Akad. wiss. Wien, cxxii., (1913) pp. 597–617 (3 pls.).
¶ SB. k. Akad. wiss. Wien, cxxii. (1913) pp. 621–30 (1 pl.).

Chlorophyceæ collected on the same expedition. One new genus and nine new species of known genera are described. These groups also reach their highest development in the summer months. The influence of the fresh water, especially that of the Po, is very marked. The vertical distribution attains its maximum in May in 20 metres depth with about 29,000 cells; in August, in 50 metres with about 62,000 cells. Light, and perhaps also salinity, are probably the controlling factors. Finally, the author states that the rich supply of Flagellate- and Chlorophyceæ-plankton in the Adriatic plays an important part in the production of organic substances by the assimilation of $CO_2$.

**Metachromatic Bodies in Algæ.***—Madame Moreau writes on the metachromatic bodies of algæ. She has examined Diatoms, Conferveæ, *Ulothrix*, Vaucherieæ, Desmids, and Conjugatæ, and states that the "Karyoiden" of Palla in Desmidieæ and Conjugatæ are identical with these metachromatic bodies. She holds the same views as Guilliermond and Foëx that they are reserve material, and finds that relations exist between them and the organs which produce reserve material in algæ.

**Diatom Structure.**†—T. A. O'Donohoe writes on the structure of *Coscinodiscus asteromphalus*, and of *Pleurosigma angulatum* and *P. balticum*. He discusses the views of T. F. Smith, with which he disagrees. As regards the most correct image of *C. asteromphalus* in photography, whether "black dot" or "white dot," he is of opinion that the black dot is the more correct. The chief difference in the minute structure of *Pleurosigma balticum* and *P. angulatum* is that in the former the fibrils run parallel with the raphe: in the latter they seem to run obliquely.

**Two Plankton-diatoms.**‡—K. Rouppert records *Chætoceros Zachariasi* in an old bed of the Weichsel in Slonsk, and is able to complete the diagnosis by measurements. He shows that Honigmann was in error with regard to the "chromatophores," which are in reality resting spores with a clearly silicified thick membrane. The author considers that Honigmann's five species belong to one very variable species. He discusses its occurrence in salt inland waters, and distinguishes between a "hyphalmyro-plankton" of the brackish waters of the sea-coast and another of the salt inland waters. The connexion of the former with pelagic forms is clear, while the occurrence of *C. Zachariasi* and *Attheya Zachariasi* in the latter is more difficult to explain. The author shows that *A. Zachariasi* is identical with *Anthoceras magdeburgense*. He agrees with A. Forti in uniting *Chætoceros*, *Peragallia*, *Atheya*, and *Rhizosolenia* in one group.

**Bohemian Diatoms.**§—K. Hoffmann writes on the diatoms of the Kieselgur and of the waste water of the Kaiserquelle in the Soos, in

* Bull. Soc. Bot. de France, lx. (1913) pp. 123–6.
† Journ. Quekett Micr. Club, xii. (1913) pp. 155–60 (1 pl.).
‡ Bull. Intern Acad. Sci. Cracovie (June 1913) pp. 298–306 (3 pls.).
§ 8 Jahresb. Staatsrealsch. im 8 Wiener Gemeindebez. Wien, 1913, pp. 3–17 (1 pl.). See also Bot. Centralbl., cxxiii. (1913) p. 617.

North west Bohemia. The region is described in detail. Diatoms described by Ehrenberg, Grunow and Biber as fossil forms, are found living in the waste water of the Kaiserquelle. Most of them are typical brackish-water species. In the Kieselgur the predominant species are *Campylodiscus clypeus*, *Ammoeoneis sphærophora*, *Navicula hungarica*, *Nitzschia spectabilis*, and *Melosira crenulata*. In the drainage ditches of the Kaiserquelle the predominant species are *Synedra pulchella*, *S. affinis*. *Amphora coffeæformis*, *Navicula hungarica*, and species of *Nitzschia*. Strata of different age occur in the Kieselgur. The Bacillarieæ of the Neusiedlersee agree closely with those of the Soos, according to Pantocsek.

**Algæ of Thermal Waters.***—J. L. Lacsny records 112 species of algæ from the thermal waters at Nagyvarad. Among them is a new variety, *striata*, of *Nitzschia lamprocarpa*. Only thirty-five species had been previously recorded. The paper is in Hungarian.

**Bacillarieæ from Hungarian Strata.**†—J. Pantocsek gives an account of sixty species and varieties of diatoms found in a grey soft light stratum at Kopacsel in Hungary. Many of them are novelties. The stratum was evidently laid down in brackish water.

**Fossil Diatoms.**‡—J. Pantocsek publishes a list of fifty-nine species and varieties of diatoms from the Klebschiefer of Lutilla in Hungary. The stratum was laid down in fresh-water, 25–30 C., in neolithic times. New species and varieties are described. The paper is published in the Magyar language, apparently as a separate publication, but a German abstract appears in Hedwigia.

**Italian Fossil Diatoms.**§—A. Forti publishes another number of his Diatomological contributions, in which he gives the diagnosis, accompanied by critical notes, of the many new species, varieties and forms of which he has written during the last few years. These writings have been scattered in various periodicals The material here described and figured is from the middle Miocene in Piedmont, Emilia, and Girgenti in Sicily.

**Nuclear Division in Tetraspora lubrica.**‖—F. McAllister gives a résumé of accounts that have been published of mitosis in *Spirogyra* and various low Algæ and Flagellatæ, and describes his own investigations of the nuclear structure and mitosis in *Tetraspora lubrica*. He finds it to be essentially the same as in other Chlorophyceæ, and gives the following summary. The nucleus of *Tetraspora* in the resting condition has a chromatic reticulum, net knots and nucleolus distributed in the same manner as in the higher plants. A definite spireme is formed from the reticulum ; and its segments form about thirteen chromosomes. The

* Bot. Közlemenyek, xi. (1912) pp. 167–85.
† Bot. Kozlemenyek, xii. (1913) pp. 126–37 (2 pls.).
‡ A lutillai ragp. elöford. Bacill. vagy Kovamoszatok leirasa. Pozsony (1913) 19 pp. (2 pls.). See also Hedwigia, liv. (1914) Belbl., p. 139.
§ Atti R. Ist. Veneto Sci. Lett. Art., lxxii. (1912–13) pp. 1535–1700 (19 pls.)
‖ Ann. of Bot., xxvii. (1913) pp. 681–96 (1 pl.).

nucleolus shows no signs of disintegration until the increase in chromatic material has come to an end. Centrosomes are not to be identified at any stage of the nuclear division. Cell-division is accomplished by the splitting of a granular cell-plate, which has been formed by the central spindle. The splitting takes place from the centre outward. The entire pyrenoid is segmented to form several starch-bodies. No differentiated central area is present.

**Oocytis.***—H. Printz publishes a systematic synopsis of the genus *Oocystis*. He describes the species fully, taking not only form and size but also cell-contents into account. Fourteen species are fully known, and diagnoses of another thirteen are incomplete. They probably represent, however, good species. Nine species are doubtful and probably worthless. The author discusses generally the cells, membrane, chromatophores, and reproduction.

**Notes on Microscopic Algæ.**†—N. Wille continues his algological notes : XXII–XXIV. In the first of these he clears up doubtful points in certain genera of Algæ by reference to the Agardh herbarium. The genus *Gloiodictyon* was regarded as a "genus dubium" by Kützing, ignored by Rabenhorst and revived by De Toni, who adds other species. An examination of the type *G. Blyttii* Ag. shows that the alga is a *Zygnema* sp. ; and the genus must therefore be dropped. *Trypothallus* should perhaps be placed near *Prasiola*. *Hæmatococcus Noltii* Ag. is *Euglena sanguinea*, as has been suggested. *Protococcus viridis* Ag. is identical with *Pleurococcus Naegelii* Chod. The genus *Cystococcus* Naeg. must be dropped in favour of *Chlorococcus* Fries. *Protococcus monas* Ag. is merely the young newly-formed autospores of *Chlorella ellipsoidea* Gern. *Protococcus glomeratus* Ag. must disappear as a name, since the type material consists of a mixture of species. The unpublished species *P. salicis* Ag. and *Apiocystis Wilsoni* Ag. resembles respectively *Trentepohlia umbrina* Born. and *Isthmia membranacea* Cl. In note XXIII the author gives further details of his *Ulothrix subflaccida*. He records gametangia and gametæ, and notes that the copulating gametæ are fairly similar in size. In note XXIV, a new epiphytic *Lyngbya*, *L. epiphytica*, is described. He calls attention to the fact that he had previously sent a different species under this name growing on *Œdogonium* sp. and *Tolypothrix* sp. to Professor Kirchner, who shortly described it in Engler and Prantl's Pflanzenfamilien.

**Swedish Fresh-water Algæ.**‡—G. R. Cedergren publishes a list of the fresh-water algæ of Sweden, giving a synopsis of the principal algal formations or associations as represented in the neighbourhood of Upsala. The commonest type is the pond formation, divided into groups according to external conditions, intensity of light, impurity of water, etc. Another type is from ponds with clear spring water, which is very similar to that from flowing and moving water, both being designated as philokinetic. Sphagnophil algæ, rain-water or ombrophil algæ, rock-wall or

* Nyt Mag. Naturvidensk, li. (1913) pp. 165–203 (3 pls.).
† Nyt Mag. Naturvidensk, li. (1913) pp. 1–26 (1 pl.).
‡ Arkiv f. Botanik, xiii., No 4 (1913) 43 pp. (figs. in text).

staktophil and aerophil formation, are described. The list contains 185 species and 34 varieties, of which 3 species and 12 varieties are new to Sweden.

**Egyptian Fresh-water Algæ.***—J. Brunnthaler gives a short list of fresh-water algæ collected by him during a three-and-a-half months' stay in Cairo and Heliopolis in the spring of 1913. In a short introductory account of previous work on the subject, he gives a résumé of a paper by P. Kaufmann not generally known, having been published in the Revue d'Egypte, not easily accessible. The paper in question deals with the plankton which colours the Nile green in the last week in June every year. Brunnthaler quotes the list of species comprising the plankton with the diagnosis of the new species, *Aphanizomenon Kaufmanni* Schmidle. As regards his own work, his collections were made in the ditches and canals in the neighbourhood of Cairo and Heliopolis. The flora is poor on account of the irregularity in quantity and movement of the water. At the time of stagnation a flora arises, rich in individuals but poor in species. A rich flora is also prevented by the quantity of detritus, mud, etc., which come down with the water. Sixty-three species are recorded, of which one is new, *Characiopsis ægypticum.*

**New Spirogyra.**†—S. Langer describes a new species of *Spirogyra*, *S. proavita*, which is remarkable for its method of copulation. The two cells which are prepared to copulate each push out a prolongation, and when these prolongations have reached a certain length they curl over each other and unite, whereby hook-shaped canals are formed, such as are described by Wood and Haberlandt. In that case, however, the canals occurred as a rare and abnormal phenomenon. In *S. proavita* it is a constant growth. The number of the spirals and the absence of swelling of the fertile cells are distinguishing features of this species. It is in some particulars allied to *S. insignis* Kütz. and *S. Hassallii* Petit. The author regards the hook-shaped canals as an interesting link connecting the section Salmacis with Conjugatæ.

**Spirogyra tjibodensis.**‡—F. C. von Faber describes a new species of *Spirogyra*, which is distinguished by the wrinkled cross-walls, the apparent lack of gelatinous sheath, and the habit of the cells to spring apart. The author investigated specially this latter peculiarity and found that the cells became so turgid in consequence of active assimilation that they burst the cuticle and fell apart. The membrane of these free cells then became stretched, turgidly decreased, and in certain cells the protoplasm contracted and spore-formation took place. If the brightly illuminated filaments were cultivated in running water, this splitting did not take place. A peculiar intertwining of the filaments always occurs in brightly lighted filaments before the springing apart of the cells, which points to the beginning of copulation. By experiment it is possible

* Hedwigia, liv. (1914) pp. 219–25 (1 fig.).

† Bot. Közlemenyek, xii. (1913) pp. 166–9. See also Hedwigia, liv. (1913) Beibl., p. 72.

‡ Ann. Jard. Bot. Buitenzorg, xxvi. (1912) pp. 258–65. See also Bot. Centralbl., cxxiii. (1913) p. 502.

so to control the light that normal copulation takes place instead of the springing apart of the cells. Single brightly lighted filaments show no spore formation in the separated cells: they either die or grow into new filaments. The author assumes, therefore, that the mutual influence gained by the intertwining of the filaments is sufficient, and suggests that this may be of a chemical nature. The spores must, therefore, be regarded as parthenospores.

**Siphonales.***—R. Mirande writes an exhaustive treatise on the chemical composition of the membrane of Siphonales and of the "morcellement" of the thallus. His general conclusions are shortly summarized as follows:—

1. As to the chemical composition of the membrane, three different types can be distinguished. (*a*) Membrane formed principally of callose intimately associated with pectic compounds without appreciable trace of cellulose (*Caulerpa*); (*b*) membranes formed principally of callose associated with pectic compounds but with cellulose present in very feeble proportion (*Bryopsis*); (*c*) membrane formed of cellulose associated with pectic compounds with the absence of callose (*Vaucheria*).

2. The "morcellement" of the protoplasmic contents:—(*a*) This phenomenon respects as a rule the continuous structure characteristic of the group, and ends at the "fractionnement" (dismemberment) of the alga into several new individuals; but in certain cases it may resemble, from the physiological point of view, a true "cloisonnement" (partitioning), as in *Codium*; (*b*) from the anatomical point of view it always appears very different from the "cloisonnement" which has been described for plants with uninucleate or plurinucleate cells, and the membranous formations which result therefrom, can in a measure be interpreted as cicatricial productions; (*c*) it is usually accompanied, in the groups of Siphonales, where callose is a fundamental substance of the membrane, by a thickening or "gélification" of the primitive membrane of the mother-plant; this thickening or "gélification" is absent in algæ with a purely celluloso-pectic membrane; (*d*) finally, attention is drawn to the remarkable analogies presented by the mechanism of "morcellement" in the genera *Bryopsis*, *Derbesia*, and *Codium*.

3. From the systematic point of view: The chemical composition of the membrane, although susceptible to slight variations, is none the less a comparable character in its entirety between neighbouring species: this character may prove to be of service in studying the classification of the group.

**Characeæ of Bulgaria.†**—S. Petkoff publishes a list of Characeæ from Bulgaria, which includes twenty-eight forms divided among a half-score or so of species. *C. fœtida* is the most widely distributed species, occurring in twenty-six habitats and being represented by nine different forms. Critical notes of structure and measurements are given.

* Ann. Sci. Nat. Bot., sér. 9, xviii. (1913) pp. 147–64 (figs. in text).
† Nuov. Notar., xxv. (1914) pp. 35–56.

**Growth of Crustaceous Algæ.***—Madame Lemoine publishes a preliminary paper on the growth of marine algæ at Roscoff. She finds that in crustaceous algæ, Melobesieæ, Ralfsiaceæ, and Squamariaceæ, the rate of growth is much slower than in other algæ. In general, it is at the rate of less than 1 cm. a year and often only a few millimetres. Most other marine algæ, on the contrary, grow at least 1 cm. a month, often 2–3 cm. The maximum observed was 5 cm. a month for certain individuals of *Fucus* and *Laminaria*. The author gives details of her experiments and tables of results, with a chart. She considers that two factors influence rate of growth, viz. exterior conditions and substratum.

**Melobesieæ of Ireland.**†—Madame Lemoine reports on the species of Melobesieæ collected by A. D. Cotton at Clare Island and in the neighbouring district. The number of species recorded is fifteen, one of which is new to Ireland. Valuable critical notes are appended to each record, treating of structure, distribution, etc. The author finds that *Lithophyllum agariciforme* is merely a local form (*L. lichenoides* Phil.), and that *Epilithon corticiforme* is a synonym for *E. membranaceum*. Hitherto this latter species has always been found growing on other algæ. In this collection it is growing on a shell of *Trochus*. The paper closes with a comparison of the Melobesieæ of the east and west coasts of Ireland.

**Rhodophyceæ of the 'Sealark.'**‡—A. Weber van Bosse reports on the Rhodophyceæ collected during the 'Sealark' Expedition by Professor J. Stanley Gardiner in the Indian Ocean. A certain number of novelties are described and figured. The critical notes appended to many of the records give important details of structure.

**Sargassum.**§—F. Börgesen writes on the species of *Sargassum* found along the coasts of the Danish West Indies, four in number, and the two floating *Sargassa* found in the Sargasso sea, *S. natans* and *S. hystrix* var. *fluitans*, a new variety. He then discusses the biology, affinities, and origin of the gulf-weed, reviewing previous work and views on the subject. He proves very convincingly that the gulf-weed is a true pelagic alga, that it is a perennial, and lives and dies at sea. As to its origin, he presumes that it has most probably descended from forms living on the shores of the West Indies and neighbouring coast of America, and he discusses the points of similarity between it and *S. vulgare* and *S. Filipendula*. He considers that the amount of organic detritus produced by the pelagic *Sargassum* may be of great importance to the economy of the sea, especially in the tropics where plankton is not very rich.

* Bull. Inst. Océanograph. Monaco, No. 277 (1913) 19 pp.
† Nouv. Arch. Mus Hist. Nat. Paris, sér. 5, v. (1913) pp. 121–45 (figs. in text).
‡ Trans. Linn. Soc. Bot., viii. (1913) pp. 105–42 (3 pls. and 1 fig. in text).
§ Mindeskrift for Japetus Steenstrup. Copenhagen: 1914, No. xxxii., 20 pp. (figs. in text).

**Marine Algæ.***—A. Mazza continues his studies on the structure of marine algæ, and in the present contribution treats of the genus *Grateloupia* (7 species) and of *Halymenia* (9 species).

**Marine Algæ of Vancouver Island.**†—F. S. Collins publishes a flora of the marine algæ of Vancouver, bringing our knowledge as far as possible up to date. Myxophyceæ and Diatomaceæ are not included. Valuable observations are made on geographical distribution. A new species of *Chantransia* is described, *C. Macounii*, and several new varieties of other species. A key to the forms of *Rhodomela* and *Odonthalia* that occur on the Pacific coast is inserted to facilitate identification.

**Japanese Marine Algæ.**‡—K. Okamura publishes a list of the marine algæ of Chosen, numbering 102 species. Among them is a new species *Ecklonia stolonifera*, which he describes and figures both in habit and structure. Interesting facts regarding geographical distribution are brought out.

## Fungi.

(By A. Lorrain Smith, F.L.S.)

**New Genus of Chytridiaceæ.**§—R. Nemec gives an account of the new fungus *Anisomyxa Plantaginis*, which he discovered on the roots of *Plantago lanceolata* on sandy soil near Prague. The fungus was lodged in the growing parts of the root but not in the meristematic cells. The youngest stage was a uninucleate plasma-body in the hypodermal cell of the host; later were to be found multinucleate bodies which filled the interior of the cell. Coalescence between parasites was not seen. Two kinds of sori are formed of small and of larger sporangia, both at first uninucleate, later multinucleate. The contents of the sporangia break up into zoospores. The author describes the cytology of the fungus; nuclear division in the vegetative period differed from that of the generative. A discussion follows as to the cytological relationship between the different genera of the family. He includes Plasmodiophoraceæ in the family.

**New Genus of Saprolegniaceæ.**‖—B. Nemec found the new fungus *Jaraia Salicis* parasitic on the roots of *Salix* sp., his attention having first been called to it in a water culture of *S. purpurea*. He was able to infect *S. amygdalina* and *S. viminalis* with the fungus, but *S. alba* remained immune. It fructifies on the meristematic cells of the root-apex and induces a gall-formation. The zoosporangia are crowded, and small, irregular, and variable in appearance, and formed in rows on the

* Nuov. Notar., xxiv. (1913) pp. 157–74; xxv. (1914) pp. 1–34.

† Canada, Victoria Memorial Museum, Bull. No. 1 (1913) Ottawa, pp. 99–137.

‡ Rep Imp. Bureau Fisheries, Sci. Investigations, ii. (1913) pp. 17–30 (1 pl.).

§ Bull. Internat. Acad. Sci. Bohème (1913) 15 pp. (2 pls and 7 figs.). See also Bot. Centralbl., cxxiii. (1913) pp. 442–3.

‖ Bull. Internat. Acad. Sci. Bohème (1913) 12 pp. (12 figs.). See also Bot. Centralbl., cxxiii. 503–4.

filament. They are provided with several evacuating tubes. Oogonia are less variable and without evacuating tubes; antheridia entirely penetrate the oogonia. There may be more than fifty oospores in one oogonium; they are globose and smooth, and escape by the decay of the enclosing membrane.

**Perennial Mycelium of Phytophthora infestans.***—There has been considerable diversity of opinion as to the persistence of the potato-disease fungus in the tubers, and as to whether the tubers give rise to healthy or infected plants. I. E. Melhus has undertaken cultural experiments to decide these questions. He found that in the large majority of cases the sprouts from infected tubers were also infected by the fungus, and very commonly the fungus fruited. Experiments were also made as regards the stalks and leaves, and Melhus found that though some diseased tubers produced healthy plants others were very seriously infected, and the mycelium spread up to the surface of the soil, where aerial spores were found, which again gave rise to secondary infection.

**Leptostromaceæ.†**—H. Diedicke publishes a critical revision of many of the genera of Nectrioideæ, Excipulaceæ, and Melanconieæ. Several of the genera he finds to be synonyms; in other cases he has extended the descriptions from his own observations. The genera omitted from the survey gave no occasion for criticism.

**Microthyriaceæ.‡**—F. Theiszen publishes a paper containing critical and descriptive notes on various genera and species of this family of Ascomycetes. He records a number of new species and several new genera, *Amazonia*, *Thallochæte*, and *Myxomyriangium*, the latter with brightly coloured minute stromata crowded on a thin olivaceous subiculum. Another new genus, *Hysterostoma*, with 2-celled brown spores, belongs to the Dothidiaceæ.

**Morphology and Physiology of Penicillium.§**—K. Schilbersky has made experimental studies on the coremium growth of *Penicillium* especially in *P. glaucum*. Several species he found were characterized by the tendency to form the compound growth, some of them irregularly and independently of any external influence (*P. luteum* and *P. glaucum*), others more constantly and in all conditions (*P. granulatum* and *P. claviforme*). On sugar, gelatin, etc. *P. Juglandis* always formed coremium growths.

The coremia of *P. glaucum* are formed somewhat rarely: they consist of upright parallel sparingly branched stalks, with the spores produced at the summit. Schilbersky found these coremia most frequently on pears not yet fully ripened; on apples and soft pears they appeared very rarely, but a good growth was obtained on the skin of lemons. He con-

* Centralbl. Bakt., xxxix. (1913) pp. 482–8.
† Ann. Mycol., xi. (1913) pp. 528–45.
‡ Ann. Mycol., xi. (1913) pp. 493–511 (1 pl. and 7 figs.).
§ Math. Naturw. Ber. Ungarn, xxvii. (1913) pp. 118–30 (2 figs.).

cludes that the presence of acid is favourable to their production. Comparative notes are given as to the size of the mycelium spores, etc.

**Notes on Puccinia malvacearum.***—W. Robinson has examined the connexion between this fungus and the host-plant. He finds that from the germ-tube is formed an infection vesicle which gives rise to branches. These grow out into the intercellular spaces; strands of hyphæ pass to the vesicular bundles of the host and haustoria penetrate the phloem parenchyma. The hyphæ in the cell lie within the protoplasm and grow towards the nucleus; they were not observed to enter the vacuole, and the cell is not killed for some time.

**Rusts on Hybrid Plants.**†—Guinier has reported an instance of the effects of hybridism. In the neighbourhood of Annecy he found that while *Sorbus torminalis* was immune from the rust *Gymnosporangium tremelloides*, *Sorbus Aria* was covered with æcidia and spermogonia. The hybrid form of these two trees presented a few indistinct spots, partly sterile, partly covered with spermogonia, more rarely with æcidia. The peridium of the latter are rudimentary, and while some of the spores were normal, others were irregularly formed.

**Mycelial Formation in Ustilago Jensenii.**‡—E. Hils notes that the smut spore of this fungus on germination produces usually a three-celled promycelium which both at the septa and tips buds off conidia. These conidia in water or culture solution give a vigorous yeast formation. In the host-plant the mycelium does not produce conidia, and Hils has sought to determine the factors that influence these different growths. He found that the formation of mycelium was furthered by a high percentage of oxygen and an alkaline reaction of the culture medium, and that an abundant and vigorous hyphal growth only occurs when the atmosphere is rich in oxygen. In other fungi a super-abundance of oxygen is favourable to spore-formation; in *Ustilago Jensenii* the opposite occurs. Hils further states that in the living host cells, especially towards the apex of the stalks where the mycelium of the parasite is most active, the presence of oxygen in large quantities has been verified; and in these cells there must be a very slight acid reaction. In older parts of the plants the mycelium dies off owing to the reaction of its own products.

**Synopsis of the Genera Cladoderris and Stereum.**§—C. G. Lloyd gives notes, descriptions and figures of *Cladoderris*, a genus of fungi very frequent in tropical America, which differs from *Stereum* in having a ribbed and generally papillate hymenium, and mostly a thick dense tomentum layer on the pileus. Most of the specimens are stalked and fan-shaped. Lloyd recognizes five good species.

* Mem. Proc. Manchester Lit. Phil. Soc., lvii. 3, No. 11 (1913) p. 22 (1 pl.). See also Bot. Centralbl., cxxv. (1914) p. 114.

† C.R. Soc. Biol. Paris, lxxiv. (1913) pp. 648–9. See also Bot. Centralbl. cxxv. (1914) p. 11.

‡ Diss. Tubin. (1912) 42 pp. See also Bot. Centralbl., cxxv. (1914) pp. 84–5.

§ Lloyd, Cincinnati, Ohio (1913) xii and 46 pp. (figs.).

With regard to *Stereum* he gives only the stipitate forms. He does not recognize the presence or absence of cystidia as generic characters, hence the genus *Hymenochæte*, based on the presence of cystidia, is sunk and *H. damæcorne* becomes *Stereum damæcorne*. Most of the species of foreign *Stereums* have hymenial hairs of some sort. *Thelephora* is separated from *Stereum* on account of the coloured spores and dark hymenium of the former.

**White Ants and Fungi.***—T. Petch has examined the evidence for associating the fungus *Entoloma microcarpum* with the growths found in termite nests. The small spheres of mycelium develop into a fungus called by Berkeley *Ægerita Duthiei*, but it was not possible to grow the *Entoloma* directly from the spheres. Once and again, however, Petch found *Entoloma* on the mycelial patches, but as it grows normally in bare soil, it may only have selected the nests as a suitable habitat. The question, he considers, requires still further investigation.

**Fungus Teratology.**†—G. Moesz, in writing on this subject, divides his paper into anomalies (1) of mycelium, (2) of fruiting bodies, (3) of stromata, (4) of asci, (5) of spores and conidia, and (6) of basidia and sterigmata. Under the first heading he places the pseudo-copulation of hyphæ in *Penicillium crustaceum*. In treating of the fruiting bodies he discusses the irregular growths found in a number of Agarics, irregularity of the opening in *Tylostoma*, etc., and abnormal colours. He finds abnormal stromata in *Cordyceps capitata*, abnormal asci in *Dermatea carpinea*, and abnormal spores in many Uredineæ. Sterigmata show unusual development in *Puccinia silvatica*.

It is not always possible to assign the causes of these anomalous growths in fungi. Experimental study of the subject is much needed.

**Influence of Metals on the Development of Aspergillus niger.**‡ M. Bornand, as a result of cultures with the fungus, found that it would not grow well on Raulin solution when that was contained in a silver capsule. The development was hindered, and though spore-formation was reached, the growth was not normal. Attempts were made by chemical analysis to determine the presence of silver in the solution, but without success. Other chemical observations were also made, and the results tabulated.

**Toxin of Rhizopus nigricans.**§—A. F. Blakeslee and Rose Aiken Gortner found that the expressed sap of the above fungus caused almost instant death when injected into rabbits. Several other species of the Mucorineæ were tested, but no such result has yet been obtained. The toxin is present in large quantities in the fungus. The activity of the poison is not diminished by peptic digestion for three hours, nor is it affected when its aqueous solution is heated to boiling for 10 minutes.

* Ann. Roy. Bot. Gard. Peradeniya, v. (1913) pp. 389–93.
† Bot. Kozl. xi. (1912) pp. 105–15 (8 figs.). See also Hedwigia, liv. (1913) p. 75.
‡ Centralbl. Bakt., xxxix. (1913) pp. 488–96 (4 figs.).
§ Biochemical Bull., ii. (1913) pp. 542–4.

As the fungus is extremely common on all bread stuffs, the authors suggest that it may have some connexion with such diseases as pellagra, "corn-stalk disease" and "horse disease," the causes of which are not yet definitely known.

**Cytology of the Plasmodiophoraceæ.***—O. Winge publishes a long paper on this subject, taking in order the following forms: *Plasmodiophora Brassicæ*, *Sorosphæra Veronicæ*, *Ligniera Junci*, *L. graminis*, *Sorodiscus Callitrichis* g. et sp. n., *Spongospora subterranea*, *Tetramyx parasitica*, *Chrysophlyctis endobiotica*, *Asterocystis radicis*, *Rhizomyxa hypogæa*, *Woronina polycistis*, *Pyrrhosorus marinus*, and *Sorolpidium Betæ*. For each of these he gives not only his own observations but the facts as ascertained by other workers. Special attention is given to the new genus *Sorodiscus* which forms small round tumours on the stems of *Callitriche vernalis*. In the vegetative state it consists of multinucleate myxamœbæ, mostly several in each herb-cell: these divide up into uninucleate spores.

**Buteshire Microfungi.**†—D. A. Boyd finds that the varied physical features of Buteshire afford conditions exceptionally favourable to the development of the lower orders of Cryptogamia. The list of fungi has been compiled from observations made by various Naturalist Societies, but as the forms are minute and little conspicuous there are doubtless many not yet recorded. The host-plant is given in the case of parasitic fungi, and the locality where they have been found.

**Fungi which cause Plant Disease.**‡—F. L. Stevens' book on this subject is a compendium of all the fungi hitherto recorded as being the cause of injury to plants, with special reference to those found in America. "It is intended to introduce to the student the more important cryptogamic parasites affecting economic plants in the United States."

Stevens gives in the introductory chapters a general account of fungi, their means of propagation, etc., and then goes on to describe the familar genera and species that are inimical to other plants in due order. These form a large percentage of the whole. Synoptic keys are provided of families and genera, and the species are more or less fully described. In the case of those with a complicated life-history, such as the Uredineæ and the Fungi imperfecti, the forms are referred when possible to the perfect stage. The illustrations are abundant and instructive, and copious bibliographies, glossary, and index are provided.

**Diseases of Tropical Plants.**§—M. T. Cook has published a book on this subject, with a view of aiding planters in warm countries to

* Ark. Bot., xii. No. 9 (1913) 39 pp. (3 pls.).
† Trans. Buteshire Nat. Hist. Soc., vi. (1913) pp. 78–89.
‡ The Fungi which cause Plant Disease, by F. L. Stevens, Ph.D. New York: The Macmillan Co. (1913) ix and 754 pp. (449 figs.).
§ The Diseases of Tropical Plants, by M. F. Cook, Ph.D. London: Macmillan and Co. (1913) xix and 317 pp. (85 figs.).

recognize and combat fungal and other pests. He devotes the first part of the book to a general discussion of plant life as regards the host, and an account of the parasites by which they are liable to be attacked. He then describes the life-history of various fungi, with a general classification of the group, always confining his attention to such forms as may be met with in the tropics.

In the second part of the book he takes the host-plants in order and then describes the diseases to which each is subject. Fungi are mainly the exciting causes, though some attention is also given to other agents such as insects, worms, physiological conditions, etc. The final chapters are devoted to an account of the best method of prevention and cure, to fungicides, spraying apparatus, etc. A bibliography and index are provided. The book is well illustrated.

**Fungi occurring in Potato Plants.***—A large number of fungi have been described associated as diseases or otherwise with the potato. F. Krause has reviewed the literature concerned with these organisms to determine which of them are originators of disease and which of them are saprophytes. He finds that fungal hyphæ are present in the tissues of sound as well as of diseased plants, as has been likewise determined in various wild plants, *Borago officinalis*, *Solanum Dulcamara*, etc. He does not think that the presence of fungi in leaf-roll disease proves that these fungi are the cause of it, as the fungi appear only late in the year, whereas the leaf-roll occurs during the summer. The fungi present he considers to be only weak or "room" parasites.

Krause gives a list of the fungi obtained by artificial culture from such diseased potato plants, but he was unable by infection with the fungi to reintroduce the disease.

**Snap-beech Disease.**†—E. M. Prior has investigated a disease of beech-trees, first noticed at Great Missenden, and later found to be prevalent in the beech woods at Tring. The trunks of affected trees snap off at a more or less constant height of 15 to 20 feet from the ground at a diseased area, the base and the upper parts of the trunk being sound.

Investigation showed that the fungus *Polyporus adustus* was present on the diseased part of the tree, and infection experiments by means of mycelium placed on the bared sapwood of the living beech-stem gave positive results and confirmed the view that the trouble was due solely to the fungus.

The writer is of opinion that the fungus enters through a wound, and that the mycelium then spreads rapidly in a longitudinal direction, but more slowly in a transverse direction. The cortex and bark are reduced to a powdery white mass, and the woody elements destroyed in time. The hyphæ enter the cells by means of the pits, and the cell-walls are attacked from the inside. The lignified membrane is reduced

* Mitt. k. Wilh. Inst. Landw. Bromberg, v. 2 (1912) pp. 143–70. See also Bot. Centralbl., cxxv. (1914) pp. 112–14.

† Journ. Econ. Biol., viii. (1913) pp. 229–63 (2 pls.).

to cellulose, which then dissolves away. The mycelium was examined for enzymes, and was found to contain diastase, invertase, tyrosinase, and emulsin. Cultures were made on blocks of wood, on gelatin, agar, etc., but though the mycelium grew freely no fructifications were formed. Hyphæ in hanging-drop cultures broke up into oidia.

**Diseases of Plants.**—Samples of wheat-grain sent to Kew* for examination were found to germinate badly owing to the presence of the fungus *Cladosporium graminum*, otherwise known as *Scolecotrichum graminum*, and long recognized as a disease of cereals. It occurs on the leaves, leaf-sheaths and ears, but except in the latter case does little injury. In some cases, that is, when the ear is attacked at an early stage, it is arrested in growth and becomes blackened. Occasionally only the chaff is affected. When the seed failed to germinate it was found that the embryo was permeated with the mycelium of the fungus which had been dormant in the pericarp of the grain. The fungus forms minute sclerotia which function as a resting-stage. They remain in a passive condition during winter and germinate in spring, forming first minute secondary conidia in chains. These conidia infect the green plant.

Chestnut-blight † disease due to the fungus *Endothia parasitica* has been very serious in America in recent years, and efforts have been made to trace the origin of the fungus which appeared rather suddenly and spread with great rapidity. C. L. Shear and Neil E. Stevens consider that they have got sufficient proof that it came from China. They have received from Meyer specimens of diseased trees from the Chili province in that country which agrees in its diagnostic characters with the American form. Cultures of the fungus from China and from America were made on corn-meal and potato-agar, and the resulting growths were identical in every respect. Further information and photographs will be published later.

The same authors ‡ have published elaborate descriptions of cultures of *Endothia radicalis* (the European fungus) and of *E. parasitica* the American disease. They found that in pure cultures they possess constant and easily recognized characters on various media of which potato agar and corn-meal are the best. The most distinguishing character of *E. parasitica* is the peculiar granular glistening light orange-coloured surface growth produced at the bottom of potato-agar cultures. The orange colour of the mycelium appears in three or four days.

A discussion § on the occurrence of *Hemileia vastatrix* in Africa is published. The writer considers that the history of the fungus there supports the view that it is endemic and not introduced. It occurs on "wild" or indigenous coffee as well as on cultivated plants. *H. vastatrix* is the only species of the genus known to attack coffee plants.

* Journ. Board of Agric., xx. (1914) pp. 894–6 (1 pl.).
† Science, xxxviii. (1913) pp. 295–7.
‡ Bur. Plant Ind., Circular No. 31 (1913) 18 pp.
§ Kew Bull., No. 5 (1913) pp. 168–71. See also Bot. Centralbl., cxxv. (1914) p. 115.

## Lichens.

(By A. Lorrain Smith, F.L.S.)

**Verrucariæ of Central Europe.***—Hermann Zschacke has begun a study of this group of lichens, and he takes first the genus *Staurothele*, in which green algal cells are enclosed in the hymenium. He makes use of the form of these cells in his classification of the different species. The thallus is crustaceous and superficial or entirely immersed in the rock, and the perithecia are also superficial or immersed. Other means of dividing species are afforded by the number of spores in the ascus; there are either 1 or 2 (*Oligosporæ*), or there are 4–8 (*Pleiosporæ*). Zschacke has worked on herbarium material to a large extent.

## Mycetozoa.

(By A. Lorrain Smith, F.L.S.)

**Myxomycetes from the Jura Mountains.**†—Ch. Meylan reports fifty-one species and varieties from the Jura, with various critical remarks. He was able to follow the development of *Colloderma oculatum* from plasmodium to sporangium. The plasmodium is a small colourless jelly-like mass which takes a spherical form. In the centre there appears a darker part which eventually becomes the round dark sporangium. Several new species and varieties are described.

## Schizophyta.

### Schizomycetes.

**Streptococcus-pneumococcus Transmutations.**‡—E. C. Rosenow, by means of inoculations into animals, growth in symbiosis with other organisms, cultivation under high oxygen pressure and upon hypertonic and hypotonic media, and treatment with filtrates from ascites broth, has brought about mutual transmutation between three types of organism, *Streptococcus hæmolyticus*, *Streptococcus viridans*, and pneumococcus. Twenty-one strains originally isolated as hæmolytic streptococci have, in one way or another, been converted into *S. viridans*, three into *S. viridans* and pneumococci, and one into *S. mucosus*. Seventeen original *S. viridans* cultures have been changed into pneumococci and three also into *S. mucosus*, ten have been converted into hæmolytic streptococci, eleven pneumococci have been converted into hæmolytic streptococci, seven into *S. viridans*; the streptococci from three of these strains by animal passage acquired all the characters of the rheumatic streptococcus, *S. viridans*, and back into pneumococci. Whenever mutation was observed, cultures of each main variety were obtained from single organisms by the Barber method.

* Hedwigia, liv. (1913) pp. 183–98 (1 pl.).

† Ann. Conserv. Jard. Bot. Genève, xv.–xvi. (1913) pp. 309–21. See also Bot. Centralbl., cxxiv. (1913) pp. 545–6.

‡ Journ. Infect. Diseases, xiv. (1914) pp. 1–32.

**Etiology of Acute Rheumatism.***—E. C. Rosenow has carried out an investigation of organisms obtained from the fluid of rheumatic joints. The fluid was aspirated from the joint under the strictest aseptic conditions, and inoculated into broth, dextrose broth (with or without ascitic fluid), blood-agar slopes (aerobic and anaerobic) and into ascites dextrose-agar stabs. In the latter medium, colonies of cocci made their appearance after incubation at 37° C. Three types of cocci were obtained. In five cases, long chains of diplococci larger and more uniform than *S. viridans* appeared; in six cases, short chains and diplococci possessing marked hæmolytic properties were found; while three cases showed greyish, non-hæmolytic colonies of micrococci. All three types showed little virulence. They seemed to be associated with different types of rheumatic lesion. The three are closely allied, and by appropriate means, mutation can be brought about.

**Indol Production of the Colon-typhoid Group.**†—I. J. Kligler compares the Ehrlich and the Salkowski methods of performing the indol test. They find that the former (paradimethylaminobenzaldehyde and hydrochloric acid) is constant and more reliable than the latter (sulphuric acid and potassium nitrite). The test should be made on the fourth to sixth day, and the tubes should be shaken up with chloroform, which dissolves the red colour, as a confirmatory test. The Salkowski test may give a red coloration with a substance which is not indol. With the Ehrlich test, *B. coli* is generally positive, *B. aerogenes* and *B. proteus* variable, and *B. cloacæ* and *B. paratyphi* always negative.

**Agglutinins for Micrococcus melitensis in London Milk.**‡—J. C. Kennedy has found that *Micrococcus melitensis* is agglutinated in high dilution by the milk and the serum of certain cows in the London district. Of thirteen samples of mixed milk from thirteen different dairies, five gave positive, one an incomplete, and seven negative reactions. The milk of three out of twenty-two cows gave complete positive reactions, one was indefinite, and the remainder were completely negative. The serum of two out of these three positive cows showed a high agglutinating titre for *M. melitensis*. Attempts to obtain the organism from the milk by plating were unsuccessful. These observations do not necessarily show that London cows are infected with undulant fever. The results obtained may be due to some other cause.

**Inagglutinable Typhoid Bacilli.**§—J. McIntosh and J. McQueen have investigated the properties of a strain of typhoid bacilli isolated from a case of enteric fever. The patient's serum agglutinated a stock typhoid suspension, but had no effect upon his own organism; nor could this organism be agglutinated by a laboratory serum. Culturally and morphologically it was identical with typhoid. This organism was then injected into rabbits, and a specific agglutinating serum for

* Journ. Infect. Diseases, xiv. (1914) pp. 61–80.
† Journ. Infect. Diseases, xiv. (1914) pp. 81–6.
‡ Journ. Roy. Army Med. Corps, xxii. (1914) pp. 9–14.
§ Journ. Hygiene, xiii. (1914) pp. 409–21.

*B. typhosus* was produced. The serum also contained group agglutinins for other members of the colon-typhoid group, but had no power of agglutinating the original bacillus. This organism, however, absorbs specific and group agglutinins from homologous and heterologous antisera to the same extent as a normal typhoid bacillus. Chemical agglutinants act similarly on both strains, though the reaction is slightly delayed in the case of the inagglutinable strain. The inagglutinable bacillus probably owes its peculiarity to some alteration of a physical character rather than to immuno-chemical changes.

**Kurloff Bodies.***—R. Knowles and H. W. Acton discuss the nature of these structures, which are found in the large mononuclear leucocytes of the normal guinea-pig. They refer briefly to the observations of Ehrlich and Lazarus and of Ledingham, who described their minute structure; of Schilling, who classes them with the chlamydozoa; and of Ross, who describes a complicated life-history with a free-swimming spirochætal stage. The authors conclude that no reliance can be placed upon the appearances presented by fixed films. No trace of a developmental cycle could be detected in Kurloff bodies stained with a dahlia solution and examined on a warm stage. They regard these bodies as vesicular structures of cytoplasmic origin, and refuse to accept the view that they are parasites.

**Brownian Movement of Bacterial Spores.**†—J. H. Shaxby and E. Emrys-Roberts in this communication give the first instalment of a series of studies upon the phenomenon of Brownian movement. The paper begins with a review of the work of Wiener, Einstein, and others, from which it appears that the persistent and irregular movement of small particles suspended in a fluid is independent of such conditions as vibration, intensity of illumination, and convection currents, but depends only upon the size of the particles and the temperature and viscosity of the fluid in which they are suspended. Einstein's formulæ expressing the physical laws governing the phenomena under varying conditions are quoted. The observations of the present authors were carried out upon drops hanging from cover-slips, resting upon slides or enclosed between glass surfaces. It was found that spores (of *B. anthracis*, *B. subtilis*, and other organisms) showed no Brownian movement. This immobility was shown to be independent of temperature and to be present in suspensions in water, saline solutions, formol solutions, and glycerin solutions. It was observed with living and dead spores. Acids had no effect, but treatment with antiformin inhibited the immobility, so that Brownian movement comparable with that of ordinary particles was observed. Further study showed that spores came to rest at the air-water interface, showing no movement even in the plane of the interface; they appear to lie in a veritable skin at the surface of the drop. Brownian movement can only be restored (*a*) by destruction of the interface by violent stirring, or by converting the

* Indian Journ. Med. Research, i. (1913) pp. 206-11.
† Proc. Roy. Soc., Series A, lxxxix. (1914) pp 544–54.

hanging drop into an enclosed drop, and (*b*) by altering the surface of the spore by means of corrosives.

Hanging drop preparations of particles, of approximately equal size, of carbon, mastic, sulphur, barium sulphate, *Staphylococcus aureus*, etc., were not affected by the air-water interface, and remained in free Brownian movement to the bottom of the drop. Two factors may be regarded as entering into the phenomenon of the immobility of bacterial spores at fluid interfaces: (1) a diminution of surface energy due to some peculiarity of the spores, causing them, as soon as they are brought within the range of action of the surface forces, to be drawn into close approximation to the interface; and (2) the abnormal viscosity of surface layers of liquids, which destroys the Brownian movement of the spores. Particles other than spores, not producing a lowering of surface energy, are not drawn into such close contact with the interface, and so do not experience the surface viscosity. There is at present no evidence of an electrical factor in the phenomenon, but further work on this point is in progress.

**Identification and Classification of Cellulose-dissolving Bacteria.*** K. F. Kellerman, I. G. McBeth, F. M. Scales, and N. R. Smith have carried out investigations upon these organisms, and find that they have a wide distribution. Fifty soils from different parts of the United States were examined, and in each case two or three types of cellulose-dissolving organisms were found. In this paper there is given a detailed account of the morphological, cultural, and bio-chemical properties of twenty-one different types. At the end of the paper the chief characteristics of these bacteria are tabulated. The most satisfactory method of isolating these organisms was found to be the following: a portion of the sample of soil or other material was added to a filter-paper nutrient solution, and after a few transfers in this medium was plated successively on cellulose-agar, starch-agar, and finally beef-agar. Many of these types grow better on peptone-media than on media containing inorganic nitrogen, in the form of ammonium sulphate. Most of them grow better and show greater activity under aerobic than under anaerobic conditions. Kept under laboratory conditions for any length of time they undergo marked physiological change, and may lose their power of destroying cellulose.

**Bacilluria in Typhoid Fever.**†—A. Patrick reports upon the results of bacteriological investigation of the urine in twenty-four cases of typhoid fever. In six cases no typhoid bacilli were found, but organisms of the typhoid-coli group not hitherto described. In none of the seventeen cases in men was the *B. coli* recovered, although nearly all the women showed it. The atypical organisms reacted in varying manner with sugar-fermentation tests, but had certain features in common. They were all Gram-negative, all formed acid in glucose, and acid and gas in maltose, mannite, saccharose, galactose, levulose, rham-

* Centralbl. Bakt., 2te Abt., xxxix. (1914) pp. 502–22.
† Journ. Path. and Bact., xviii. (1914) pp. 365–78.

nose, glycerin, and inulin. All six strains failed to ferment erythrite, adonite, dulcite, and dextrin: none liquefied gelatin, and Vosges and Proskauer's reaction was negative in each case.

New Fœtid Coccobacillus.*—R. S. Williams and W. R. Wade isolated from a case of suppurative fœtid arthritis a coccobacillus which has the following characters. It is motionless, polymorphic, does not stain by Gram's method, does not form spores, has no capsule, and is a strict aerobe. It grows well on the usual media, the colonies at first transparent become yellowish after the second day. Broth is rendered turbid and gelatin is slowly liquefied. Milk is coagulated but no indol is produced. It ferments glucose, galactose, and arabinose without production of gas. Its action on other sugars is nil. It is non-proteolytic, and when cultivated on nasgar, agar, or in broth, a fœtid odour is exhaled. It is pathogenic to mice, guinea-pigs, and rabbits. The differential diagnosis from other fœtid bacteria is given.

Bacterial Treatment of Peat.†—W. B. Bottomley describes the methods of treating peat, and the beneficial effects of bacterized peat as a dressing. After alluding to the failures, the author remarks that it was by a happy chance discovered that certain aerobic bacteria possess the power of converting natural peat into a "humated" neutral medium to which *Azotobacter*‡ is added. The treatment consists of three stages: first, the raw peat is moistened with a culture solution of the special "humating" bacteria, and the mass kept at a constant temperature for a week or ten days; during this time the bacteria act on certain organic constituents of the peat and gradually convert a large amount of the humic acid present into soluble humates; second, the humating bacteria, having done their work, are destroyed by sterilizing the peat by live steam; third, the sterilized peat is treated with a mixed culture of nitrogen-fixing organisms—*Azotobacter chroococcum* and *Bacillus radicicola*—and after a few days' incubation at 26° C., is ready for use. The gratifying results on soil, radishes, potatoes, turnips, grass, and *Primula malacoides* are then given, and, to quote one example only, it was found that a plot of radishes watered once only with an extract of the bacterized peat gave an increase by weight of 54 p.c. over the untreated plot.

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 263–5.
† Journ. Roy. Soc. Arts, lxii (1914) pp. 373–80.
‡ For information in regard to *Azotobacter*, see this Journal, 1901, p. 687 1906, p. 374; 1907, pp. 88, 468: 1910, p. 109; 1911, p. 686; 1912, p. 342.

# MICROSCOPY.

## A. Instruments, Accessories, etc.*

### (1) Stands.

**Leitz' Stereoscopic Binocular Microscope for Metallurgical Purposes.**†—A very complete and substantially built binocular Microscope, giving an erect and truly stereoscopic image and possessing many desirable features, has been constructed by the firm of E. Leitz to the specification

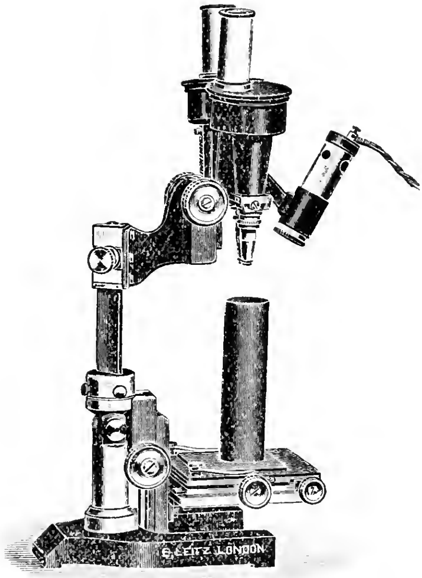


Fig. 20.

and design of Wesley Lambert, late Chief Metallurgist of the Royal Gun Factory at Woolwich. Figs. 20 and 21 serve to show the principal features of this model which is of the Greenough type. Two body-tubes are so arranged as to bring the same object into focus in the axis

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

† Special Catalogue. E. Leitz, London.

of each tube, the tubes being set at an angle to each other for this purpose. Each tube carries both an objective and ocular. The two objectives are mounted on a single slide, the lenses being carefully paired, and provision is made by a suitable adjusting arrangement to enable one to focus the object for each eye separately. Correction is thus made for any slight difference that may exist in the eyes of the observer. Provision is also made for adjusting the oculars to the correct width between the pupils of the observer's eyes. The stand comprises a heavy horse-shoe base, of generous dimensions, carrying a substantial pillar, to which the stage and body are fitted. The latter is considerably over-

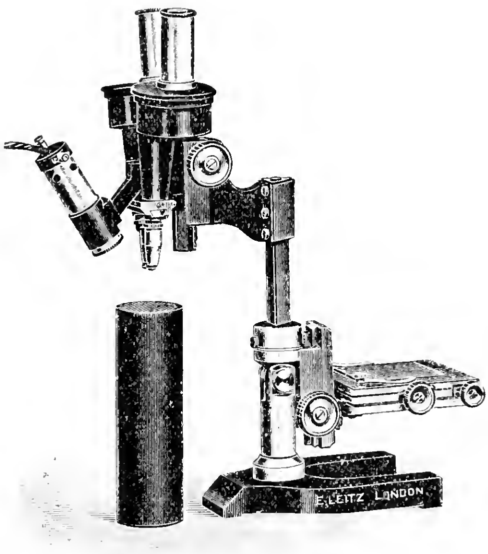


Fig. 21.

hung, and is secured by an approved hinged joint which permits the tilting of the instrument through an angle of 90°. By an extremely simple slide joint, locked by a single milled-head screw, the upper portion of the instrument may be detached and reversed (fig. 21). An examination is thereby possible of bulky specimens of too great a weight for the stage, or of such size that the Microscope must be mounted above or placed upon them. Independent rack-and-pinion movements are provided to the Microscope and the stage. These adjustments, together with the slide and clamp of the body of the Microscope, permit of the examination of specimens of considerable variation in length. The stage is modelled upon the English pattern, and is strongly constructed. It is provided with anterior, posterior, and lateral movements of considerable range. The surface-plate upon the stage is removable, and covers an opening. The instrument is thus available for such other purposes as will readily suggest themselves to the laboratory worker. Further details include a small fixed illuminating lamp placed in such a position as will best illuminate the object. The 25, 40, and 48 mm. paired objectives with the 0 and III paired oculars are particularly suited for the examination of fractures, etc., at varying magnifications.

**R. and J. Beck's New Binocular Microscope.***—The makers of this instrument (fig. 22) summarize its advantages thus: (1) resolution equal to that of monocular: (2) equal illumination, both eyes; (3) equal optical path and magnification, both eyes; (4) converted into a monocular by a touch; (5) prism removable for cleaning; (6) short tube length, compact microscope; (7) no special object-glass or oculars, no special requirements; (8) simple adjustment for interocular distance; (9) the standard angle for convergence, ensuring perfect comfort; (10) stereoscopic vision; (11) binocular vision, saving eye-strain and giving better results than monocular vision. The vital element in a binocular is, of course, the prism, and in this respect Messrs. R. and J. Beck have introduced a novelty which is responsible for most of the advantages claimed above. The prism is shown separately in fig. 24, and is placed above the object-glass. The whole of the light from the object-glass O passes through the surface of the glass B A to a surface E A, which is coated with a semi-transparent surface of silver. This allows part of the light to pass through and part to be reflected into the second tube of the Microscope as shown by the dotted lines; thus the full-size beam goes to form each image and no lack of resolution occurs. Two perfect pictures are produced, one in each eye. As the transparency and reflecting power of the surface E A can be regulated according to the amount of silver that is deposited, the relative intensity of each image can be made identical, and the right- and left-hand images are equal in brilliance. As to the intensity of the mental impression, it has been urged that when an initial body of light is divided into two parts, and one part is sent into each eye of the observer, the effect of brilliance is the same as if the whole light be directed into one eye only. Certainly there is some reason for this argument, though it may be an over-statement of the case. It is, however, no disadvantage if a slightly stronger light is required with a binocular than a monocular Microscope. The monocular observer, in order more readily to concentrate his attention on the employed eye, is apt to use an illumination that is far too brilliant, to the detriment of his eyesight. In the use of the binocular both eyes are equally stimulated, and there is no temptation to use excessive illumination, and theory goes to show that a low illumination is more efficient for displaying fine detail. The diagram of the binocular prism (fig. 24) shows that the distance from the surface E A, where the beam of light is divided into two portions to the two eye-pieces, is not of equal length; the light on the right-hand side has to travel a distance G H farther than the light that passes directly through. It would, therefore, not be possible to focus both beams of light to the same points in the two eye-pieces: if this were not compensated, one

* Special Catalogue: The Beck Binocular Microscope. Messrs. R. and J. Beck, London, 20 pp.

image would be out of focus when the other was sharp. The focus is corrected in the Beck Binocular by combining a parallel plate of glass of the required thickness with the right-hand prism: thus equality in the focus and in the magnifying power of the two images is ensured. The binocular prism is carried in a sliding box in the body of the Microscope (fig. 22). By sliding it out of the optic axis the Microscope is

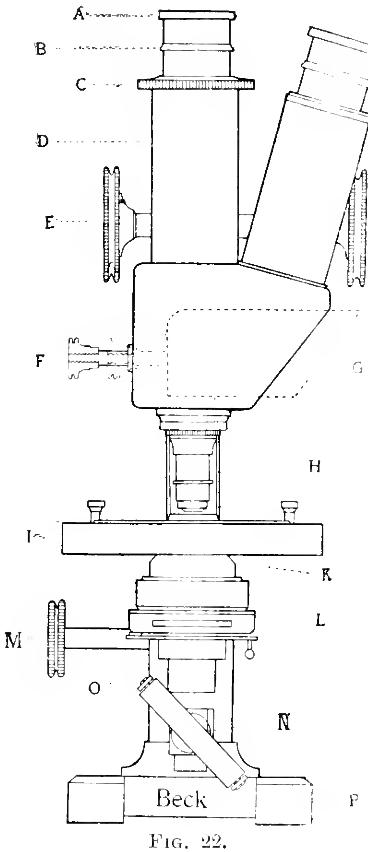


FIG. 22.

converted into a monocular instrument, or by unscrewing the knob (F, fig. 22) it can be slid completely out of the Microscope for cleaning or dusting. It is quite safe to remove the prism complete in its box, as it returns with accuracy to its exact position, and the adjustment will not be interfered with. The fact that when the prism moves to one side the instrument becomes absolutely the same as a monocular Microscope renders this Microscope equally useful for photography. drawing, micrometry, or any other purpose.

The construction of this binocular renders it possible to retain the short tube of the compact monocular Microscope. When the draw-tubes are partially extended the tube is of the standard 160 mm. length; the binocular Microscope is thus rendered as compact and serviceable as the monocular type. In the older types of binocular Microscopes a tube of about 9 in. to 10 in. in length was required in order to extend the eye-pieces to the necessary interocular distance; but examination of the diagram fig. 23 shows that, owing to the peculiar construction of the prism, the tubes, instead of converging towards the prism, converge to an apex about $3\frac{1}{2}$ in. below it; thus, although the standard angle of normal con-

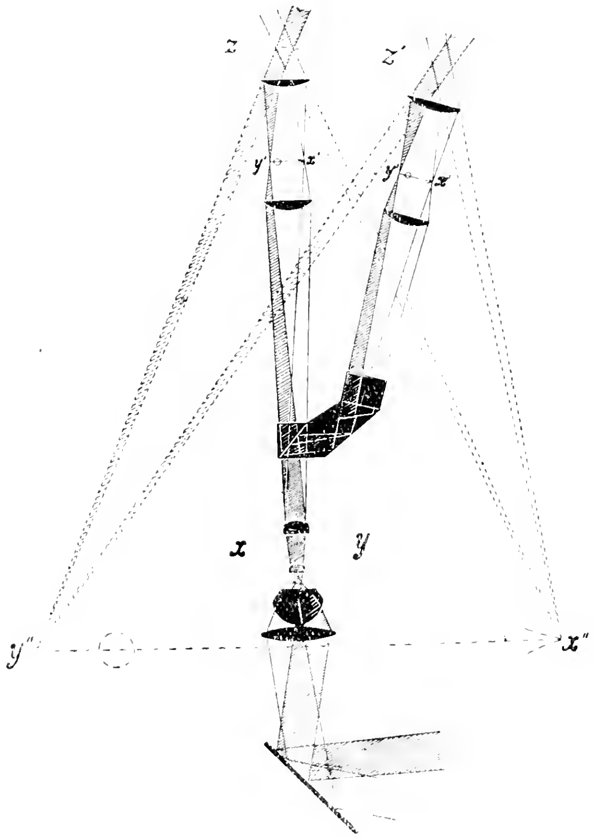


Fig. 23.

vergence is retained, the tubes need not be long to give the required separation for the eyes. The tubes converge at an angle of about 14°. This will be found in practice to give absolute comfort for either long or short periods of working. The eyes are in exactly the condition required for reading a book. Any make of object-glass or eye-piece of the standard size can be used. There are absolutely no special requirements—a revolving nose-piece, an objective changer, or any form of apparatus can be employed. The interocular distance is varied by turning the milled ring (C, fig. 22) on the direct tube of the Microscope; this causes both draw-tubes to move in or out, and alters the distance between the oculars from 2 in. to $2\frac{1}{2}$ in., which, as the observer's eyes cannot be in contact with the eye-pieces, represents interocular distances of about $2\frac{1}{4}$ in. to $2\frac{3}{4}$ in. The tube-length is the standard 160 mm. at an intermediate position. For those whose eyes are farther apart than this, special tubes can be constructed to give the extra separation. If the two eyes of an observer are dissimilar, the necessary lens to render them equal is supplied in a cap to fit over the eye-piece.

Doubt has been at times expressed as to whether a Microscope looking at an object with a single object-glass can under any circumstances give a really stereoscopic relief. Those who have worked with a binocular Microscope do not retain such a doubt, and the explanation of the phenomenon is quite satisfactory. Suppose that O, fig. 25, represents the objective, and that an object at X consists of a fine blade

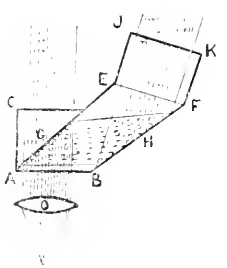


Fig. 24.

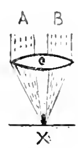


Fig. 25.

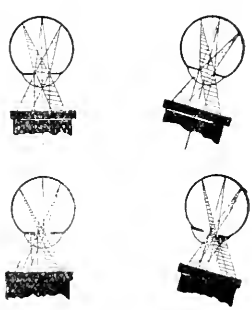

Fig. 26.

of material placed on end, all the light from the left hand of this blade which enters the object-glass at all reaches the left hand of the lens only, and from the right-hand side of X reaches the right-hand side only. If the light from the lens O is geometrically divided and passed to one eye at A, and the other at B, a perfect stereoscopic picture will result, as though the eyes were looking on both sides of a card held in front of them in the well-known experiment on binocular vision. A Microscope inverts the image, and consequently to pass the correct image to the eyes to obtain the stereoscopic relief, the light from the right-hand side of the object-glass must be passed to the left eye, and vice versa. By examining the diagram of the rays passing through a Microscope, as indicated in fig. 23, it will be seen that the rays of light intermingle after they leave the object-glass, and at no other place between the lenses could the right-hand half of the rays entering the object-glass be separated from the left half. It will, however, be noticed in fig. 23 that all the rays of light, after passing through the Microscope, pass through the Ramsden circle ($ZZ^1$) just above the eye-piece.

The observer naturally places his eyes so that the whole of the Ramsden disks (fig. 26) enter the pupils of the eyes, and he thus obtains all the advantages, as to aperture, resolution, and illumination, of a

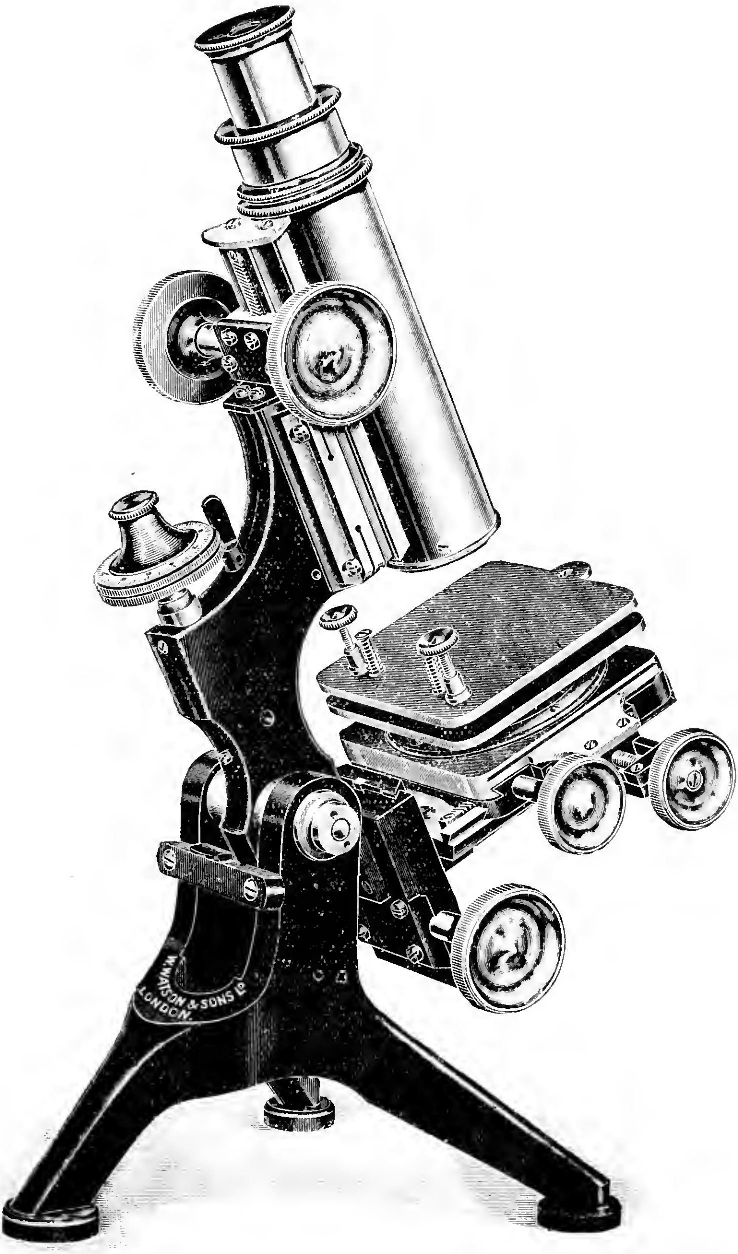


FIG. 27.

monocular Microscope. Then, by moving his head either forward or backward, he cuts off with his pupils the one or other side of the Ramsden disks, and obtains either stereoscopic or pseudoscopic relief instantly. The movement required is scarcely over one-eighth of an inch, and the result is that all the advantages of stereoscopic relief are obtained without sacrificing anything. The result of the movement of the head is very astonishing; if objects are being examined which lie on different levels, one point appears either in front of or behind another at will, and the position of the observer's head indicates which is the stereoscopic or pseudoscopic picture.

The makers adapt the binocular equipment to several of their well-known stands.

**Watson and Sons' No. 2 Metallurgical Microscope.***—This instrument (fig. 27) is identical with the same firm's No. 1 model † except that it has a tripod instead of a horseshoe foot. This variation has been made to meet what is, apparently, a growing preference for the tripod on the part of microscopists.

### (4) Photomicrography.

**Handbook of Photomicrography.**‡—This excellent text-book, the work of H. Lloyd Hind and W. Brough Randles, is, as the authors explain, the outcome of a series of articles originally published in the Photographic Monthly, and is intended as an introduction to photomicrography from a photographer's point of view. The first five chapters deal with the necessary apparatus; then follow experiments on illumination, including critical light. After this come chapters on low-power and critical photomicrography, colour screens and colour-sensitive plates, exposure, oblique and dark-ground illumination, metallography and colour photomicrography.

The last chapters are devoted to development, printing, enlarging, and lantern-slides, and to the use of photomicrography in pathology and medical practice.

The volume concludes with an appendix of formulæ and reagents.

The work is copiously and extremely well illustrated, and the publishers are to be congratulated on producing this handbook at a very moderate price.

### (6) Miscellaneous.

**Quekett Microscopical Club.**—The 495th Ordinary Meeting was held on January 27, the President, Prof. A. Dendy, D.Sc., F.R.S., in the Chair. S. C. Akehurst on "Some Observations concerning Substage Condensers." The opinions of various authorities as regards the use of annular stops were reviewed. Only one phase of the subject was

* W. Watson and Sons' Special Catalogue: Microscopes and Accessories for Metallurgy, pp. 10, 11.

† See this Journal, 1903, p. 87.

‡ London: George Routledge and Sons, Ltd., 1913, xii and 292 pp. (44 pls. and 71 text-figs.).

dealt with—annular light produced by a reflecting condenser used in conjunction with an oil-immersion objective for resolving fine structure on diatoms and displaying stained bacteria. The Leitz concentric reflecting condenser was the form used, and the results obtained when resolving fine structure in diatoms were very striking. T. A. O'Donohoe: "An Attempt to resolve *Pinnularia nobilis*." A series of lantern-slides were shown of photomicrographs of this diatom with varying illuminations, all of which failed to resolve it until the reflecting condenser above described was brought into use.

A very successful conversazione was held at King's College on February 10, about 500 members and visitors being present.

The 48th Annual General Meeting was held on February 24. The Presidential address was delivered by Prof. Dendy, who spoke on "Organisms and Origins." The extraordinary theories held even by leading men of science in the early part of the eighteenth century, relating to the nature and origin of fossils, were briefly dealt with. Spontaneous generation was considered, especially with reference to the recently published results of Dr. Charlton Bastian. The President said that these results to a certain extent are in accord with purely *à priori* expectations, but in other respects they appear improbable to the last degree, especially with regard to the claimed production of such comparatively highly organized forms as a *Penicillium* producing spores in the ordinary way.

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Collection and Preservation of Hydroida.**†—Generally speaking, says G. T. Harris, a shore strewn with large fucus-covered boulders, interspersed with rock-pools, indicates a good collecting ground, though even on such a shore the hydroid life may be curiously confined to a limited area. Clear limpid rock-pools are *not* necessarily indicative of hydroids, and they may often occur in abundance in muddy pools, where they are with great difficulty caught sight of. The easiest and best way of working a rock-pool is, as was pointed out by T. Hincks, to lie at full length on a mackintosh sheet with shoulders and arms projecting over the pool. Pools heavily draped with fucus afford the best chance of success, the sea-weed being turned back so as to expose the sides of the pool. The finer species of seaweed are very remunerative if taken home and looked over under a low-power of the Microscope. Small shells should be carefully examined if encrusted with marine growth, and also the carapaces of rock-pool dwelling crabs. Dredging is more especially the work of the professional naturalist; when undertaken by the amateur a small dredge and moderate depths will offer the best chance of success,

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

† Journ. Quekett Micr. Club, xii. (1913) pp. 143-54.

and it is wise to be guided by local boatmen, who will have a more intimate knowledge of the nature of the bottom than a chance visitor can hope to possess even with the aid of a chart. The sooner the hydroids are killed and fixed after collecting the better, as once the sea-water becomes stale the hydroids are with difficulty prepared in a sufficiently expanded condition. It answers best to divide the gathering by separating the Gymnoblastea from the Calyptoblastea, as the former can be best prepared by killing without the intervention of a narcotic. Before killing, the polyparies should be cleaned as much as possible from adherent matter, by gently brushing with a soft camel-hair pencil. Placed in clean fresh sea-water they quickly recover from the cleansing process, and are ready for narcotization and killing. With the Gymnoblastea it suffices to spray over the colony the killing and fixing agent when the tentacles are well extended. Lang's fluid is a good and quick acting solution, and so also is picric acid; Hermann's solution is excellent for small specimens, but with large colonies and robust forms killing is not sufficiently rapid to prevent considerable retraction of the tentacles. Cocaine hydrochlorate is probably the most generally useful narcotizer for the Calyptoblastic forms. A few drops of a 1 p.c. solution are added to a colony in a watch-glass and time allowed for it to become accustomed to the narcotizer before adding a further dose. When the tentacles fail to respond to the prick of a needle killing may take place. If it is necessary to store the material before staining and mounting, 70 p.c. alcohol seems the most satisfactory medium. Material stored in formalin does not always stain satisfactorily. Hydroids intended for mounting *au naturel* may, of course, be quite well stored in 5 p.c. formalin. It should be observed that specimens intended for mounting unstained require killing with an agent that leaves the cœnosarc in its natural condition—i.e. without rendering it opaque. If osmic acid is used, either alone or as in Hermann's solution, clearing afterwards with hydrogen peroxide, or potassium ferrocyanide, is certainly desirable. For permanently mounting small species, or representative portions of the trophosome, excavated glass slips are very convenient, more especially the oval excavations. A ring of old gold size is first run round the edge of the cell and allowed to become thoroughly tacky. The object is then placed in the cell with a suitable amount of $2\frac{1}{2}$ p.c. formalin solution, the cover-glass placed on and thoroughly pressed into contact with the ring of gold size. Successive coats of gold size are then applied to finish.

**Cultivations of Adult Animal Tissues in vitro.***—A. J. Walton describes his work upon the cultivation of tissues, such as spleen, thyroid, kidney, testicle, and liver from the adult rabbit. The article is illustrated with plates showing the nature of growth of these organs on artificial culture. The technique followed is that practised by Carrel, and is described in detail, particulars as to the preparation of the animal, the apparatus necessary, the method of removing tissues and plasma and of preparing the cultures being concisely stated. Throughout the whole experiment the utmost sterility is observed, every step being carried out

* Journ. Path. and Bact., xviii. (1914) pp. 319–24.

with the same precautions as in a surgical operation. Each step is important and therefore the description cannot be satisfactorily condensed.

**Thermos Apparatus in Laboratory Work.***—J. L. Kritschewsky discusses the use of the "thermos" flask for scientific purposes, and points out that for cultural work, as well as for general pathological work in small laboratories, such apparatus may act as a fairly efficient substitute for a thermostat. Culture tubes inoculated and enclosed in a metal case are put into the flask and water at 38° C. is poured in. In this manner cultures of *Gonococcus*, *Staphylococcus aureus*, and other organisms may readily be obtained. The author describes a form of test-tube rack to fit the flask, with the help of which he has been able to carry out serological investigations, such as Wassermann and agglutination reactions. A larger type of flask than those at present available would be of use.

**New Anaerobic Methods.**†—M. Ogata and M. Takenouchi describe two simple methods of plate culture under anaerobic conditions. The apparatus required is as follows. Petri dishes, of two different sizes (10 cm. and 13 cm. diameter), a piece of glass rod bent into triangle form, a glass U-tube, potash, pyrogallic acid solution, and fluid paraffin. The necessary plate culture is made in the smaller-sized Petri dish on glucose-gelatin or agar. The large dish is half filled with 5 p.c. pyrogallic acid solution, the glass triangle is placed in position in this solution, a small piece of solid potash is put into the pyrogallic acid, and the inoculated culture plate inverted and set resting on the glass triangle. A piece of absorbent paper placed in the pyrogallic solution prevents frothing. The surface of the solution beyond the margins of the inverted culture-plate is covered with liquid paraffin. The cover of the large Petri dish is then placed over all.

In the second method, instead of a glass triangle, is used a circular glass trough of a sufficient diameter and size to permit of the margin of the inverted culture-plate resting within the trough. Three glass feet raise this trough from the bottom of the large Petri dish, which contains, as in the first method, pyrogallic acid and potash. The trough itself contains mercury, thus forming a perfectly air-tight joint all round the margin of the culture-plate. The free surfaces of pyrogallic are covered as before with liquid paraffin. In order to avoid splashing when removing the plate, air is introduced by means of a bent tube as shown in the diagram.

**Diagnosis of Diphtheria.**—E. Gildemeister and Günther ‡ have investigated certain recent methods for the demonstration or isolation of diphtheria bacilli. They first discuss the staining method of Gins, which consists of the following steps: stain with Neisser I (acetic methylen-blue) for a few seconds; wash; treat with Lugol's iodin containing one p.c. lactic acid for five seconds; wash well and counter-

* Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 77–80.
† Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 75–7.
‡ Centralbl. Bakt., 1te Abt. Orig., lxxii. (1913) pp. 237–45.

stain with chrysoidin. The authors find that this method is very satisfactory for the examination of fresh films. The plating methods of Conradi and Troch, who recommend a tellurium medium and of von Drigalski and Bierast, who use a bile-serum medium, do not give results any better than those obtained on Loeffler's medium. Heymann's enriching method has been found useless in the authors' hands.

A. Hanan * has carried out observations upon the relative values of Loeffler's serum, Rankin's potassium-sulphocyanide-neutral-red-glucose serum, and Conradi and Troch's tellurium medium. His results show that the newer media are in no way more reliable than Loeffler's serum.

E. Seligmann † has examined 86 cultures from 42 patients, including 11 cases of diphtheria, 3 cases of ozæna, 8 convalescents, and 20 healthy carriers, in the hope of finding certain criteria which would permit of a sharp line being drawn between diphtheria bacilli and certain allied forms. He finds that in the majority of cases the true diphtheria may be readily recognized, but there is no certain means of assigning some doubtful forms to their proper place.

### (2) Preparing Objects.

**Demonstrating Presence of Chondriosomes in Cartilage.‡**—L. Torraca amputated the tails of a number of Tritons (*Triton cristatus*) and fixed the material at various periods of regeneration. The fixative used was Regaud's fluid (3 p.c. potassium bichromate 8 parts, formalin 2 parts). The decalcifiers were 3 p.c. nitric acid and 1 p.c. chromic acid or a mixture of equal parts of the two solutions. For staining, Heidenhain's iron-hæmatoxylin was exclusively employed. The technique was as follows:—1. Fixation in Regaud's fluid for 3 to 4 days; the solution being renewed on the least evidence of turbidity. 2. Decalcification for 4 days in nitric acid or 5 to 6 days in chromic acid, or in the mixture for 4 to 5 days. 3. Prolonged washing in running water. 4. Mordanting in 3 p.c. bichromate of potassium for 10 days, the fluid being frequently renewed the while. 5. Washing in running water. 6. Dehydration in alcohol, and embedding in paraffin. Sections:—7. Immersion for 24 hours in 2½ p.c. iron alum. 8. Staining in 1 p.c. hæmatoxylin for 24 hours. 9. Washing in running water. 10. Differentiation in the alum solution used for mordanting. 11. Washing in running water until the preparation has a distinct blue tint. 12. Dehydration; balsam.

**Fixation of Soil Protozoa.§**—K. R. Lewin and C. H. Martin refer to a previous communication on this subject.‖ They have since found that the following mixture gives better results than picric acid. Saturated aqueous solution of mercuric chloride 1 part, methylated spirit 1 part. The soil should be crumbled into this fluid, and mixing is best accomplished by gently shaking the containing vessel, care being taken to avoid making the clay component of the soil pass into suspen-

* Centralbl. Bakt., 1te Abt. Orig., lxxii. (1913) pp. 245–9.
† Centralbl. Bakt., 1te Abt. Orig., lxxii. (1913) pp. 127–47.
‡ Anat. Anzeig., xlv. (1914) pp. 459–74 (5 figs.).
§ Nature, xcii. (1914) p. 632.
‖ See this Journal, 1913, p. 329.

sion. A delicate film containing Protozoa will appear on the surface of the liquid, and this can be removed by floating cover-slips over it and stained by the usual methods.

### (4) Staining and Injecting.

**McFadyean Staining Reaction for Anthrax Bacilli.***—J. D. E. Holmes reports that he has used the violet reaction in the diagnosis of anthrax for some years, and has never failed to obtain a positive result in anthrax blood. It is important that the original directions should be strictly followed. The film should not be too thin and should not be completely fixed: the temperature should not much exceed 100° C. if heat be used. Fixation may also be effected by immersing the dried films in absolute alcohol or methylated spirit for a few minutes. The preparation must not be washed in alcohol after staining. The staining solution should be freshly prepared from pure medicinal methylen-blue. Performed according to the original rite, the body of the bacillus is stained violet, and is surrounded by a well-marked pink capsule.

**Staining Connective-tissues.†**—P. Krüger recommends the following procedure. His method succeeds best after fixation in sublimate-acetic acid (5 p.c. solution and 5 p.c. acid). The sections (frozen, paraffin, or celloidin) are placed in iodopotassic-iodide solution until they are dark yellow. The preparation, having been rapidly washed, is placed in a solution of hæmatoxylin composed of: (1) a saturated solution of crystalline hæmatoxylin dissolved in absolute alcohol: (2) saturated solution of ammonia alum; (3) pure glycerin; and (4) methyl-alcohol. The constituents are mixed in the following proportions: (1) 100 c.cm.; (2) 3750 c.cm.; (3) 625 c.cm.; and (4) 625 c.cm. This must be allowed to mature for at least three months. In this solution the sections are immersed for several hours to a day or more. When removed the preparations are washed in distilled water and then differentiated with hydrochloric acid-alcohol. Any excess of acid should be removed with ammonia-alcohol. Contrast-staining is best effected with eosin. The hæmatoxylin solution is approximately the same as Delafield's. The illustrations are very effective.

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

**Mounting Preparations of Amyloid Material.‡**—T. Mironisco gives the following method for mounting sections of material containing amyloid. The sections are made on a freezing microtome, and are then treated with a 1 p.c. solution of methyl-violet for 1 to 2 minutes. They are then washed for 2 or 3 minutes in a 2 p.c. solution of acetic acid, and afterwards with distilled water. After draining off the water one or two drops of a thick clear solution of gum-arabic are placed on this preparation. The slide is then placed in an incubator until the surface of the gum is dry. It is then mounted in balsam. In this way excellent permanent preparations can be obtained. The drying of the

* Agric. Research Inst. Pusa, Bull. No. 36 (1913) 3 pp. (1 pl.).
† Arch. Mikr. Anat., lxxxiv. (1914) pp. 75–90 (1 pl.).
‡ C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 215–16.

gum requires attention, for if allowed to proceed too far the preparation loses its transparency: if not sufficient the thin pellicle may be torn by the balsam.

**Circular Slide for Opaque Objects.***—At the December 1913, Meeting a circular revolving slide for opaque objects was exhibited by R. Finlayson. The illustration (fig. 28) shows this ingenious apparatus as fixed on the Microscope. A description of the apparatus was given by the inventor.

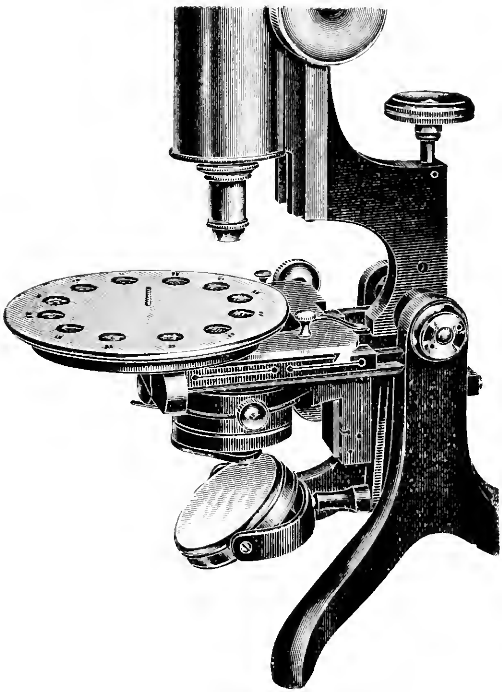

Fig. 28.

**Simple Device for obtaining a Moist Chamber.**†—R. Legendre describes this method of making a moist chamber for examining microscopical preparations which may be damaged or spoilt by the weight of the cover-glass. A clean rectangular cover-glass is picked up with forceps and the corners successively softened in the by-pass flame of a Bunsen burner. In this way little balls are formed which are of the same size when each of the corners are heated for the same time. A little practice will enable anyone to obtain balls of any desired thickness. Thus prepared, the cover-glass rests on its four corners and prevents the specimens from being unduly pressed on.

* See this Journal, 1913, pp. 94–5.
† C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 265–6 (1 fig.).

### (6) Miscellaneous.

**Enumeration of Bacteria.***—E. Glynn, M. Powell, A. A. Rees, and G. L. Cox give the results of a large number of observations upon the counting of bacterial vaccines by the Wright, the hæmatocytometer, and the plate culture method. The cytometer method recommended by the writers is as follows: two stock solutions are prepared, one of saturated thionin blue (Grübler) in absolute alcohol, the other of 1 p.c. pure carbolic acid in tap-water. These are mixed in the proportion of 1 to 40 for most organisms, 1 to 20 for streptococci. The bacterial emulsion is suitably diluted and mixed with the stain. A drop is mounted in a Helber-Glynn counting-cell, that is to say, a cell 0·02 mm. deep and having an extra wide trough around the counting disk. A thin optically plane coverslip, strengthened by a glass collar, is pressed into position, and the drop examined with an immersion lens. The authors from their comparative observations find that the hæmatocytometer method is the best counting method available, and that the cell of 0·02 mm. depth is better than that of 0·1 mm. depth; in the former the optical definition of the bacteria is sharper and the free working distance greater; in the latter, settlement of bacteria upon the bottom of the cell is much delayed, and so counting is rendered more difficult. The Wright method, based on comparative enumeration of bacteria in an emulsion and cells in normal blood, usually greatly under-estimates the strength of the bacterial emulsion sometimes by 100 or even 200 p.c. This is largely due to defective distribution of the cells and bacteria in the film. The plate culture method is cumbersome and tedious. This also under-estimates the number of bacteria, first, on account of the impossibility of obtaining a homogeneous emulsion; second, because all cultures contain a large number of dead or moribund organisms incapable of forming colonies. Gravimetric methods of estimating bacterial vaccines will be considered in a further paper.

G. H. Macalister† recommends that organisms in a bacterial vaccine be counted directly in a Helber cell with dark-ground illumination. The suspension is diluted with decinormal hydrochloric acid, and a drop is mounted and examined. The Microscope is fitted with a Zeiss compensating ocular 18 and a dry 7 mm. objective Zeiss C. The eye-piece carries a grating micrometer, and the tube-length is so adjusted that four eye-piece squares fit one of those on the Thoma-Zeiss rulings. The condenser is Beck's old type of Abbe, carrying on the centre of the under surface of its lower lens a disk of black paper to cut off central rays of light. The acid diluent causes the bacteria to settle on the glass surfaces and become immobilised. They can then be counted in the two optical planes, and by focusing from one to the other, and observing the fine-adjustment graduations, the cell depth may be checked. Comparative observations show that this method gives more constant results, takes less time and causes much less eye-fatigue than any of the other methods in use. Further work is proceeding in order to find the effects

* Journ. Path. and Bact., xviii. (1914) pp. 379–400.
† Journ. Path. and Bact., xviii. (1914) pp. 441–2.

of different diluents, and to discover a means of ensuring evenness of distribution of the organisms over the surface of the cytometer field.

A. Cunningham* discusses the use of agar and gelatin plates for the enumeration of organisms in milk, soil, etc. He points out that on plates at 22° C. fresh colonies continue to appear on plates until the tenth day, so that counting of colonies at an earlier date gives wrong results. Liquefying organisms will, under ordinary circumstances, spoil a gelatin plate in four or five days, but if liquefying colonies, whilst still young, are touched with a fine silver nitrate point, as suggested by Hiltner and Störmer, further liquefying is prevented and the plate after ten or eleven days is still fit for counting. In platings from dung and soil, more organisms, as a rule, are found on gelatin plates than on agar at 22° C. In the case of milk more colonies appear on the agar than on the gelatin plates.

## Metallography, etc.

**Annealing of Gold.**†—T. K. Rose shows that when hard-rolled plates of pure gold, consisting microscopically of thin parallel laminæ, are annealed, re-crystallization does not take place simultaneously throughout the mass, but occurs first in particular laminæ. Photomicrographs of partially annealed gold plates are given, showing some laminæ largely converted into minute crystals, while others remain unchanged.

**Metallography of Commercial Zinc.**‡—G. Rigg and G. M. Williams describe the microscopic appearance of the common impurities of zinc. Iron occurs as well-formed crystals, which are probably a solid solution of zinc and $FeZn_7$. Lead appears as small black globules, or as a black network if present in sufficient quantity. Cadmium is present in solid solution up to 1 p.c., and forms a eutectic at higher concentrations.

**Copper-rich Kalchoids.**§—S. L. Hoyt has investigated the equilibrium of the copper-tin-zinc system in the range 0–50 p.c. zinc 0–30 p.c. tin, and describes the microstructure of the alloys. The addition of tin to the brasses causes the visible breakdown of the $\beta$ solid solution. The microstructure of the ternary alloys corresponds closely to that of the two binary systems. Two etching reagents were used, basic cuprous chloride, suitable for the zinc-rich alloys, and acid ferric chloride, preferable for the tin-rich alloys. Both reagents attack the copper-rich constituent first and leave the $\gamma$ a bright grey.

**Molybdenum-cobalt Alloys.**‖—U. Raydt and G. Tammann describe the microstructure of the alloys used in their thermal study of this system. With 25 p.c. or less molybdenum, cored polyhedric structures

* Journ. of Hygiene, xiii. (1914) pp. 433–7.
† Journ. Inst. Metals, x. (1913, 2) pp. 150–74 (9 figs.).
‡ Proc. Amer. Soc. for Testing Materials, xiii. (1913) pp. 669–98 (25 figs.).
§ Journ. Inst. Metals, x. (1913, 2) pp. 235–74 (48 figs.).
‖ Zeitschr. Anorg. Chem, lxxxiii. (1913) pp. 246–52 (1 fig.).

were obtained; they were rendered homogeneous by annealing at 1250° C. At 30 p.c. molybdenum a eutectic appeared. In alloys containing 40 p.c. or more molybdenum a compound MoCo was observed as long needles. Primary molybdenum, or a solid solution, was found at concentrations exceeding 65 p.c. as small rounded masses enclosed in crystals of MoCo.

**Silicon in Arsenical Copper.***—F. Johnson has studied the effect of silicon when used to deoxidize arsenical copper, and describes the micro-structures of specimens containing varying small amounts of arsenic, silicon, iron, and oxygen. The deoxidized specimens contained no cuprous-oxide globules, and the arsenic, silicon, and iron were present in solid solution in the copper. When specimens containing oxygen were annealed in hydrogen, the blue cuprous-oxide globules became black, the oxide being reduced to metallic copper.

**Manganese-cobalt Alloys.**†—K. Hiege finds that manganese and cobalt form a continuous series of solid solutions. Alloys containing more than 40 p.c. cobalt showed a cored structure, which was removed by annealing at 1000° C., except in the case of the alloy containing 90 p.c. cobalt: this still showed a want of homogeneity. Manganese-rich alloys were etched with 3 p.c. acetic acid, and cobalt-rich alloys with hydrochloric acid.

**Lead-tin-antimony and Tin-antimony-copper Alloys.**‡—W. Campbell discusses the constitution of the alloys of these two ternary systems, and describes their micro-structure in some detail. In the alloys are found crystals and dendrites of antimony, SbSn, $Cu_3Sn$, CuSn, lead, and $\alpha$-tin set in a more or less plastic ground mass, which may be composed of Pb–SbSn, Pb–Sn$\alpha$ or CuSn–Sn$\alpha$. The crystals and dendrites and the ground mass vary in hardness and plasticity: thus by varying the composition the physical properties may be controlled. Antimony and SbSn are lighter than the liquids out of which they freeze and tend to concentrate in the upper part of the ingot. 2 p.c. nitric acid in alcohol was found to be a good etching reagent for the lead-tin-antimony alloys.

**Alloys of Zinc, Tin, and Cadmium.**§—R. Lorenz and D. Plumbridge have studied the three binary systems and the ternary system formed by zinc, tin, and cadmium, and give a number of photomicrographs illustrating the structure of the alloys. The few solid solutions occurring are of very low concentration. Hydrochloric acid in alcohol was used for etching.

**Thallium-bismuth Alloys.**‖—N. Kurnakow, S. Zemczuzny, and V. Tararin give an account of their exhaustive revision of the equili-

* Journ. Inst. Metals, x. (1913, 2) pp. 275–303 (11 figs.).
† Zeitschr. Anorg. Chem., lxxxiii. (1913) pp. 253–6 (8 figs.).
‡ Proc. Amer. Soc. for Testing Materials, xiii. (1913) pp. 630–68 (24 photomicrographs).
§ Zeitschr. Anorg. Chem., lxxxiii. (1913) pp. 228–42 (24 figs.).
‖ Zeitschr. Anorg. Chem., lxxxiii. (1913) pp. 200–27 (16 figs.).

brium of the thallium-bismuth system, and suggest that the $\gamma$-phase is a compound of variable composition. In spite of the softness of the alloys, fairly good sections were obtained by the usual cutting and polishing methods, but preparations for microscopic examination were also made by casting on a polished glass plate. With the thallium-rich alloys, however, the casting adhered so strongly to the glass that it could not be separated without spoiling the surface. The sections prepared in the ordinary way had been annealed, and sometimes differed markedly from the glass-cast preparations since the rapid cooling of the latter resulted in incomplete equilibrium. A dilute solution of bromine and hydrochloric acid in water, and a mixture of concentrated nitric and hydrochloric acids were used as etching reagents.

**Influence of Phosphorus on Copper-aluminium Alloys.***—A. A. Read has studied the properties of a number of alloys containing 0–11 p.c. aluminium, 0–1 p.c. phosphorus, and describes their microstructure. The phosphorus remained in solid solution up to about 0·2 p.c. Alloys containing more phosphorus showed envelopes of phosphide surrounding the crystals. On annealing, the phosphide was found to ball up.

**Egyptian Metal Antiquities.**†—H. Garland describes the microstructure of a number of copper and bronze Egyptian tools from 2000 to 7000 years old. Cored structures were prominent in some specimens, and the distorted crystalline structures also found were evidence of hammering or similar cold-working. Where re-crystallization had occurred the crystals were small. The author concludes that the structural changes taking place in such metals and alloys at atmospheric temperatures are trifling. 10 p.c. ammonium persulphate solution was found to be the best etching reagent for revealing cores, while chromic acid proved suitable for sharply defining the crystal boundaries.

**Microchemistry of Corrosion.**‡—C. H. Desch and S. Whyte have carried out corrosion experiments upon three copper-zinc alloys of $\beta$ composition. One alloy contained 53 p.c. copper, 47 p.c. zinc; the other two were similar, but also contained respectively 1 p.c. tin and 1 p.c. iron. A surface finished on fine emery-paper was made the anode in a 5 p.c. solution of sodium chloride, the cathode being a platinum wire. An E.M.F. of 3 volts was applied. Corrosion was found to take place by removal of zinc from a surface layer, a skin of nearly pure copper remaining. This copper skin was not united to the alloy below by any zone of intermediate composition, the boundary between copper skin and unchanged alloy being quite sharp. The copper skin showed the outlines of the $\beta$ crystals from which it was derived; it could be peeled off, leaving clearly visible the microstructure of the unchanged alloy beneath. Indications that corrosion began at the boundaries of the crystal grains were obtained.

* Journ. Inst. Metals, x. (1913, 2) pp. 344–70 (16 figs.).
† Journ. Inst. Metals, x. (1913, 2) pp. 329–43 (14 figs.).
‡ Journ. Inst. Metals, x. (1913, 2) pp. 304–28 (11 figs.).

**Iron-cobalt System.***—R. Ruer and K. Kaneko find that the iron-cobalt alloys have a homogeneous polygonal microstructure. Alloys in the range 100–30 p.c. iron showed large polygons subdivided into smaller ones, while in the range 20–0 p.c. iron only large polygons, usually showing twinned lamellæ, were seen.

**Structure of Zinc-iron Alloys.**†—The zinc-iron system has hitherto been investigated only in the range 0–24 p.c. iron. U. Raydt and G. Tammann have now prepared a series of alloys containing 26–97 p.c. iron, by melting zinc and iron together, in an atmosphere of hydrogen, under pressures up to 130 atmospheres. The only phases found in the range of composition studied were the compound $FeZn_3$ and a solid solution of zinc in iron having a concentration of 20 p.c. zinc when saturated. Copper sulphate solution, nitric acid in amyl-alcohol, and iodine solution were the etching reagents used; some specimens were lightly re-polished after etching.

**Iron-copper System.**‡—R. Ruer and K. Fick, finding that iron and copper are incompletely miscible in the molten state, and yet do not separate into two layers, have made a microscopic examination of a number of melts. The presence of a little carbon causes separation of an alloy of equal weights of iron and copper into two layers, rich in iron and in copper respectively. It is suggested that in pure iron-copper alloys the copper may separate in "submicroscopic" form. The alloys 0–8 p.c. copper, and 0–2·5 p.c. iron, were microscopically homogeneous.

**Heat-treatment of Steel.**§—J. H. Nead has examined, microscopically and otherwise, specimens of steel which had been heat-treated in the form of round bars of sizes ranging from $\frac{1}{2}$ in. to $1\frac{3}{4}$ in. diameter. The bars of one series having the composition carbon 0·2, nickel 3·5 p.c., were quenched in oil from 1550° F., the bars of the other series, containing carbon 0·4, chromium 0·9, vanadium 0·2 p.c., were quenched in oil from 1650° F. and re-heated to 500° F. The bars $\frac{1}{2}$ in. in diameter in both series consisted solely of uniform martensite. The bars $1\frac{3}{4}$ in. in diameter contained some quantity of ferrite, with granular pearlite in the case of the nickel steel and granular troostite in the case of the chromium-vanadium steel. The effect of mass of quenched specimen upon the rate of cooling in oil, and thus upon the microstructure, was apparent in the gradual transition, with gradual increase in diameter of bar, from the martensitic to the pearlitic, or to the troostitic structure.

**Heat-treatment of Hypo-eutectoid Steel Castings.**‖—J. H. Hall describes the structure of specimens cut from steel castings containing less than 0·9 p.c. carbon, heat-treated in various ways. Ingotism is defined

* Ferrum, xi. (1913) pp. 33–9 (8 photomicrographs.).
† Zeitschr. Anorg. Chem., lxxxiii. (1913) pp. 257–66 (12 figs.).
‡ Ferrum, xi. (1913) pp. 39–51 (6 photomicrographs.)
§ Proc. Amer. Soc. for Testing Materials, xiii. (1913) pp. 489–509 (18 photomicrographs).
‖ Proc. Amer. Soc. for Testing Materials, xiii. (1913) pp. 514–24 (18 photomicrographs).

as the coarse crystalline structure of steel in the cast condition; in hypo-eutectoid steels it is characterized by the presence of primary ferrite, which exists in one of two forms: (1) a network; (2) as needles in a triangular or "delta" arrangement, constituting the Widmannstätten structure. If steel in the cast condition is heated above $Ac_3$ and cooled slowly, ferrite is re-precipitated more or less upon the lines originally occupied by it in the raw steel. The author's experiments now show that if the coarse casting structure is effaced by heating to 900° C. and cooling rapidly, it tends to re-appear if the steel be again heated above $Ac_1$ and cooled slowly.

**New Etching Reagent for Steel.***—W. Rosenhain describes the action of a reagent composed of an acid solution of ferric chloride, such as is used for etching copper alloys, to which have been added about 0·1 p.c. cupric chloride and 0·05 p.c. stannic chloride. When this reagent is applied to a polished steel specimen, a thin deposit of copper is slowly formed on the ferrite, while pearlite and cementite are only very slightly affected. Under the Microscope the ferrite appears to be blackened, while the pearlite remains bright. In commercial steels the ferrite is not darkened uniformly, a strongly banded structure being developed. Apparently the rate of deposition of copper is greater as the freedom of the ferrite from impurities, especially phosphorus, is more complete. The patterns obtained by the use of the reagent indicate clearly the distribution of the phosphorus, and have been found to be identical with patterns obtained by Stead's "heat-tinting" process.

**Optical Orientation of some Cast Metals.**†—K. Endell and H. Hanemann give an account of their applications of Königsberger's methods by which opaque bodies are microscopically examined in polarized light. Sections are polished by the usual methods, but not etched; they should show no "relief" effects. According to the character of the light which they reflect constituents, are distinguished as isotropic or anisotropic. The appearances observed in sections of quickly solidified ingots of the anisotropic metals, zinc, antimony, bismuth, and tin, are described. When allowed to solidify without disturbance, zinc and antimony form similarly oriented crystals, having their optical axes at right angles to the cooling surface. Primary crystals of the same metals occurring in a ground mass of eutectic were examined, as were also the various constituents and slag inclusions occurring in steel.

* Nature, xcii. (1914) p. 529.
† Zeitschr. Anorg. Chem., lxxxiii. (1913) pp. 267–74.

# PROCEEDINGS OF THE SOCIETY.

## MEETING

HELD ON THE 18TH FEBRUARY, 1914, AT 20 HANOVER SQUARE, W., PROFESSOR G. SIMS WOODHEAD, M.D., ETC., PRESIDENT, IN THE CHAIR.

**The Minutes** of the Meeting of January 21, 1914, were read and confirmed, and were signed by the President.

**The List of Donations** (exclusive of exchanges and reprints) received since the last Meeting was read as follows, and the thanks of the Society were accorded to the donors :—

| | From |
|---|---|
| Houghton, W., The Microscope. 4th ed. .. .. .. .. | *Mr. John Hopkinson.* |
| St. Vincent, M. Bory de, Essai d'une Classification des Animaux microscopiques. 1826 .. .. .. .. .. | *Ditto* |
| Loeb, J., Artificial Parthenogenesis, etc. .. .. .. .. | *The Publishers.* |
| Hind and Randles, Handbook of Photomicrography. 1913 | *Ditto* |
| Shelford, E. V., Animal Communities in Temperate America .. .. .. .. .. .. .. .. .. .. .. .. | *Ditto* |

A paper by the Rev. Hilderic Friend, F.R.M.S., entitled "British Enchytræids. VI. New Species and Revised List," was then read by the Secretary, and a very hearty vote of thanks was unanimously accorded to the author for his valuable contribution to the Society's records.

**Mr. D. J. Scourfield, F.Z.S.**, then made a communication on "The Methods of Collecting, Examining, and Preserving Entomostraca," prefacing his demonstration with the suggestion that many workers regarded systematic methods as superfluous so far as concerned the organisms under consideration. This might be true with regard to the commoner species, but if the study of Entomostraca was taken seriously special methods of collecting were necessary, and even the services of other organisms in the lakes and ponds might be secured. For example, the first record of *Bosmina coregoni* was from the stomach of a *Vendace* caught in Lochmaben Castle Loch, in Scotland ; and, similarly, he had first found the very rare *Monospilus dispar* in the stomach of the roach from a particular pond in Epping Forest. With regard to apparatus, the simple hand-net fixed to a stick was undoubtedly the most valuable, but he advised the use of nets of at least two different grades of mesh: a coarse net of between thirty and forty threads to the inch for larger forms, whilst one of about 100 threads to the inch was sufficiently fine to secure all but some of the minute larval forms. In addition to the hand-nets, others (preferably of two grades of mesh as before), attached to a line to be used as tow-nets or dredges from a boat, or thrown out some distance from the shore when it was not possible to get a boat, were needed. A small naturalist's dredge might also prove useful when large quantities of bottom material were required.

A cone-dredge, consisting of a net with a cone of wire gauze over the mouth, which could be thrown out amongst weeds and pulled in quite easily, was used by some workers, who considered it kept out the larger organisms and gave a fairly clean collection of Entomostraca. Apparatus, however, was of less importance than the knowledge of how, when, and where to collect.

Numerous forms could be secured by carefully working the hand-nets at the margins of ponds and lakes; but samples from the bottom should also be taken, and in the case of the larger pieces of water the use of the tow-net was essential. On Lake Windermere he had but poor success at the surface during the day time, rare forms, e.g. *Leptodora* and *Bythotrephes* and others, being obtainable only at a considerable depth; but after dark they were abundant on the surface. The most favourable season of the year to collect varied somewhat with the different species; generally speaking, the autumn was the best, not only for the number of species, but also for the probability of obtaining the comparatively rare males and ephippial females of the *Cladocera*. For the species favouring small shallow ponds and pools liable to be dried up annually, the best time was obviously late spring and early summer.

Entomostraca were not limited to lakes, ponds, pools, and ditches, but were found often in strange places—in mosses growing just above the water level and in damp hollows, in the roots of aquatic plants, and consequently had to be collected by washing the mosses and roots. The water lying in the hollows on the trunks and roots of trees was sometimes the habitation for an apparently new species of Harpacticid, and he had gathered many examples from this source in Epping Forest. Another peculiar Harpacticid, *Belisarius*, was found in the little cups formed by the leaves of various Bromeliaceous plants kept in hot-houses in this country.

In the examination of specimens with pocket lens and low powers of the Microscope certain appliances were particularly helpful, such as a black photographic developing-dish for picking out specimens, as the Entomostraca were mostly light in colour, and the contrast aided differentiation; Petri dishes also could be used with either a black or white background or transparently; small sieves of gauze were most useful for removing the larger organisms, such as snails, insect larvæ, etc., and also the fine mud. For isolating specimens little glass evaporating basins (with spout) were very convenient; and a very small brush was indispensable; large quantities of material should be spread out on ordinary lantern slide covers which were of thin clear glass of a very handy size. For higher power microscopy the speaker modified the Rousselet live-box by having a thin ring of metal put into it, to the underside of which was cemented a very thin cover-glass. This device made it quite possible to focus a $\frac{1}{12}$ immersion objective upon details in the median plane of a fair sized *Daphnia.* The Rousselet live-box was preferable to a compressor, since the lid could be moved in two planes and so controlled the position of the objects. For certain purposes he attached the animals to the end of a very fine wire with a minute drop of sealing-wax or shellac varnish. If carefully done without entangling the antennæ all the movements of the creature could be performed in a perfectly natural manner, and yet it could not escape from the field of vision—points of the utmost importance when investigating the currents produced by the antennæ, etc.

He wished to insist very strongly that these small aquatic animals should be studied under natural conditions, and for this purpose he suggested a large observation tank sunk into the ground with a passage-way all round it. and hoped that some day this might be arranged. For the preservation of specimens he usually employed formalin—spirit was also good, but not so generally useful ; spirit and glycerin, or formalin, spirit and glycerin together were also useful compounds.

His specimens were stored in tubes about $1\frac{1}{2}$ in. by $\frac{3}{8}$ in., packed in boxes or drawers between strips of cardboard arranged to form a series of divisions as in an egg-box, and seldom mounted on slides.

The President congratulated not only Mr. Scourfield, but the Society on the extremely practical manner in which the subject had been put before them. It was the exposition of a man of experience, and Mr Scourfield had explained just those things which were essential for working purposes.

Mr. E. J. Spitta was interested in Mr. Scourfield's method of restructing the movements of animals such as the water-flea, as he had experienced much difficulty in keeping them continuously in the field of view. When preparing kinematograph films of pond-life, his own plan was to make a series of vulcanite cells of different depths varying from a fiftieth to a hundredth of an inch, and to suit the depth of the cell employed to the thickness of the object—a matter of trial and error, for the cover-glass must be just heavy enough to press upon the object *lightly* and yet firmly, but not too heavily, or the animal would be killed. To make these cells of different depth, he stuck a few on to ordinary micro-slips, and filed them down with a broad fine flat file ; a coarse file tore the vulcanite and the scratches prevented the cover-glass fitting closely.

Mr. Scourfield said that the question of holding Entomostraca under water was one of considerable difficulty. The varnish he used set very well in water, and held *Daphnia* for a considerable time, but would not hold a *Cyclops* for more than two or three minutes. He would like to hear of a suitable cement for the purpose.

Mr. Spitta said he had secured on his film a peculiarly jerky *Cyclops*, and thought perhaps the animal waited before making one of those violent jumps until the coast was clear of all obstructions, since he had no record of any one *Cyclops* colliding with another.

Mr. Heath said that shellac was soluble in hot dilute ammonia, and would probably hold Entomostraca with sufficient tenacity.

In reply to Mr. E. J. Sheppard, Mr. Scourfield said the cement used need not be transparent.

Mr. E. J. Sheppard then stated that the dental cement known as "Calxine" set very rapidly under water in considerably less than a minute. It was supplied by Messrs. C. de Trey and Co., 13–14 Denman Street, W.

Mr. Maurice Blood remarked that he understood the cement was essentially composed of zinc oxide and phosphoric acid, which behaved in the same way, and formed a very hard quick-setting cement (i.e. as the preparation mentioned by Mr. Sheppard). He questioned, however, how the phosphoric acid would affect the organisms, and suggested zinc oxide and zinc chloride solution, which acted in a similar manner but would not be so poisonous. He also thought that the ammonia in the cement mentioned by Mr. Heath would probably be even more deleterious to these organisms. He asked if the difficulty of retaining *Cyclops* might not be due to some difference in the surface causing less adhesion of the cement. He further suggested that rubber solution might be tried, but agreed that the petrol used as solvent would almost certainly be too poisonous, and carbon bisulphide worse still.

Mr. Heath further remarked that a gelatin solution to which a little sugar had been added and into which the wire could be dipped, would set on the wire yet remain insoluble in the water, although it would be tacky and adhesive in the presence of water.

In reply to a query by Mr. Coon, Mr. Spitta pointed out that gelatin was soluble in hot water but not cold.

Mr. Coon asked whether Mr. Scourfield had used any special staining methods after preservation, and suggested that Heidenhain's iron-alum followed by Congo-red ($\frac{1}{4}$ minute) was useful.

Mr. Scourfield replied that stains generally penetrated all the tissues without differentiation. Certain results could be obtained by intra-vitam staining with methylen-blue; certain other stains gave some results in connexion with the nerves, but by the time the stain acted, the normal structure seemed to have broken down.

Mr. Rogers asked if bird-lime had been tried for fixing purposes? He had used it with good effect for flies, but for nothing smaller: it was not soluble in water. Old bird-lime was used. See the Extra Pharmcopœia (Martindale), 14th ed., 730.

The President remarked that the discussion, ranging from old bird-lime to the modern kinematograph, had been of a most interesting nature. One reagent had not been mentioned in connexion with staining, especially with intra-vitam staining: Ehrlich's neutral red. In leucocytes, this stain brought out the changes resulting from phagocytic action with great distinctness, and marked the active cells as compared with the cell in which there was no functional activity. He thought they would agree that they owed their very hearty thanks to Mr. Scourfield for bringing forward his communication in such an interesting fashion.

The vote of thanks was cordially acknowledged by all present, and passed unanimously.

**The President** called the attention of the Meeting to an exhibit by Mr. Watson Baker, demonstrating certain methods of staining, especially triple staining, and a hearty vote of thanks was accorded to the exhibitor.

A similar hearty vote of thanks was passed in favour of Mr. Angus, for the loan of Microscopes.

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**The President** announced that the next Ordinary Meeting would take place on Wednesday, March 18.

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The next Meeting of the Brass and Glass Section would be held on Wednesday, the 25th inst., when Mr. Cheshire would introduce a discussion on Kepler's famous book on geometrical optics, entitled Dioptrice, published in 1611, immediately after the invention of the telescope.

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The Biological Section would meet on Wednesday, March 4, when a communication would be made by Mr. Rousselet on "Parasitic Rotifers and Parasites of Rotifers."

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**New Fellows**:—The following were elected *Ordinary* Fellows of the Society: Sydney Charles Akehurst and Stanley Halford-Roberts.

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

Mr. D. J. Scourfield, F.Z.S.:—Apparatus for collecting, examining, and preserving Entomostraca.

Mr. F. W. Watson Baker:—Sections of the Earthworm: Sections of the Frog; Heart of Crayfish.

## MEETING

Held on the 18th March, 1914, at 20 Hanover Square, W., Mr. E. Heron-Allen, F.L.S., etc., Vice-President, in the Chair.

**The Minutes** of the Meeting of February 18, 1914, 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 |
|---|---|
| Prof. Sigmund's Histological Preparations. Part 7, with text | *Messrs. Carl Zeiss.* |
| Leiss (C.) Die optischen Instrumente, 1899 .. .. .. .. | *Sir Frank Crisp.* |

**The Chairman** said that Messrs. Zeiss's presentation of Part 7 of Professor Sigmund's preparations—the other parts of which the Society already possessed—formed a very valuable contribution to their Cabinet, and that Leiss's book, "Die optischen Instrumente," also formed an interesting and important asset to the Library, especially from an historical point of view in the cataloguing of microscopical and other instruments. He was sure that it would be the wish of the Society that their cordial thanks be accorded to the donors of these two gifts.

**Mr. C. F. Rousselet** described a very curious old French Microscope which the Society had just acquired, viz. one of the instruments invented by L. Joblot, Professor at the Royal Academy of Painting and Sculpture in Paris, and described in his book, "Descriptions et usages de plusieurs nouveaux Microscopes," published in Paris in 1718. It was richly engraved with ornate design and was made by I. Langlois, a pupil of the "Sieur" Butterfield, both well known as astronomical, quadrant, sundial, and other scientific instrument makers at this period in Paris. The object-glasses consisted of single bi-convex lenses, mounted between two brass plates in the manner of Loeuwenhoek's Microscopes. The instrument possessed a screw-focusing arrangement, and a barrel-shaped diaphragm, lined with black velvet inside, with perforated cap at each end, which effectually excluded all but central light for the illumination of the objects. It was proposed to publish a full description with illustrations of this interesting old Microscope in the next Journal.

The Chairman pointed out that this communication was peculiarly apposite after the demonstration of one of Loeuwenhoek's Microscopes at a previous Meeting. The possession of such examples of early Microscopes was of great value, not only to those studying the progress of the science of Microscopy, but also to specialists in all branches of zoology, as it was thus possible to see things practically with the same eyes as the old pioneers in natural history.

The vote of thanks to Mr. Rousselet was passed unanimously.

**The Chairman** said it devolved upon him to perform a duty which was a melancholy one, but one which at the same time he accepted, with a certain sense of satisfaction in the thought that it had fallen upon him as a personal friend, to bring to the notice of the Society the loss that England had sustained in the death of one of her greatest scientists, Sir John Murray. Their Meeting that evening was the first Meeting of any leading scientific society to take place since the tragic death of this great man, and he thought it would not be inappropriate for their Society to record their sense of the loss science had sustained, and at the same time to convey through their Secretaries the condolence and the sympathy of the Royal Microscopical Society with Lady Murray, and with her little daughter, whose unconscious hand upon the wheel of that motor-car hurried him to what, though he was 73 years of age, must be regarded by anyone who knew the youthfulness of Sir John's enthusiasm as a premature death.

John Murray was one of the most significant figures in science of the present day. Born in 1841, he had studied in the schools of Scotland from his earliest years, and one saw him in Tait's laboratory in Edinburgh, sitting side by side with Robert Louis Stevenson, and again at the age of 27—as keen then on oceanography as at the age of 73—as naturalist on board a whaler going to Spitzbergen. But the great work with which his name would always be associated was that of the 'Challenger' Expedition, and it was characteristic of the man that but few were aware of the immense influence he had upon the labours and the success of that historic voyage.

The year 1871 was almost entirely occupied in arranging for that wonderful journey, and students of every branch of oceanographical science would appreciate how enormously important the year of preparation for that voyage must have been, when they realized and acknowledged the immense debt they owed Sir John Murray for the results of the expedition, as set forth in his fifty great volumes of reports.

The years 1872–76 were passed upon the voyage, and it had been the great privilege of Mr. Earland and himself to read the Private Journals (or rather the Laboratory Notebooks) of Sir John Murray, in which he had recorded from day to day the things he saw that came from the surface and median waters and from the bottom of the sea. The characteristic modesty of the man prevented the publication of these journals as one of the many travel volumes which were the direct outcome of the voyage, but they threw a brilliant light upon many problems originating in the later reports upon that particular branch of science to which the speaker's colleague, Mr. Earland, and himself devoted their attention.

Not least important amongst the vast contributions to science, both pure and economic, that he made was that of the discovery and annexation to the British Crown of Christmas Island. It was to experience gained upon the voyage of the 'Challenger' that he owed the discovery of the phosphate deposits on that island.

The fifty volumes of the reports of the voyage took from 1876 to 1895 to complete, and it is a matter of common knowledge that many thousands of pounds were contributed by him out of his own pocket towards the expenses of printing and publishing that great work, the grants made him by the Treasury proving altogether inadequate for the purpose; and it was always his proud boast that he had paid in taxes and royalties to the Government more than twice as much as the whole of the 'Challenger' Expedition had cost them. He (the speaker) could not refrain from quoting the following pregnant sentence from the introduction to the great and important "Summary of Results" (1895):—"It has been my earnest endeavour to complete the publications in a manner worthy of the naval position and scientific reputation of this great empire." That spoke the man in the most illuminating manner. He was devoted, absolutely devoted, to the last days of his life, to the science of the sea. Anyone who had been to Edinburgh and been in the 'Challenger' Office, maintained at Sir John Murray's expense, must realize what a priceless treasure the nation possessed in the collections which were there stored. Sir John possessed in the 'Challenger' Office the deep-sea deposits from every known corner of the world. The results of every Oceanographical Survey undertaken by any nation were sent to Sir John Murray, and these were all classified and stored to form an index and reference museum of the oceanographical spoils of the whole world. Only last week, when the speaker was staying with him in Edinburgh, he had stated his ambition was to send these collections to London, to become a department of the new Science Museum, a permanent source of reference, under conditions which were then discussed, for students of marine biology. He founded the marine laboratories at Granton and at Millport, and he was honoured not only by his Queen and by the Royal Society, who awarded him their Royal Medal, but among other distinctions conferred upon him he was one of the very few foreign Members of the Prussian Order of Merit. To the day of his death he was ever keenly enthusiastic, and was seriously contemplating another 'Challenger' expedition, to start within the next few years; and only half an hour before he departed on the journey which ended in his death, he sent a letter to him (the speaker) enclosing to Mr. Earland and himself a pinch of sand which he had just picked out of some dredgings from the West Coast of Africa, containing a Textularian which he was unable to identify, and asking them to help him in its classification.

That he should have been cut off in so tragic a manner was terrible. Only that afternoon he (the speaker) was sitting looking at the wonderfully interesting photographs and listening to the accounts of Scott's expedition to the Antarctic, and he could not help comparing these two men, and wondering which was more to be envied—Scott, a comparatively young man, who laid down his life at the moment of its greatest achievement, or Sir John Murray, who, having finished work as great, in its own line, lived to see the results published to the profit of the whole world. It seemed to him that there was nothing to choose between them —each had died at the moment when his fame was at its greatest, and his name most sympathetically cherished by the world.

He earnestly desired the Fellows of the Royal Microscopical Society to authorize their Secretaries to communicate their deep-felt sympathy with Lady Murray in her bereavement in the usual manner. The proposition was accepted, the Fellows of the Society rising in their places.

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**Mr. C. H. Caffyn** then demonstrated his method of the preparation of a rock section, which demonstration was followed by another by Mr. C. H. Caffyn and Mr. J. W. Ogilvy of a series of Colour Photomicrographs of Rock sections.

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**Mr. H. F. Angus** demonstrated a "Comparison Eye-piece," which he described as an apparatus of value when it was desired to observe two images placed side by side.

The Chairman said that there was no doubt that an arrangement enabling one to compare two organisms of whatever nature without having to shift the slides would prove of great value. He was sure that all would concur in passing a hearty vote of thanks to Mr. Caffyn, Mr. Ogilvy, and Mr. Angus, for their communications, and for the very remarkable display of Microscopes and specimens which were exhibited on the table that evening.

The vote of thanks was carried unanimously.

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**Dr. Shillington Scales** then read a communication from Mr. E. Moore Mumford, on "Some Observations on the Morphological Changes occurring in *Beggiatoa alba* on Staining by various Methods," which was illustrated by lantern slides.

A hearty vote of thanks was unanimously accorded to the author for his interesting contribution to the Society's records.

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**Dr. J. Evans** then read a paper on "Recent Developments in the Petrological Microscope," illustrated by lantern slides.

After the paper, the Chairman said he deeply regretted that time passed so fast, and that the lateness of the hour precluded any discussion taking place on Dr. Evans's extremely interesting and learned paper, for there were many points which opened up fields for debate. He was sure, however, that all would be in accord with him when he proposed a very hearty vote of thanks to Dr. Evans.

The vote of thanks was carried with acclamation by all present.

A cordial vote of thanks was also passed to those gentlemen who had so kindly lent Microscopes that evening.

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It was announced that the next Ordinary Meeting of the Society would be held on Wednesday, April 15, when Mr. Enock would give a Lantern Demonstration.

The next Meeting of the Brass and Glass Section would be held on Wednesday, March 25.

The Biological Section would meet on Wednesday, April 1.

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**New Fellows**:—The following were elected *Ordinary* Fellows of the Society: E. Moore Mumford, M.Sc., and Rev. George Herbert Nall.

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

Petrological Microscopes, by Messrs. Beck, Leitz, Swift, Watson, and Zeiss.

Mr. H. F. Angus:—Comparison Eye-piece.

Mr. C. H. Caffyn:—Rock Sections.

Messrs. J. W. Ogilvy and C. H. Caffyn:—Series of Colour Photomicrographs of Rock Sections.

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# JOURNAL

OF THE

# ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1914.


## TRANSACTIONS OF THE SOCIETY.

### VII.—*Some Observations on the Morphological Changes occurring in Beggiatoa alba on Staining by various Methods.*


By E. Moore Mumford.



(*Read March* 18, 1914.)


Plates VI, VII.

Having occasion to attempt to prepare some stained preparations of *Beggiatoa alba* Winogradsky for photographic reproduction, the author experienced considerable difficulty in obtaining a stained preparation of a typical thread.

On fixing and staining by the usual bacteriological methods, it was found that the sheaths suffered morphological changes and completely altered in appearance, resembling indeed the higher bacterium *Sphærotilus.*

Experiment, however, showed that the changes occurring in the sheath were not only conditioned by the fixing by heat and the staining with dyes such as gentian-violet, but that the deciding

EXPLANATION OF PLATE VI.

Fig. 1.—Strand of *Beggiatoa alba* (× 750). Collapse of cells, the matter in which still exhibits granulation. There is a distension of the sheath between the cells.

,, 2.—Strand of *Beggiatoa minima* Winogradsky (× 1000). Typical appearance. From a creamery effluent.

,, 3.—Strand of *Beggiatoa alba* (× 1000). Collapse; no granulation visible; distortion of sheath between the collapsed cells. From sulphuretted hydrogen water culture.

,, 4.—Strand of *Beggiatoa alba* (× 1000). Typical appearance. From natural stream growth transferred to sulphuretted hydrogen.

factor was the age or relative healthiness of the sheath. That is, fresh sheaths growing freely in a pabulum of sulphuretted hydrogen collapsed at once, but sheaths which had had very little sulphuretted hydrogen for twelve hours or so suffered less collapse, while the sheaths which had been transferred to fresh water with very little sulphuretted hydrogen, for twenty-four hours, rarely exhibited collapse.

The collapse is caused, therefore, by the mounting methods, but depends on the "sulphur state" of the bacterial thread; it seems probable, therefore, that when the sheath is in exceptionally favourable circumstances part of the sulphur is present in the colloidal state in the cell, which, therefore, when surrounded by a reagent of high osmotic pressure, will collapse; when, however, the cell is not so well supplied with sulphuretted hydrogen, the colloidal sulphur in the cells changes to the granular form, and, as a consequence, the cell becomes permeable to reagents, and so exhibits no collapse.

The author's reason for making this small communication is that stream-growths are frequently identified from stained preparations which, on occasion, as can be seen from the slides, would certainly lead to *Beggiatoa* being described as *Sphærotilus.* Growths of higher Bacteria should invariably be identified, unstained and untreated in any way, in a film of water illuminated with a dark-ground illuminator.

A point which the author would like to raise for discussion is why the sulphur granules in the sheaths have not reverted to *a*-sulphur, a change which, as Winogradsky describes, takes place in forty-eight hours in sheaths killed in dilute picric-acid solution, but which receive no further treatment.

The dye used in making the preparations for these slides was gentian-violet in alcoholic or anilin solution.

The negatives were made in a vertical camera by Nachet, the optical equipment being a 2 mm. semi-apochromat N.A. 1·32 by Leitz and a X4 complanat eye-piece by Winkel; illumination was effected by a Thoria composition "lime" heated by oxygen and coal gas, the light being filtered by a copper-sulphate and picric-

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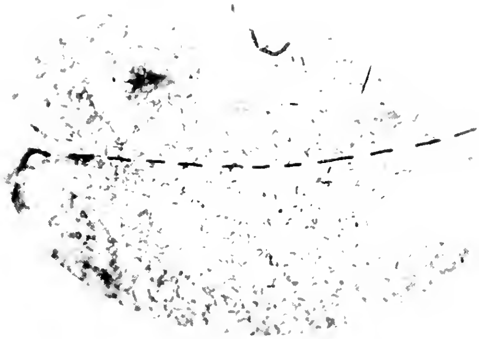
EXPLANATION OF PLATE VII.

Fig. 5.—Strand of *Beggiatoa alba* (× 750). Collapse and disappearance of sheath. From infusion.

„ 6.—Strand of *Beggiatoa* (× 1000). Collapse; no granulation visible; collapse of sheath in places; cell-material collapsed in one place to a thread with slight bulging of sheath. From infusion.

„ 7.—Strand of *Beggiatoa alba* (× 750). Collapse and granulation of cells; very visible distortion of the collapsed cells has also taken place; the sheath is nearly invisible, but is outlined against the other bacteria present. From infusion.



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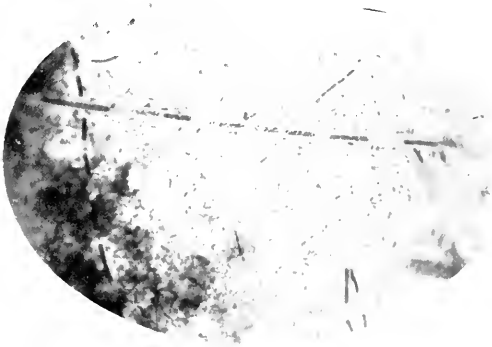

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acid tank, and focused with a Watson Holoscopic condenser N.A. 1·00.

The stand was by Swift, and the plates used were Barnet Medium Isochromatic, which are well sensitized to wave-lengths passed by the screen and which afford good contrast with gentian-violet stained objects.

The slides were made from the negatives by contact by Messrs. Flatters and Garnett.

By infusion is meant strong sewage, allowed to become septic, which has calcium sulphate added and sulphuretted hydrogen blown through at intervals.

# OBITUARIES.

## Albert Grunow, Hon. F.R.M.S.

By J. B. De Toni, Hon.F.R.M.S.

One of the oldest Honorary Fellows of the Society, Albert Grunow, elected in 1879, died in Berndorf, Austria, on March 17, 1914, where he was born on November 3, 1826.

Albert Grunow was Chemist to the Berndorf Dye Works, but he soon became attracted to the microscopical investigation of unicellular Algæ, his first studies being on the new or critical species of Austrian Desmidiaceæ, Pediastreæ, and Diatomaceæ, edited between 1858 and 1863. During the same period he published a criticism on the Desmids and Diatoms distributed by Gersternberger in Rabenhorst's Decaden and on the genera Ceratoneis and Frustulia. Afterwards, Grunow described the species of the Algæ collected by H.M.S. 'Novara' in the voyage round the world, 1867, and of the Algæ from the islands of Fiji, Tonga, and Samoa (1874). He also made observations on other subjects, e.g. on Diatoms from the deposit of Jutland (1866); on the Diatoms on Sargassum from Honduras (1867); on the distinction of the forms of Schizonema and Berkeleya 1868; etc.

In 1878 Grunow published a study of the Caspian Algæ, which was followed by other interesting papers on some new species of Nitzschia (with notes by Fred. Kitton) and on species of Grammatophora.

Grunow's fame was much increased by his important contributions to the knowledge of the fossil Austro-Hungarian Bacillarieæ (1882), of the Diatoms from Franz Josephs Land (1884) the region of Bogos in Africa (1886), the Kaiser Wilhelms Land (1889), and other extra-European regions.

In collaboration with P. T. Cleve, a distinguished chemist and Diatomologist of Upsala, he published a remarkable study of the Arctic Diatoms, which was a veritable monograph especially as regards the genera Achnanthes, Navicula, Pleurosigma, and Nitzschia.

The name of Albert Grunow is closely united with that of Henri van Heurck, in the publication of the well-known and much appreciated "Synopsis des Diatomées de Belgique." This afterwards appeared in an English translation under the editorship of Mr. Wynne E. Baxter, F.R.M.S.

Grunow also wrote a great number of summaries on various microscopical subjects, and on Algology, which are to be found in the list made by Julien Deby for the bibliography of the Diatomaceæ. This was published in the second volume of my "Sylloge Algarum omnium."

Recently Grunow devoted himself to a critical revision of the genus Sargassum, but was doubtful about publishing this revision owing to the many gaps in our knowledge.

May I express the hope that the results of the patient and distinguished Algologist may not be lost, and that some competent botanist will complete and bring to perfection the monograph of this difficult genus of Fucoideæ? With these few words I will conclude a modest but sincere tribute of esteem to the memory of our illustrious colleague.

The following is a list of the most important publications by the late Albert Grunow:—

Die Desmidiaceen und Pediastreen einiger Oesterreichischen Moore. Wien, 1858.

Ueber neue oder ungenügend bekannte Algen. Erste Folge: Diatomaceen-Familie Naviculaceæ. Wien, 1860 (5 Taf.).

Die Oesterreichischen Diatomaceen. I–II. Wien, 1862 (7 Taf.).

Ueber einige neue und ungenügend bekannte Arten und Gattungen von Diatomaceen. Wien, 1863 (2 Taf.).

Reise seiner Majestät Fregatte Novara um die Erde. Botanischer Theil. Bd. I. (Algen) Wien, 1867 (12 Taf.).

Algen der Fidschi-, Tonga- and Samoa-Inseln. Hamburg, 1874.

Algen und Diatomaceen aus dem Kaspischen Meere. Dresden, 1878.

On some new Species of *Nitzschia* (with notes by F. Kitton). London, 1880.

Beiträge zur Kenntniss der Arktischen Diatomeen (in collaboration with P. T. Cleve). Stockholm, 1880 (7 Taf.).

Beiträge zur Kenntniss des fossilen Diatomeen Oesterreich-Ungarns. Wien, 1882 (2 Taf.).

Die Diatomeen von Franz-Josefs Land. Wien, 1884 (5 Taf.).

Diatomaceæ. In Martell's U., *Florula bogosensis.* Firenze, 1886.

Some Critical Remarks on the Oamaru Diatom papers of Messrs. Grove and Sturt. London, 1889.

Algæ. In Schumann k. u. Holbung M., Die Flora von Kaiser Wilhelms Land. Berlin, 1889.

Algæ marinæ nonnullæ. In Lauterbach u. Schumann, Flora des Deutschen Schützgebietes in d. Südsee. Berlin, 1900.

## Thomas J. Barratt.

### 1841–1914.

Mr. T. J. Barratt was best known as the Managing-director of the great firm of A. and F. Pears, which, under his able administration, had been raised to an eminent position in the commercial world. He joined the Society in 1898, but his attendances at the meetings were few and far between. When a young man he was a regular attendant at the scientific meetings held at the house in Piccadilly of Mr. Robert Hardwicke, a publisher of many scientific works. It was possible that from these meetings, attended chiefly by young men, the Quekett Microscopical Club first sprang: at any rate the first or preliminary meeting took place in the Piccadilly House. Of the Quekett Mr. Barratt was an original member, but on leaving for Australia he resigned his membership and did not rejoin till 1885.

As far as can be ascertained, Mr. Barratt never made any communication to the Royal Microscopical, the Quekett, or other Society. Though his interest in microscopical work was great, it was almost entirely limited to the optical side. His aquaintance with the Microscope dated from 1856, when he was presented with a cheap German model as a school prize; his microscopical equipment, however, eventually amounted to about a dozen Microscopes and fifty objectives, among the former being one made by Powell and Lealand for Dr. Dallinger. This, which had agate bearings, was his favourite instrument. The objects of his research were chiefly Diatoms, of which he possessed a large collection (over 4000 slides).

In the Art world he was well known. He began collecting Morland prints when about 25 to 30 years of age. At that time the prints fetched £10 apiece: nowadays they are worth ten times that amount. He left a fine collection of these Morland prints, of paintings of the Norwich School, of blue china, sculpture, antique silver, and numerous examples of the art of Raeburn, Morland, Constable, Old Crome, Burgess, Lawrence, John Gilbert, Rochard, and others.

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## John Davies Siddall.

### 1844–1914.

J. D. Siddall is appreciatively described by a great friend as "a self-made man who had an innate talent for acquiring knowledge, and a special aptitude for distributing it." For many years he gave with great success lectures on Botany, and was associated with Mr. H. B. Brady in working out the 'Challenger' collection of Foraminifera. He wrote a paper on the Foraminifera of the Dee, the specimens being collected from the ripple marks in the sand, caused by the receding tide. The days when living specimens were found in these forays he used to mark as red-letter days.

Mr. Siddall was for several years President of the Chester Society of Natural Sciences; for a long time he was a member of the Town Council, and also auditor for the city. To this Society he was best known by the paper he read in April 1912, "Notes on the Life-history of some Marine Diatoms," and by the specimens he showed on the same occasion of *Coscinodiscus heliozoides.*

# SUMMARY OF CURRENT RESEARCHES

RELATING TO

# ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

# MICROSCOPY, ETC.*

## ZOOLOGY.

### VERTEBRATA.

#### a. Embryology.†

**Development of the Heart in Fishes and Amphibians.**‡—Jaromir Wenig has studied the early development of the heart in *Scyllium*, *Pelobates*, and *Bufo*, and comes to the conclusion that while the mesoderm is chiefly responsible for the establishment of the heart, there is a giving off of endoderm cells to share in forming the endothelium. There seems to have been a transference of endothelium-forming function from endoderm to mesoderm, but the endoderm still assists.

**Yolk-granules of Amphibians.**§—C. Saint-Hilaire discusses the structure and chemical composition of the yolk-granules, the changes that they undergo in the cells of the larva, in degenerating ova, in the phagocytes of various animals, in the intestine of *Dendrocœlum lacteum*, and in Amœbæ and Infusorians. The yolk-granules are quite definite structural elements of definite chemical composition, specific in both respects for different types. They may melt away as in the cells of the larvæ; or become rounded and gradually dissolve, as in follicle cells; or become dissolved in vacuoles, as in amœbæ; or break up into disks, in rare cases; or be gradually hollowed out, as in the cells of the intestinal epithelium. There is a complex chemico-physical interaction between the yolk-granules and the protoplasm of the cells in which they find themselves. Substances pass from the protoplasm into the yolk-granules and weaken them. Dissolved nutritive materials pass out from the granules into the protoplasm.

* 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.

‡ Morphol. Jahrb., xlviii. (1914) pp. 281–342 (2 pls. and 27 figs.).

§ Zool. Jahrb. (Abth. Allg. Zool. Physiol.) xxxiv. (1914) pp. 107–232 (7 pls.).

**Action of Corpus luteum on Mammary Glands.***—P. Bouin and P. Ancel have shown that the development of the mammary gland in pregnancy is due to the influence of the corpus luteum, and, furthermore, that there is another influence exerted by the same body, which has the effect of sensitizing the glandular cells so that they respond to another factor (normally a specific hormone), and begin to secrete.

**Artificial Production of Corpora lutea.**†—Chas. H. O'Donoghue corroborates the observation of Ancel and Bouin that artificial bursting of the ripe follicles in a rabbit may be followed by the formation of the corpora lutea. He found, however, that this was not invariable. If the rupture of the follicles was followed by the formation of corpora lutea, there was also a growth of the mammary glands. The amount of growth in fourteen or fifteen days was about equal to that in the normal pregnant female of twelve days. On the other hand, if the follicular rupture was not succeeded by the formation of corpora lutea, then there was no growth of the mammary glands, although the operation performed had been precisely the same in the two cases.

**Corpus luteum in Marsupials.**‡—Chas. H. O'Donoghue has studied the corpus luteum in *Perameles obesula*, *P. nasuta*, *Macropus ruficollis*, *Petrogale penicillata*, and *Phascolomys wombat*. In these species the ovaries have far fewer corpora lutea than the ovary of *Dasyurus viverrinus* has; the wall of the ripe follicle has the same structure as in *D. viverrinus* or in higher mammals; the formation of the corpus luteum in *P. obesula*, *P. nasuta*, and *M. ruficollis* is similar to that described for *D. viverrinus*; the structure of the fully formed corpus luteum in *P. penicillata* and *P. wombat* is as in related species: the corpus luteum spurium is precisely identical with the corpus luteum verum; in the ovaries of *M. ruficollis*, *P. penicillata*, and *P. wombat*, but not in *P. obesula* and *P. nasuta*, there are degenerating corpora lutea or corpora fibrosa, which probably disappear through the agency of leucocytes.

The lutein cells are derived exclusively from the cells of the membrana granulosa, while the proliferations of the theca folliculi (both theca interna and theca externa) give origin only to the connective-tissue of the corpus luteum. In *P. obesula* and *P. nasuta* the lutein cells multiply by mitosis. A corpus luteum also occurs in the duckmole. That of the Marsupials examined is not distinguishable from, nor inferior to that of Eutheria.

**Regeneration of Testes in Birds.**§—C. J. Bond has studied the consequences of orchectomy in fowls and pigeons. When the testis is removed intra-capsularly, a regeneration of the secreting-tissue of the testis and the tubuli seminiferi takes place within the emptied capsule. This regeneration must take place from the capsule, or, more probably, from microscopic fragments of secreting-tissue which are left adhering

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 150–3.
† Ex Journ. Physiol., xlvi. (Feb. 15, 1913) 1 p.
‡ Arch. Mikr. Anat., lxxxiv. (1914) 2te Abt., pp. 1–47 (4 pls. and 1 fig.).
§ Journ. Genetics, iii. (1913) pp. 131–9 (2 pls. and 9 figs.).

to the capsule at the time of operation. It seems that the cell-divisions of the mother sperm-cells which provide the spermatozoa in the regenerated testis do not take place in exactly the same order, or are not exactly of the same kind, as those which form the sperm-cells before the castration. The facts suggest that the stimulus may alter the character of or the proportionate rate of cell-division; but further enquiry is necessary.

**Influence of Röntgen Rays on Ovaries.***—Manfred Fraenkel has experimented with guinea-pigs. An animal was subjected to the rays on the fourth day after birth. Its growth was retarded. It became mature and had offspring which were undersized. Their offspring were undersized also and were sterile. In the experiments several servings and pregnancies were failures. A hair defect was produced by the rays on the head of the first animal, and a similar defect appeared on the same place in the next generation: and similar cases were observed. All the animals showed an accumulation of fat. Cystic degeneration of the ovaries was observed in the sterile forms.

**Development of Gonads in Chick.**†—Jean Firket has made a careful study of this problem. In the early primordium two formations are to be distinguished, similar in aspect, but different in significance: (*a*) the urogenital connexions or the rudiment of the rete; and (*b*) the genital strands or epithelial strands of the first proliferation. In the chick the urogenital connexions appear first. They are seen in an embryo of ninety-five hours, as a mass of compact tissue adjacent to sixteen primary Wolffian glomeruli. These glomeruli form part of the middle portion of the mesonephros. In the chick, the urogenital connexions differentiate within the mesenchyme, which occupies the space between the germinative epithelium and the Wolffian glomeruli. They are distinctly isolated from the former. Their relations with the glomeruli are secondary.

In Amniota the urogenital connexions appear early. They are derived from the special portion of mesoblast which lies at the point where the pedicel of the somite is continued into the lateral plate. They are homologous with nephrostomial canaliculi. The differences in the relations between the urogenital connexions and the Wolffian body in Mammals and in Sauropsida are due to the fact that the urogenital connexions form a phylogenetically stationary ensemble, which does not share in the cranio-caudal shortening of the urinary apparatus and the genital primordium.

The epithelial portion of the supra-renal capsule is derived from a special portion of the peritoneal epithelium. This portion forms a longitudinal linear zone, marked in its cephalic part by a deep and constant groove; it corresponds to the narrow space which separates the Malpighian glomeruli of the Wolffian body and the sub-cardinal vein. A portion of the supra-renal capsule arises, in its caudal half, from cellular buds detached from the mass of the urogenital connexions.

* Arch. Mikr. Anat., lxxxiv. (1914) 2te Abt., pp. 111–18 (1 pl. and 6 figs.).
† Arch. Biol., xxix. (1914) pp. 201–351 (5 pls.).

The genital strands are formed rather late in the chick, in the course of the sixth day of incubation. They are true buds of the germinative epithelium, as in Mammals. Their formation is rapid and soon ceases. The connective-tissue of the genital rudiment arises from the sub-germinative mass of mesenchymatous origin from which the urogenital connexions are also differentiated. The derivatives of the germinative epithelium do not share in the formation of the connective cells. With the appearance of the connective trabeculæ there coincides the appearance of blood-vessels coming from the Wolffian body.

When the strands of the first proliferation are formed, this ends the period of sex-indifference—on the seventh day. The distinctive sex-characters are at first far from well-marked. The right ovarian primordium is seen to be smaller. The young ovary shows, as compared with the young testis, a greater thickness and inequality of the superficial epithelium, a less definite limitation of the medullary strands, and less abundance of connective-tissue. The precocious degeneration of the Müllerian duct is the characteristic sign of the male sex.

In the embryo of eleven days the ovarian rudiment of the chick shows two zones:—(1) the medullary zone, formed in greater part by the epithelial strands of the first proliferation; and (2) the cortical zone, resulting from a second proliferation of the germinative epithelium. In the chick, as in Mammals, the medullary strands are ephemeral formations. They disappear a few days after hatching; the chicken fourteen days old shows no trace of them. They have a progressive period of development with cellular differentiation, which gives place to a counter process of regression.

The ovary of birds is characterized by the appearance, within the medullary strands, of a system of closed cavities, which have no communication with blood-vessels or with urinary canaliculi. These medullary cavities play a part in the process of degeneration, of which indeed they are the first sign. In this process an important part is played by leucocytic elements of mesenchymatous origin, which form groups in the medullary zone into which they penetrate. The medullary oocytes, very numerous at the end of incubation, have a brief existence. Their nuclei never get past the "pachytene" stage. They are never surrounded by a follicular envelope.

The medullary strands undergo a fatty degeneration, which is particularly marked when the constitutive cells are dis-aggregated and fall into the medullary cavities, where they undergo liquefaction and absorption. The more resistant gonocytes may pass from the cavities into the blood stream.

The interstitial tissue of the chick ovary appears on the twelfth day of incubation. It is represented by two cellular types which differ in aspect, position, and origin. The interstitial cells have a history parallel to that in Mammals. There is no evidence of any trophic function of the interstitial tissue in relation to the epithelial tissue.

A constant phase in the development of the medullary strands is the accumulation in their interior of fatty globules. This precedes the differentiation of the medullary oocytes, and seems to be an index of a transitory recrudescence of cellular metabolism.

The strands of the second proliferation—the cortical strands—enter into the composition of the cortical zone of the ovary. It is from their elements that the definitive ova are formed. These are large, as in all animals with meroblastic ova [but some Teleostean ova cannot be called large ?] ; they are directly surrounded by follicular epithelium ; there is no follicular cavity. The first cortical zone corresponds to the primary cortical zone in Mammals. There is not in birds any third proliferation of the germinative epithelium. A few cortical strands degenerate, and this seems to point towards the complete retrogression of these structures in Mammals, such as the cat. In exceptional cases the cortical zone does not completely surround the medullary zone, which may be compared with what is normal in the ovary of the mole.

There is a duality of origin in the gonocytes of birds. The primary gonocytes appear very early in the course of ontogeny, before the formation of the definitive genital primordium. The secondary gonocytes differentiate at the expense of cells of the cœlomic epithelium, which, because of this, deserves the name of germinative epithelium. The primary gonocytes are from the first independent of the cells which surround them. This independence is marked by the faculty they have of changing their position within the tissue by amœboid movements, and by the absolute parallelism of development in the case of gonocytes occupying quite different positions. The primary gonocytes pass through the typical phases of other sex-cells. They have the value of oogonia till the eleventh day of incubation in the female embryo. Most of them degenerate. It is impossible to determine whether in the cortical zone of the ovary some of the primary gonocytes may not attain to maturity. The fact is that the primary gonocytes have mainly a phyletic interest. They are the vestiges of elements which became definitive ova in Cyclostomes and Acrania. The history in Amphibians is much the same as in Birds. The granular form of chondriosomes, which Rubaschkin regards as characteristic of the gonocytes, is not a constant character.

In the development of the ovary, the first step, occurring at the end of the second day, is the appearance of the primary gonocytes. They appear on both sides of the middle line in the splanchnopleure of the 24–30th somites. They approach the middle line, reach the internal side of the Wolffian body, and penetrate into a differentiated portion of the cœlomic epithelium formerly called the genital primordium.

Subsequently there are formed the "urogenital connexions," that is to say the rudiment of the rete ovarii. They differentiate within the mesenchyme from a special portion of mesoblast, as already noted.

The rete having been formed, all that remains is due to the germinative epithelium—a specialized portion of the peritoneal epithelium which gives origin by successive proliferations to cellular buds. The first formed are the future medullary strands ; these are followed by epithelial strands of the second proliferation. Some elements of the ovary show retrogressive changes, others progressive changes. The medullary strands illustrate the former, the cortical strands the latter. There is a struggle among the possible ova, and only a small percentage attain to maturity.

**Development of the Centrifuged Egg of the Frog.***—J. W. Jenkinson notes that the egg of the frog has a polar structure—the plasma and glycogen gradually decreasing in concentration from one point on the surface towards the diametrically opposite point, while the yolk gradually increases in concentration in the same direction. The pigment lies in a superficial sheet in the plasmatic two-thirds of the egg. As a result of fertilization this polar structure is replaced by a bilateral structure when the grey crescent appears on one side of the egg at the margin of the pigmented area.

To this structure the embryo's ordinary development is definitely related. The head of the embryo is formed near that pole towards which the concentration of the plasma is increasing—the animal pole. The blastopore closes near the vegetative pole, that towards which the concentration of the yolk is increasing, while the dorsal side is that on which the grey crescent appeared.

By the centrifuge the materials of the egg are driven past one another in opposite directions, the fat towards the centripetal (animal) pole, with some entangled pigment and some plasma, the yolk and pigment towards the centrifugal (vegetative) pole, while the movement of the plasma is opposite at one end to that of the fat, at the other to that of the yolk.

Where the separation of materials is nearly or quite complete no development is possible, nor even a normal cleavage. In less severely centrifuged eggs there may be abnormal development.

Yolk deprived of its plasma cannot divide, though nuclei may be present. Meroblastic eggs may result. Derangement of material may lead to degeneration of the front part of the head and the blastopore may fail to close, the yolk plug remaining exposed. The first of these malformations must be assigned to the excess of fat and lecithin, the deficiency of plasma and possibly of glycogen, and probably also of yolk, since the yolk contains a store of nucleo-protein which is presumably normally used in the production of fresh nuclear material. The persistence of the yolk plug, on the other hand, is caused ultimately by a deficiency of plasma.

When the distribution of materials remains approximately normal in the equatorial tract while altered at the poles, the development of the middle part may be regular. With more centrifuging, however, the usual distribution is lost in this region also, and then the power of development disappears. The heart, pronephros, auditory vesicles, nervous system, and alimentary canal all go, and an embryo results, in which no development has occurred beyond the differentiation of some mesoderm.

A certain arrangement of most of the visible materials of the cytoplasm is a condition of normal development. The concentration of the plasma, glycogen, and yolk must be graduated in a certain way, that of the fat must be uniform. As Morgan pointed out, the position of the pigment is alone unessential. But with this exception the factors to which the egg owes its visible polar structure are also the causes of the production from that egg of a normal organism.

* Quart. Journ. Micr. Sci., lx. (1914) pp. 61–158 (6 pls. and 18 figs.).

**Development of Mucous Membrane of Stomach.***—Maurice de Laet has studied this in embryos of the rabbit, and finds that the stomach grows by its epithelium, the mesoderm only following this growth and adapting itself thereto. Processes of vacuolization, growth of epithelium, formation of primary villosities, and transformation into secondary villosities occur in a fashion analogous to that described by Tandler for the duodenum, and by Kreuter for the œsophagus. But the epithelial proliferation never amounts to a transitory obliteration of the lumen of the stomach. Increase "by vacuolization" is characteristic of the narrower and more muscular regions of the alimentary canal. At first the epithelial proliferation appears to be of equal intensity all over, and it seems everywhere to secrete, or at least to allow the filtration of, a fluid charged with mucus. In the fundus the musculature, reduced in the adult, rudimentary and slow of development in the embryo, offers hardly any resistance, and readily allows the epithelium to extend. In the œsophagus and duodenum, and in the pyloric region, it resists more and thus modifies the intra-epithelial processes. But this is the limit of the rôle of the mesoderm in the development of the stomach. It has but a mechanical influence, supporting the epithelial layer that covers it. The latter develops of itself in virtue of its inherent properties.

### *b.* Histology.

**Tadpole Epithelium cultivated in Plasma.**†—S. J. Holmes has studied the behaviour of the ectodermic epithelium of tadpoles of *Rana*, *Hyla*, and *Diemyctylus*, the tissue being kept alive in culture media, such as blood-plasma and lymph. Pieces of tissue frequently send out extensive strands or sheets of ectodermic cells into the surrounding medium. The cell masses tend to extend upon some solid surface such as the cover-slip, fibres of cotton, or the surface of a coagulated mass of plasma. The isolated cells of ectodermic epithelium show a tendency to spread out widely and to creep along a solid surface. Scattered cells which come into contact in the course of their spreading may form a perfectly continuous secondary membrane. Active epithelial cells have a thin clear margin of protoplasm which puts forth fine pseudopods and undergoes marked changes in outline. It is probably by means of this amœboid movement that the spreading and migration of individual cells are accomplished. Evidence from several cases was obtained to show that the masses of cell that were put forth were not pushed out and did not grow out, but were drawn out by the amœboid activity of the cells at the free surface of the mass. Unfavourable conditions tend to make the epithelial cells assume a rounded form. Heat causes them to retract their pseudopods and makes the strands of cells contract and break up into masses. There is a limited amount of multiplication in the isolated cells of the ectoderm. Amitotic divisions of the nucleus may occur *in vitro*, but they were not found to be followed by a cleavage of the cytoplasm. Isolated cells from young

* Arch. Biol., xxix. (1914) pp. 353-87 (1 pl. and 1 fig.).
† Public. Univ. California (Zool.) xi. (1913) pp. 155-72 (2 pls.).

embryos undergo comparatively little differentiation, while cells that form part of an organized mass of tissue may continue to develop.

**Elastic Tissue of Hard Palate of Mammals.***—Jakob Rehs has made a topographical and histological study of the elastic tissue of the hard palate throughout the class of Mammals. In general, it may be said that the elastic fibres mostly coming from the propria mucosæ are spread out in the periphery of the primary papillæ, but in the different orders there is considerable diversity in detail, which is discussed at length.

**Isolated Living Pigment Cells.**†—S. J. Holmes has studied isolated living chromatophores from the larvæ of *Hyla renilla* and *Diemyctylus torosus*, and has convinced himself that the black and yellow cells of the former have an amœboid movement. It is, of course, possible that in the adult the cell-processes of the chromatophores are more fixed in outline, and that the changes in the distribution of pigment may be brought about largely by the flow of granules within the cell. But the extent to which amœboid-movement occurs in the pigment-cells of the larva suggest scepticism as to the commonly received interpretation that the pigment moves within the cell.

**Regeneration of Intestinal Epithelium in Insects and Amphibians.**‡—J. Duesberg refers to Braun's description of the phenomena observed in the metamorphosis of the intestinal epithelium in the larvæ of *Deilephila euphorbiæ*, and points out the remarkable resemblance between what occurs in the insect and what occurs in tadpoles. Duesberg has described in the latter how the basal cells regenerate the whole intestinal epithelium and show such rapid nuclear multiplication that each forms a syncytium.

**Femoral Pores.**§—H. v. Eggeling finds that the integumentary structures found on the ventral surface of the upper part of the hind leg in some Anura and Urodela have nothing to do with the femoral pores of lizards. In Anura they are typical skin-glands. The femoral pores of lizards are perhaps approached by the femoral folds in *Diemyctylus viridescens*, and it is suggested that the gland-like epidermoid structures of lizards have been evolved from thickenings of the integument at the breeding season which are associated with strong cornification. These thickenings are well seen in the males of *Diemyctylus*; they are of use for adhesion in the amplexus and perhaps also serve in tactile stimulation.

### *c.* General.

**Uro-patagial Stylet or Calcar in Bats.**‖—Ed. Retterer and F. de Fénis have studied the development of this structure, which

* Zeitschr. wiss. Zool,, cix. (1914) pp. 1–127 (4 pls. and 7 figs.).
† Public. Univ. California (Zool ) xi. (1913) pp. 143–54 (2 pls.).
‡ Zool. Anzeig., xlii. (1913) pp. 1–2.
§ Jen. Zeitschr. Naturw., li. (1914) pp. 123–62 (9 figs.).
‖ C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 418–21.

helps to support the caudal part of the patagium. It has been described as tendinous, cartilaginous, and osseous; it has been regarded as part of the calcaneum, and otherwise interpreted. The authors find that in young bats it is independent of the calcaneum. In the course of time its axis ossifies at the expense of cartilaginous cells, and its proximal end is united by amphi-arthrosis to the internal surface of the calcaneum.

**Respiration in Amphibians.***—H. L. Brunner has studied the mechanism of pulmonary respiration in Amphibians with gill-clefts. It is a force-pump mechanism as in higher Amphibians. In *Necturus* and *Proteus* and the larvæ of higher lung-bearing Urodeles, a median choanal valve prevents the escape of the air from the mouth through the nasal cavity; in *Siren* there is this median valve and there is a posterior one, enclosing the antorbital cartilage, by means of which the choana can be opened; in *Amphiuma* there are smooth muscles for opening and closing the nasal vestibule, and there is a complicated choanal mechanism, which includes the antorbital cartilage and two striated muscles; in *Cryptobranchus* the choana is closed by the hyoid arch, and respiration, both bucco-pharyngeal and pulmonary, is similar to that in *Amphiuma*. It may be said that *Necturus* and *Proteus* are slightly modified permanent larvæ, that *Siren* is a modified larva whose choanal mechanism has been brought under muscular control; that Cryptobranchiata are much modified arrested larvæ with the essential parts of the aquatic mechanism except gills, and also with the pulmonary mechanism of the higher Urodeles.

**Olfactory Sense in Amphibians.**†—H. L. Brunner finds that the usual medium of smell is the same as that used in bucco-pharyngeal (or branchial) respiration, which is renewed by regular oscillations of the floor of the mouth. Under ordinary conditions the intermittent pulmonary respiration has little or no value for olfactory purposes. The olfactory medium may be air or water. In adults the olfactory organ is more highly developed in air-smellers than in water-smellers.

There are two types of olfactory (respiratory) mechanism; (*a*) in the first type the respiratory medium passes freely inward through the nasal cavity to the mouth, but its return is prevented by a valve; (*b*) in the second type the respiratory mechanism is wholly under muscular control, and the olfactory medium passes freely in and out through the nasal cavity.

Thus Brunner distinguishes (*a*) monosmatic forms (single smellers) including *Necturus* and the larvæ of *Amblystoma* and *Rana*, in which the olfactory organ is used to test only the external medium, from (*b*) diosmatic forms (double smellers) including *Siren*, *Cryptobranchus*, *Amphiuma*, larvæ of lungless salamanders, and the adult stage of higher Amphibians, in which ingoing and outgoing currents bear odorous matter to the olfactory organ, which is accordingly used to test both the external medium and the contents of the oval cavity.

In single smellers, Jacobson's organ is wanting, and the olfactory

* Morphol. Jahrb., xlviii. (1914) pp. 63-82 (11 figs.).
† Morphol. Jahrb., xlviii. (1914) pp. 157-65.

organ is simple ; in double-smellers the olfactory organ is complex and Jacobson's organ is present. Thus Seydel's view is confirmed, that the organ of Jacobson is used primarily to test the contents of the oral cavity.

**Respiratory System of Thyphlonectes.***—O. Fuhrmann has studied the extraordinary peculiarities of the respiratory system in this Cæcilian. In other Gymnophiona the left lung is very rudimentary and the right lung reaches to about the posterior third of the liver (exceeding the liver a little in *Chthonerpeton*). In *Thyphlonectes* the right lung reaches to near the cloaca and the left lung reaches well below the liver. Both are very narrow and show all along their length cartilaginous rings, like the trachea, sometimes with a slight trace of ossification. The right lung has about 180 of these. This is quite unique. The long trachea gives off ventrally in front of the heart a peculiar spindle-shaped enlargement, which turns out to be an accessory third lung. There is also cutaneous respiration and probably buccal respiration. The animals often swim actively in pursuit of fishes, and the narrow lungs evidently require to be assisted.

**Peculiar Air-sac in a Lemur.**†—R. Anthony and I. Bortnowsky describe in *Microcebus* from Madagascar a very interesting subcutaneous cavity, lined with stratified epithelium, which extends along the dorsal surface to the bases of the limbs. It appears to be in connexion with the air-passages, probably opening into the trachea behind the larynx, like the retro-tracheal sac of some other Lemuroids, but this point has not been cleared up. It is suggested that the sac has to do with equilibration.

**Poison-glands of Snakes.**‡—Marie Phisalix finds that the differences in the poison apparatus in different kinds of snakes cannot be used for taxonomic purposes. The elaborateness of the apparatus as a whole is not correlated with the toxicity of the poison. The poisoning function has been superposed on the older function of salivary digestion, and a salivary toxicity is observed in other types. The poisonous quality is an exaggeration of a more general disintegrating and digestive action.

**Modifications in Birds due to Changes of Diet.**§—A. Magnan has made an interesting series of experiments on the mechanical and chemical effects of different diets on young ducks belonging to the same brood. The different diets were insects, fish, flesh, and vegetables, and the naturally omnivorous ducks were able to live normally on any one of these. These experiments showed that a vegetable diet considerably increases the surface of the digestive tube, while a carnivorous diet reduces it. The cæca and the large intestine vary in the same manner, being most developed with a vegetable diet. The weight of the intestine is greater in animals which subsist on rigid prey, because of the

* Zool. Anzeig., xlii. (1913) pp. 229–34 (7 figs.).
† Arch. Zool. Expér., liii. (1914) pp. 309–24 (2 pls. and 7 figs.).
‡ Ann. Sci. Nat. (Zool.) xix. (1914) pp. 65–104 (5 pls.).
§ Ann. Sci. Nat. (Zool.) xix. (1914) pp. 115–225 (32 figs. and tables).

thickening of the muscular walls. This was specially apparent in the fish-fed birds, though the intestinal surface was not the largest. The weight and surface of the proventriculus increase in proportion to the size of the prey. This is purely the result of a mechanical action and was well shown by the fish-eaters.

The chemical effects of the different diets were seen first in the liver, which underwent profound modification. Fish-diet and insect-diet caused hypertrophy, but both a pure flesh-diet and a vegetable-diet caused a diminution in weight. The kidneys were modified in a precisely similar way in relation to the different diets, and this seems to the author to point to the greater toxicity of fish and insect as compared with flesh and vegetable food, but further investigation would be required to show whether some other organ, such as the skin, does not react more to a purely flesh diet. The young ducks required more food than the adults. A flesh-diet proves the best as regards growth, and the best even in adult life, though less markedly so. Insects were nearly as nutritive as beef during growth, but in adult life they proved inferior. Fish and vegetables showed themselves unsuited for the younger stages, but in adult life vegetables proved only slightly inferior to beef. Laying began earliest and was most abundant in the fish-fed birds. The modifications brought about in the ducks by each class of diet correspond generally to the characters of the birds whose natural food resembles that class, and the experiments therefore afford striking proof of the great importance of diet as a factor—direct or indirect—in evolution.

## Tunicata.

**Central Nervous System of Tunica nigra.***—W. A. Flitton describes the central nervous system of *Tunica nigra*. The ganglion of this form possesses more branches than have been described for related forms. Many of these branches are quite small, and seem to supply the muscles near them. The neural gland on the ventral side of the ganglion is in places almost fused with the nerve-centre, but free nerve-cells were not found among the gland-cells. The duct from the gland to the ciliated funnel was much like what has been described for other forms. Small somewhat variable strands were recognized in some specimens as rapheal nerves. Another rather thicker mass of nervous substance was found ending abruptly in connective tissue. None of these peripheral nervous structures contained nerve-cells. The nerve-cells of the ganglion were densely crowded into a cortical layer, the central cone being composed chiefly of nerve-fibres. There were a few scattered cells in the central part of this mass of fibres. A large proportion of the cells of the periphery evidently supply muscles. A few cells of the peripheral portion of the ganglion, and many of the scattered central cells, serve apparently for various kinds of associations. In all parts of the ganglion are cells which are apparently connective rather than nervous in function. These are usually smaller than the nerve-cells and have very little cytoplasm, for the central

* Zool. Jahrb., xxxvii. (1913) pp. 113–30 (11 figs.).

portion of the ganglion is an intricate network of fibrillæ, which in places is seen to be continuous from cell to cell, and with the fibrillæ between the nerve-cells. Tigroid-like substance is found in the nerve-cells, sometimes as dense masses, sometimes as flakes or dots. Vacuoles, often containing yellowish pigment, are frequently seen in the nerve-cells. The simple structure, with the relatively small number of association-cells, shows a very simple type of central nervous system.

## INVERTEBRATA.

### Mollusca.

#### γ. Gastropoda.

**Chromosomes in Snail.***—C. F. U. Meek finds that the length of the mitotic spindle, i.e. the distance between the centrosomes, is 15·3 μ at the conclusion of each primary spermatocyte metaphase of *Helix pomatia*, and that the length of the mitotic spindle is 12·1 μ at the conclusion of each secondary spermatocyte metaphase.

The ratio between the lengths of the mitotic spindle at the conclusion of the primary and secondary spermatocyte metaphases is approximately the same in *Helix pomatia*, *Forficula auricularia*, and Man; and, since these ratios are either identical or almost identical with the ratio between the radii of two spheres, of which the relative volumes are the same as those of the cells in question, connexion may exist between spindle-length and cell-volume at this stage.

A comparison of mitotic figures in *Helix pomatia*, *Forficula auricularia*, and Man, proves that the length of the spindle in spermatocyte metaphases cannot be correlated with the volume of chromatin in the cell.

**Structure of Conus.**†—H. O. N. Shaw has made a study of *Conus tulipa* and *C. textile*, and describes the structure of the teeth, the mouth, the gullet, the poison-gland, the poison-duct, the salivary gland, the stomach, the nervous system, and the circulatory system. In spite of the difficulty of the material, it was found possible to make a number of histological observations.

**Metabolism of Snail.**‡—W. Kühn gives an account of observations on *Helix pomatia*, with special reference to the metabolism during the winter sleep, and the periods of torpor brought about by hunger and drought. During the winter sleep there is an exchange of gases both through the epiphragm and through the shell. Hibernation takes place even when external conditions are favourable; a period of summer torpor does not affect the need for the winter sleep. Both during winter sleep and drought torpor loss of weight varies in consecutive periods, and is associated with the temperature. The loss is greater during a period of hunger torpor in summer than during a corresponding

* Proc. Roy. Soc., B, lxxxviii. (1914) pp. 192–7 (1 pl.).
† Quart. Journ. Micr. Sci., lx. (1914) pp. 1–60 (6 pls. and 12 figs.).
‡ Zeitschr. wiss. Zool., cix. (1914) pp 128–84 (9 figs.).

period in winter at the same temperature. The difference is probably referable to the presence of the epiphragm in winter. Emergence from the shell is the result of external conditions of moisture and temperature, and may be brought about at any time, though more slowly in winter than in summer. The snail is able to absorb considerable quantities of water through the skin, but absorption from a damp atmosphere does not take place.

**Structure of Vitrina.***—Ernst Eckardt has studied the structure of various species of *Vitrina*—small snails with somewhat degenerate shells. Ciliated epithelium occurs on the sole and at the spiracle; there are two kinds of mucus-glands in the skin; there are two special glandular areas—one corrresponding to the "Nackendrüse" of *Buliminus*, the other around the spiracle; there are glandular cells with homogeneous secretion among the epithelial cells of the roof of the canal of the pedal gland.

There is only a slight development of ostracum and hypo-ostracum; the peri-ostracum is formed in the mantle-groove; there seems to be a secretion of the calcareous shell from the whole surface of the intestinal sac. The surface of the shell in the embryos shows pores which afterwards disappear; there is no lime in the embryonic shell. There is internal pigmentation even when there is none in the skin.

"Semper's organ" is not a definite organ; it consists mainly of the ganglia of the oral lips. There is a richly innervated transverse ciliated groove on the roof of the mouth, which is probably gustatory and tactile. The cells of the supporting epithelium of the radula share in forming the sub-radular membrane. Twelve odontoblasts form the rachis-tooth in *Vitrina brevis*, and ten the lateral tooth.

There are two kinds of cells in the salivary glands. The calcareous cells of the liver serve secondarily for absorption, which also occurs in the mesenteron. It seems that the gut is shorter in the mountain species, which are in part carnivorous.

The optic nerve is an independent nerve. The buccal nerves are poorly developed. The most anterior pedal nerves are probably concerned with touch. The penis nerve arises high up on the pedal. There is no trace of olfactory organ. The lens of the eye is probably formed from Beck's cells. The statoliths are formed by the vacuole cells of the statocysts from the fluid contained in them.

By the torsion of the shell a transverse position of the kidney has been induced. The podocyst appears to be a motor embryonic organ connected with the circulation. Ureter and rectum open separately into the respiratory passage. There is a typical urinary groove. The reproductive organs have many peculiarities in detail, and particular attention is devoted to the dart-sac and its gland.

### δ. Lamellibranchiata.

**Insertion of Muscle on Shell.**†—A. Brück has studied this in freshwater mussels. The attachment of the muscle to the shell is effected

* Jen. Zeitschr. Naturw., li. (1914) pp. 213–376 (1 pl. and 82 figs.).
† Zool. Anzeig., xlii. (1913) pp. 7–18 (5 figs.).

by the mediation of a specially differentiated epithelium, the so-called attaching epithelium. This secretes hypostracum and also "epithelial fibrils," each of which is fused at one end with a muscle-fibril and cemented at the other end on to the hypostracum. Each fibril is thus indirectly connected with the calcareous shell.

## Arthropoda.

### a. Insecta.

**Eyes of Nocturnal Insects.***—E. Bugnion discusses the peculiarities of the eyes of nocturnal insects. Those of *Oryctes rhinoceros* obliquely illumined at night shine like two rubies. The same phenomenon is seen in *Xylotrupes gedeon* and *Catharsius molossus*, and in some nocturnal Lepidoptera. The eyes of *Sphinx* shine with a reddish colour; those of some species of *Bombyx* with a golden yellow. In *Sphinx euphorbiæ* the retina is very thick and infiltrated with rose-coloured "erythropsin." Each retinule is divided into a deeper and a more superficial segment, and a retinal tapetum is developed like the choroid tapetum in Mammals. The flat cells filled with crystalloids which reflect the light in the cat, are represented in the hawk-moth by a reticulum of fine tracheæ full of air. The reflection is facilitated by a movement of the pigment. The colour is probably due to the erythropsin. It is probable that the light reflected from the tapetum influences the visual cells a second time. It is possible that invisible rays are changed into visible rays in the reflection.

**Germ-track Determinants in a Parasitic Hymenopteron.**†—Robert W. Hegner has pointed out in previous studies that in almost every case where an early segregation of germ-cells has been demonstrated in the development of animals, a peculiar inclusion appears in the cytoplasm of the egg at or near the time of maturation. This body finds its way into the primordial germ-cell or cells, breaks up into granules, and becomes distributed among the descendants of the primordial germ-cells. These inclusions make the determination of the germ-track possible, and have been called "the Keimbahn-determinants." Hegner has studied the matter in a poly-embryonic Hymenopteron parasite—*Copidosoma* (*Litomastix*) *truncatellus*, previously investigated by Silvestri.

A "nucleolus" was described by Silvestri near the posterior end of the egg. But it does not arise from the nucleolus of the germinal vesicle as he supposed. It consists of the entire chromatin content of an oocyte nucleus. Because of its constitution and fate, this body has been named the "Keimbahn-chromatin." Its history is as follows:—The chromatin within the nucleus of the young oocytes seems to form a spireme, which breaks up into chromosomes; these appear to unite in pairs at or near their ends, and are then drawn upon an asterless spindle; this spindle does not proceed to divide the chromatin, forming two

* Bull. Soc. Vaud. Sci. Nat., xlix. (1913) pp. xxxiii–vi.
† Anat. Anzeig., xlvi. (1914) pp. 51–69 (18 figs.).

daughter-nuclei, but gradually contracts and condenses until it becomes an almost spherical mass of chromatin; this Keimbahn chromatin becomes situated near the posterior pole of the egg, and is recognizable as the "nucleolus" of Silvestri.

The nucleus of the fully developed egg seems to arise in the following manner: oocytes fuse end to end in pairs: the posterior member is the older and contains the Keimbahn-chromatin only; the anterior oocyte of the pair possesses a spindle which breaks down and transforms into a resting nucleus. Thus every egg of *Copidosoma* consists of two oocytes which have united end to end.

**Parthenogenesis in Otiorhynchus.***—G. Grandi finds evidence of parthenogenesis—cyclical at least—in a Mediterranean beetle, *O. cribricollis*; and the same fact has been noted in *O. turca* and *O. ligustici* by Ssilantjew and Wassiliew respectively. Grandi examined hundreds and all were females, which showed considerable variability. The males remain unknown. Egg-laying was observed. The spermotheca was found to be somewhat reduced in size, and without trace of spermatozoa.

**Contents of Adipose Cells of Caterpillars.**†—A. Ch. Hollande has investigated the formation of albuminoid crystalloids and of urates in the adipose cells of *Vanessa io* L. and *Vanessa urticæ* L. The cells are of two kinds: (1) large cells situated round the intestine, containing numerous yellow globules of fat; and (2) much smaller cells, with white fat-globules about the periphery of the body. This difference is only a transitory result of the more rapid accumulation of fat in the peri-intestinal cells, and it tends to disappear towards the approach of the pupal stage. At this stage two new elements appear in the adipose cells; granules of urates of soda and albuminoid crystals. The author has studied the formation and origin of these elements. Unlike previous investigators, he does not find that the urates are eliminated from the blood by the adipose cells; these have no excretory function. The urates within them have not an exogenous origin, and their accumulation is not associated with non-functioning of the Malpighian tubules, so that the adipose cells cannot be regarded as a "supplementary kidney." The urates arise as products of the transformations of the albuminoid substances within the adipose cells themselves. The disappearance of the fat vacuoles, the formation of minute albuminoid globules round the nucleus, and the appearance of fine granules of urate of soda are described in detail, and the urates are seen to be the final stage of the nucleo-proteids. When the pupal stage in over, the adipose cells contain very few albuminoid crystals; the cells again become filled with fat globules, but the granules of urates persist for a long time, if indeed, they ever disappear. The origin of the perinuclear albuminoid globules is still unknown. It is possible that the adipose cells abstract from the blood the albuminoid materials necessary to their formation, but that is doubtful. It seems to the author probable, though not yet demonstrable,

* Boll. Lab. Zool. Scuola Agric. Portici, vii. (1913) pp. 17–18.
† Arch. Zool. Expér., liii. (1914) pp. 559–78 (1 pl.).

that a part of the fat of the adipose cells may be transformed into an albuminoid substance.

The relations subsisting between the appearance of the albuminoid substances in the adipose cells and the formation of urates lead the author to believe that, while among Lepidoptera and Coleoptera the adipose cells themselves have the power of modifying nucleoproteids into biuretic polypeptids and urates of soda, in some Hymenoptera the function may be distributed between two distinct cellular elements: an adipose cell which modifies the albuminoid substances, and a cell closely apposed to it which eliminates from it the urates resulting from this modification.

**Structure of Necrobia ruficollis.***—N. Cholodkovsky describes the structure of this minute insect, and calls attention to some histological peculiarities. The epithelium of the chylific stomach is very low, and forms a net of irregular polygonal meshes in which lie numerous crypts with minute cells. The anal glands are also remarkable. They consist of two epithelial layers; the cells of the outer layer are small, with clear protoplasm and a small nucleus, and are continued into a long chitinous efferent duct, which is enveloped by a membrane-like efferent cell (whose nucleus alone is distinct), and is continued between the large cells of the inner epithelial layer. The cells of the latter are rich in sap and have large vesicular nuclei. The lumen of the gland shows a chitinous cuticle, which is perforated in sieve-like fashion by the ducts of the above-mentioned small glands.

**Anoplura of Forth Area.**†—W. Evans submits a list of the Anoplura (true lice) found on Mammals in the Forth area. In the family Hæmatopinidæ there are four species of *Polyplax*, two of *Hæmatopinus*, two of *Linognathus*, and *Hæmodipsus lyriocephalus* from the hare. The interesting *Linognathus ovillus* (Neumann) occurs on the faces, cheeks, and legs of black-faced sheep. The family Pediculidæ is represented by *Pediculus capitis*, *P. vestimenti*, and *Phthirius inguinalis*, all from man. The family Echinophthiriidæ is represented by *Echinophthirius phocæ* (Lucas) from a common seal, which was so terribly infested with this interesting species that forty-three were taken from one square inch. Its thick coating of stiff hairs no doubt serves to retain a supply of air for respiration while its host is under water.

**Development of Male Copulatory Apparatus in Mealworm.**‡ Th. Kerschner finds in the newly-hatched larva of *Tenebrio molitor* an invagination of the epithelium near the posterior margin of the twelfth sternite. This is the genital pouch. At its blind end two club-shaped structures appear, from which arise the vasa deferentia and accessory glands. Before the last larval moult a pair of papillæ develop at the foot of the genital pouch. Between these the ductus ejaculatorius develops and pushes the accessory glands in a proximal direction. In

* Zool. Anzeig., xlii. (1913) pp. 529–31 (1 fig.).
† Proc. Roy. Phys. Soc., xix. (1913) pp. 93–5 (1 fig.).
‡ Zool. Jahrb., xxxvi. (1913) pp. 337–76 (4 pls. and 11 figs.).

the pupæ the primitive papillæ coalesce; a second pair is formed—the penis papillæ; the cardo appears; a shallow penis pouch arises. In the metamorphosis into the imago, there are changes of form and structure, and the chitin is deposited. The copulatory apparatus is connected with the accessory part of the genital apparatus by two diverticula from the ejaculatory duct. Thus it appears that in Coleoptera, as Zander has shown for Hymenoptera, Lepidoptera, and Trichoptera, the development of a pair of primitive papillæ at the foot of a genital-sac associated with the post-segmental margin of the twelfth abdominal sternite is the starting-point of the whole copulatory apparatus.

**New Genus of Mallophaga.***—J. H. Paine describes *Somaphantus lusius* g. et sp. n. from the guinea-fowl (*Numida ptilorhyncha*) in British East Africa. It is a minute inconspicuous form, structurally near *Menopon*, but having an elongated body, and the sides of the head nearly straight. In general appearance it is unlike any other Mallophagan.

**Remarkable Caterpillar.**†—F. Le Cerf describes a very remarkable onisciform, or *Chiton*-like Lycænid caterpillar, which appears to be reared by ants of the genus *Cremastogaster*, inside galls made on acacia trees on the Kikuyu escarpment. It is the first instance of a Rhopaloceran caterpillar from within a gall. The thick, livid grey, spotted skin is covered with remarkably specialized setæ. The mouth-part suggests a vegetarian diet, and the caterpillar, which is much too large to enter the doorway of the gall, probably feeds on the acacia leaves which the ants store. It must be reared in its prison.

**Peculiar Psychodid Larva.**‡—D. Keilin calls attention to the fact that *Trichomyia urtica* Curtis is xylophagous, thus differing extraordinarily in habit from all other Psychodid larvæ as yet known, which live in a fluid medium. Some live in decomposing fluids, others in streams. All show a posterior respiratory siphon, except this aberrant form, which was found making galleries in old felled trees and eating the wood.

**Structure of Psychoda albipennis.**§—Albert Koch gives an anatomical account of this minute Dipterous insect, with special reference to the alimentary, vascular, and reproductive systems, and enters into considerable detail in reference to the minute structure. He alludes at the outset to the curious development of the scutum and post-scutellum of the mesonetum, as described by Dell in *P. sexpunctata*. The scutum extends forwards above the head, the scutellum underlies the metathorax and the dorsal part of the first and second abdominal segments. Some particles of food were found in the gut, but these may be remains of the larva's meals, and the question whether the adult feeds or not, remains unsettled.

* Smithsonian Misc. Coll., lxi. (1914) No. 23, pp. 1–4 (1 fig.).
† Comptes Rendus, clviii. (1914) pp. 1127–9.
‡ C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 434–7 (2 figs.).
§ Jen. Zeitschr. Naturw., li. (1914) pp. 163–212 (27 figs.).

**Ectoparasitic Insects on Mammals.***—Vernon L. Kellogg has previously considered the distribution of bird-infesting Mallophaga, and comes to the conclusion that their host-distribution is governed more by the genetic relationships of the hosts than by their geographical range, or by any other œcological conditions. He has raised the same question in regard to the Mallophaga and Anoplura of Mammals, and has come to the same conclusion. "Considering how few Mammal-infesting parasite species we yet know, it is surprising how repeatedly the commonness of parasite species to two or more related, although geographically well-separated, host-species, is illustrated." All through the class from Marsupials to Quadrumana, this condition is again and again exemplified. If the conclusion be right, there is an interesting practical corollary, that the distribution of the parasites may give a valuable clue to the genealogical affinities of the hosts.

### δ. Arachnida.

**Two New British Water-Mites.**†—C. D. Soar describes the males of *Arrhenurus scourfieldi* sp. n. from Cornwall and *Acercus longitarsus* sp. n. from South Devonshire. Attention is called to Williamson's records of *Sperchon clupeifer* Pier. and *S. thienemanni* Koen., new to the British area.

### ε. Crustacea.

**Optic Tubercles in Stalk-eyed Crustaceans.**‡—H. Coutière calls attention to these organs which occur on the stalk of the eye in the Penæid *Gennadas* and other forms, e.g. *Euphausia* and *Glyphocrangon*. In some types they are quite well-developed, in others vestigial. They are most complex in bathypelagic Penæids, and are doubtless sensory perhaps appreciating some physical character of the water Just as the Nauplius eye may persist in some higher Crustaceans, so the "frontal organs" of some Entomostraca and of larval Euphausids and Penæids may persist as these optic tubercles; and an interesting corroboration is afforded by the fact that their nerve, though apparently coming from the optic ganglion, goes right through that structure to the brain.

**New Copepod parasitic on Octopus.**§—G. P. Farran describes a new Harpacticid, *Cholidya polypi* g. et sp. n., from a new situation—the arm-membrane of *Polypus ergasticus*, from the west coast of Ireland. It is an Idyoid, adapted for parasitic life, with the swimming appendages reduced or absent, and the cephalon and thorax soft and swollen. The cephalic appendages have the same general structure as in the rest of the family; the inner ramus of the second antenna is very small; the

* American Naturalist, xlviii. (1914) pp. 257–79.
† Journ. Quekett Micr. Club, 1913, pp. 139–42 (2 pls.).
‡ Comptes Rendus, clviii. (1914) pp. 886–8.
§ Ann. Nat. Hist., xiii. (1914) pp. 472–5 (1 pl.).

mandible has an unbranched palp; the first maxilla forms a simple piercer; the first foot is reduced in size, but resembles in form that of *Idya*; the second foot is two-branched, but with its joints and setæ reduced; the third and fourth feet are absent; the fifth feet are highly chitinized and ventral in position, connected by a chitinized ventral plate. The abdomen is not chitinized, and has feebly-marked segmentation. There is one egg-sac. The new form bears some resemblance to *Balænophilus*, described by Aurivillius from the baleen plates of the blue whale, but in *Balænophilus* the adaptation to the peculiar mode of life has not gone so far, and the relationship with *Harpacticus* is at once apparent. Both are parasites in the making.

**Reproduction in Cladocera.***—W. E. Agar has experimented with *Simocephalus vetulus*, and gives the following summary of his conclusions. Certain not yet fully elucidated factors in the environment influence the onset of sexuality. Certain factors likewise bring about "degeneration," or high rate of mortality. Certain factors of the environment may act cumulatively over a number of generations.

Therefore the increasing sexuality and "degeneration" (or high mortality) observed under certain supposedly constant experimental conditions receive a ready explanation in the supposition that the environment is one favourable to the development of these phenomena. This explanation is made much more probable when we find that under other environmental conditions there is no tendency to increasing sexuality or degeneration.

Many species exhibit the phenomenon of specially labile periods, when sexuality is easily influenced by certain factors in the environment. This labile condition is usually ascribed to the fact that the line is in about the middle of the reproductive cycle, the diminishing tendency to parthenogenesis being about equally balanced by the increasing tendency to sexual reproduction. Such a balanced condition must, however, be passed through equally, whether the tendency to sexuality is being increased by the progress of the "cycle," or by the cumulative effect of an unfavourable environment. Hence the existence of labile periods is as readily explained on the one hypothesis as on the other.

There is no justification for retaining the hypothesis of an inherent reproductive cycle—that is to say, the hypothesis that the number of generations or lapse of time since the last fertilized egg influences, as such, the production of sexual or degenerate forms. For the production of these forms is under certain conditions not influenced even by the lapse of an enormous number of parthenogenetic generations, while their production certainly is influenced by environment in other cases. The residuum of cases being equally well explicable on either hypothesis (cycle or environment), it is most reasonable to suppose that the factor that was effective in the one case (environment) was the one that was effective in the other, and conversely, that the ineffective factor of the one case ("reproductive cycle") was ineffective in the other.

* Journ. Genetics, iii. (1914) pp. 179-94.

## Annulata.

**Minute Structure of Sclerocheilus minutus.***—Armand and Lota Dehorne have made an intimate study of this Scalibregmid Polychæt. They deal with the alimentary canal, the circulation, the brain, the eyes, and the nephridia. There are four masses of visual cells, and four optic nerves. The ocular masses may be regarded as formed of a large number of inverted ocelli of the Platyhelminth or Rhynchobdellid type. The visual cells are intra-epithelial, never sub-epithelial. A detailed histological account is given of the eyes and the nephridia.

**Nervous System of Polychæts.**†—David Nilsson has made a detailed study of the nervous system and sensory structure of Amphictenidæ, especially *Pectinaria* (*Lagis*) *koreni*. The brain is three-lobed. In Amphictenidæ, Ampharetidæ, and Terebellidæ it is possible to distinguish three portions like the fore-, mid-, and hind-brain of the free-living forms. The oral tentacles, antennular membrane, and nuchal organs of Amphictenidæ are shown to be homologous with the palps, antennæ, and nuchal organs of free-living forms. The lateral nerves show a dorsal motor root and a ventral mixed root. There is a sub-epithelial nerve plexus. Bipolar isolated sensory cells occur all over the body: they form an essential part of nuchal organs and lateral organs. The theory is upheld that the definitive brain of Polychæta is composed of three pairs of pedal ganglia shunted forwards, and is anatomically comparable to the brain of Arthropods.

**Modifiability of Leech Behaviour.**‡—Wilson Gee has made a study of the behaviour of leeches, with special reference to its modifiability. His observations were made on two species, *Dina microstoma* Moore and *Glossiphonia stagnalis* Linn. The first part of the paper discusses the general reactions of the species in question. The author finds that the most significant single feature of leech behaviour is the tendency to exploratory "random" movements, and that the chief function of the brain in the leech appears to be the production of spontaneity of movement, since decapitated specimens show a marked decrease in the number of internally initiated movements. No trace of a "parental instinct" could be found in the adults; they carry their young only because the small leeches are very persistently and strongly thigmotactic.

In studying modifiability of leech behaviour the investigator considers only the modifications of reflex responses without the intervention of intelligence, and attempts to analyse behaviour into its component physiological factors. Contact-stimulation of the anterior end of the body evokes responses varying with the intensity and localization of the stimulus, the position of the body at the time, the tonus of the organism, and the sequence of the reaction in the chain-reflex involved. The leech readily becomes accustomed to slight shocks and shadows

* Arch. Zool. Expér., liii. (1913) pp. 61–135 (4 pls. and 27 figs.).
† Zoolog. Bidrag Uppsala, i. (1911–12) pp. 85–161 (3 pls. and 12 figs.).
‡ Univ. California Publications (Zool.) ii. (1913) pp. 197–305 (13 figs.).

repeated at thirty-second intervals. Repeated contact-stimulation of the posterior end induces first a gradual increase in activity, followed by a gradual decrease, ending in complete depression. The effects of strychnin, nicotin, cocain, chloretone, and magnesium sulphate, appear essentially the same as those produced in higher animals. Carbon dioxide, mono-potassium, phosphate, and lactic acid produced at first a much increased activity, followed by complete depression. The internal state of the leech exercises a profound influence on its behaviour, hunger producing a greater relative responsiveness, satiety a greater sluggishness The presence of a superfluity of foodstuffs within the body may lead to the accumulation of intermediate metabolic products, which may react on the animal as do the fatigue substances.

## Nematohelminthes.

**Antarctic Nematodes.***—N. A. Cobb reports on the free-living Nematodes collected at Cape Royds by the Shackleton Expedition—twenty-five new species and two new genera—*Aplectus* (near *Plectus*) and *Austronema* (near *Monhystera*). There appears to be great abundance of these Nematodes, mostly vegetarian. The Antarctic species are on the whole somewhat smaller than those of warmer seas, but they are very like them. They seem to be equally prolific. In *Terschellingia polaris* there is marked dimorphism in the spermatozoa ; indeed, it is suggested that three members of the spermatid complex may correspond to "polar bodies." The author also suggests that there are dimorphic species with free-living and parasitic phases.

**Marine Nematode in Sub-alpine Swiss Lakes.**†—B. Hofmänner makes a careful comparison of *Monohystera setosa* Bütschli and *M. dubia* Bütschli, and finds that the former must include the latter. It has been found in the Baltic, in the North Sea, in the Botanic Garden at Frankfort, and now it turns up in sub-alpine lakes in Switzerland.

**Fresh-water Nematodes.**‡—H. Micoletzky gives a systematic account of no fewer than fifty-seven fresh-water Nematodes from the Lake of Lunz, in the East-Alps. He also discusses some of the variations observed, the young stages, the mode of life, and the reproductive relations. In five cases no males were found. As Maupas observed, parthenogenesis and hermaphroditism occasionally occur. All the forms seem to be vegetarian, eating algæ and parts of plants. Infection with parasites is very rare.

**New Nematode from a Buzzard.**§—L. G. Seurat has recently referred the form known as *Spiroptera leptoptera*, from birds of prey, to

* Antarctic Marine Free-living Nematodes. Baltimore, 1914, pp 1–33 (25 figs.).
† Zool. Anzeig., xlii. (1913) pp. 413–18 (4 figs.).
‡ Zool. Jahrb., Abth. Syst., xxxvi. (1914) pp. 331–546 (11 pls. and 1 map).
§ C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 427–9 (3 figs.).

the genus *Habronema*, and to this genus he now adds a new species, *H. mansioni*, from the stomach of the buzzard (*Buteo*). He describes the minute characters of the surface, the spines, the bursa, the ovijector, and the eggs.

**Female Reproductive System of Tropidocerca.*** — L. G. Seurat describes this in two species of this peculiar genus. The deformed globular females are found in the walls of the proventriculus of various birds—such as birds of prey, crows, and sparrows. In *Tropidocerca inermis* there is a greatly elongated very muscular vestibule; in *T. fissispina* the vestibule is very short and gives off a bursa copulatrix, which receives the sperms. The great difference in the vestibule in the two species is correlated with the very long spines of the male in the first case, and the very short spines in the second.

**Plastochondria in Dividing Ova of Ascaris megalocephala.**†—Fr. Meves describes accumulations of plastochondria in the immediate vicinity of the centrosomes, or centrospheres. For the idiosome envelope around the centriole in testicular cells, the term centrotheca is proposed, and it is pointed out that this is not to be regarded as comparable to an attraction sphere. The study of the plastochondria in the *Ascaris* ovum shows clearly that the centrotheca and the attraction sphere are two quite different things.

**Development of Gordius aquaticus.**‡—A. Mühldorf finds that there is total almost equal cleavage. Each blastomere has four chromosomes. A blastula, with a spacious segmentation cavity, is followed by an atypical gastrula. The mesenchyme is formed from both ectoderm and endoderm. The mesenchyme forms "residual mesenchyme-cells," the larval musculature, and two refractive "globules." The embryo elongates, and a transitory præsomatic portion is distinguishable from a persisting somatic portion.

A second invagination at the animal pole forms the region of the spines and the proboscis. A club-shaped swelling of the archenteron forms the "brown gland," which comes to be bigger than the gut itself. After it is separated from the archenteron, it communicates with the proboscis.

The larva is bilateral, symmetrical, and has two anterior ends—represented by the proboscis and the blastopore. Corresponding thereto are two posterior ends. At the "ontogenetic-anatomical" posterior end, there is formed the anterior end of the adult. The præcephalon is very complicated.

Except the protractors of the proboscis, the musculature is mesodermic; there are only longitudinal muscles; they do not form a continuous layer. There is no trace of metamerism. There is no secondary cœlom, nor cerebral ganglion, nor specific sense-organ. The nervous system is a median thickening. Of the parenchyma, which is

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 173–6 (3 figs.).
† Arch. Mikr. Anat., lxxxiv. (1914) 2te Abt., pp. 89–110 (2 pls.).
‡ Zool. Anzeig., xlii. (1913) pp. 31–6.

so characteristic in the adult, there is no trace in the larva. There is no mouth, no anus, no excretory organ, and there are no cilia. It may be that the residual mesenchyme cells eventually form gonads and parenchyma.

## Platyhelminthes.

**New Trematode from the Dark Green Snake.***—Marie V. Lebour describes *Lechriorchis inermis* sp. n. from the body-cavity of *Zamenis gemonensis*. This appears to be the first time that a member of this group, usually occurring in the air-passages, pharynx, and anterior œsophagus, has been found in the body-cavity. Unlike other species of *Lechriorchis*, it has a smooth cuticle, but in some specimens spines can be seen below the surface. This may indicate a gradual disappearance of spines in a situation where there is no danger of being swept away, as is the case in open passages.

**Studies on Double Planarians.**†—L. Böhmig has studied in particular a double form of *Polycelis nigra* var. *brunnea*. The duplication began a short distance behind the mouth; there was a double copulatory apparatus and two genital pores. A pair of cocoons was deposited at intervals. The condition of the nervous and alimentary systems is carefully described.

**New Avian Cestode.**‡—F. E. Beddard describes the structure of *Eugonodæum œdicnemi* g. et sp. n. from a Thick-knee (*Œdicnemus bistriatus*). The rostellum is very muscular, long and retractile, without hooks: the suckers are unarmed; the dorsal excretory tube is much smaller than the ventral, lying more or less laterally to it; the ventral vessels are connected by transverse vessels in each proglottis. The longitudinal muscles are disposed in two rows. The genital pores are unilateral; the genital ducts pass between the excretory tubes; the testes are chiefly behind the ovary, and not very numerous; the ovary is to the pore side, in front of the vitelline gland; the genital atrium is very deep, with radiating muscles; the cirrus-sac is large and muscular, lying in front of the vagina; the sperm-duct has a coil; the cirrus is unarmed; the receptaculum seminis is present, but not strongly marked; no uterus is present. The ova are embedded singly in parenchyma, accompanied by other cells. Round each ovum a cavity is formed later, which is lined by cells.

**Cestodes from Centrolophus pompilius.**§—G. Schumacher gives an account of *Amphicotyle heteropleura*, *Bothriocotyle solenosomum*, and *Echinophallus wageneri*, discussing cuticle, musculature, nervous system, reproductive organs, and other structures in detail.

* Proc. Zool. Soc., 1913, pp. 933–6 (1 pl.).
† Zool. Jahrb., xxxvi. (1913) pp. 307–36 (2 pls. and 5 figs.).
‡ Proc. Zool. Soc., 1913, pp. 861–77 (9 figs.).
§ Zool. Jahrb., xxxvi. (1914) pp. 149–98 (3 pls. and 9 figs.).

## Incertæ Sedis.

**Development of Balanoglossus clavigerus.***—Gustav Stiasny finds that "*Tornaria mulleri*" of the Gulf of Trieste is a pelagic stage of *Balanoglossus clavigerus*, and that the Adriatic "*T. krohnii*" is a later stage of the same. The ova are liberated within the tubes, and form a layer embedded in mucus. There, or after the eggs have been wafted out by the tide, fertilization occurs. There is a double egg-membrane. The segmentation is total, equal, and radial. A cœloblastula exhibits typical invagination.

Stiasny distinguishes (1) a period of progressive development, marked by increase in size, in transparence, and in ciliation, and ending in the *Tornaria krohnii* stage; (2) a period of retrogressive development, in which there is decrease in size and transparence and in ciliation; and (3) the metamorphosis of the pelagic larva into the sand-inhabiting worm.

The author describes the development of the ciliated wreath, the lobes, the cœlomic pouches, the gill-clefts (as endodermic folds of the enteric wall), and the proboscis-gut (as a diverticulum of the œsophagus).

**Gastrotricha.†**—James Murray gives a useful general account of these minute animals, and a bibliography. Most have a roundish, often lobed, head, a more or less distinct neck, a slightly expanded body, diminishing posteriorly to a usually forked, but sometimes undivided extremity. The principal external features are the tubular mouth, certain sensory hairs on the head, various forms of scales and hairs on the dorsal surface, two bands of vibratile cilia along the ventral surface. The animals are on about the same plane as Rotifers for complexity—with alimentary canal, well-developed muscular system, a brain and nervous system, a water-vascular system. They are believed to be hermaphrodite. Most of them occur among the bottom sediment or vegetation in ponds; at least one species (*Chætonotus marinus*) occurs in the sea. They are always in motion, foraging about for food, which they pick daintily here and there.

Murray gives a key to genera, based mainly on the characters of the furca, and a list of the species recorded. He describes some representatives of *Ichthydium*, *Lepidoderma*, *Chætonotus*, and *Chætura*.

## Echinoderma.

**Viviparity and Growth in Amphiura squamata.‡**—A. Djakonov observes that this Ophiuroid must be added to the list of viviparous forms. Numerous young forms of various ages were found in the brood-pouches. During the growth some characters remain constant, especially the mouth-parts, while others, such as the number of arm-spines, the shape of the dorsal arm-plates, and the presence of primary

* Zool. Anzeig., xlii. (1913) pp. 487–500 (16 figs.).
† Journ. Quekett Micr. Club, 1913, pp. 211–38 (1 pl.).
‡ Zool. Jahrb., xxxvi. (1914) pp. 291–302 (1 pl.).

plates on the disk, change with age. It is to be suspected that many so-called species of Ophiuroids are only growth-stages.

**Evisceration and Regeneration in Thyone briareus.***—John W. Scott has made a very interesting study of this Holothurian. The evisceration affects œsophagus, stomach, intestine, calcareous ring, nerve ring, tentacles, ring canal, Polian vesicles, stone canal and madreporite, and the retractor muscles of the œsophagus. The method used to produce evisceration was to allow the animal to stand in stagnant water for some time, and then to flood it with running water containing much oxygen. Alternating these processes produced as many as 65 p.c. of self-mutilated individuals. It has been suggested that breakages occur where there are accidental structural weaknesses, but at times the skin of *Thyone* appears to dissolve away with little or no pressure present, and retractors frequently break off by local constrictions instead of by longitudinal pull.

The eviscerated parts of *Thyone* showed for a time great irritability and could be kept alive for some time. The part remaining was less responsive, but reacted to tactile stimulus, and to lack of oxygen. As regards regeneration, it was found that all lost organs may be regenerated. But this occurred only when all parts concerned in evisceration were completely expelled. Otherwise, the animal dies. During the process of regeneration, the behaviour gradually becomes more responsive and is finally like that of the normal individual. This appears to be connected with the growth of a new nervous system.

It appears that while *Thyone* is functionally a bilateral animal, the most conspicuous individual differences involve structures that have a radial arrangement. The Polian vesicles vary greatly in number, in size, and in location. There is a strong tendency for these to occur on the left side, and this arrangement is undoubtedly due to ancestral conditions, for the present bilateral habits of *Thyone* are not likely to have had any influence in producing the asymmetry in question. The retractor muscles in a single radius consist of single or multiple strands, and this variation is closely correlated with a similar variation in the number of Polian vesicles. It was found from the study of a number of specimens that individual peculiarities of structure tend to be reproduced in regeneration, even against the generalized ancestral influence.

It is evident that autotomy enables *Thyone* to survive for a considerable period on a smaller than normal supply of oxygen. Nevertheless, the conditions which seem to give rise to self-mutilation have all a pathological aspect.

The conditions in *Thyone* afford some evidence for believing that when this animal abandoned the fixed stage the Polian vesicles conformed more or less to the radial type. The author maintains that the present arrangement of Polian vesicles in *Thyone* can be best accounted for on the theory of phylogenetic influence. Those vesicles have retained their most complete radial arrangement in those species of Echinoderms which have maintained to a high degree the functional activity of the water-vascular system.

* American Naturalist, xlviii. (1914) pp. 280–307.

## Cœlentera.

**Hypertrophy of Tentacles in Hydra.***—P. Schulze describes a peculiar swelling of the distal ends of the tentacles in *Hydra oligactis*, which seemed to be a reaction due to the presence of swarms of the hypotrichous Infusorian, *Kerona pediculus*. G. Entz jun. has recently reported a degeneration of the tentacles due to *Amœba hydroxena*, but the swelling in this instance was more irregular and less confined to the tips.

**Siboga Plumularids.**†—A. Billard reports on a collection of 71 forms, which include 26 new species and 19 new varieties. A number of other species have not been seen more than once or twice before. Many show a bathymetric distribution, varying from a score of metres to six hundred; *Plumularia ventruosa* was obtained from a depth of 1914 metres. A new genus, *Hemicarpus*, is established for species of *Lytocarpus*, in which the phylactocarp forms a demi-corbula.

**Australian Hydroids.**‡—W. M. Bale reports on a collection of thirteen species, of which seven are new, namely, species of *Campanularia*, *Synthecium*, *Plumularia*, and *Aglaophenia*. Most of the specimens were collected from the Great Australian Bight. A noteworthy feature is the robust character of some of the Plumularians, three of which were fully 2 feet in height.

**Formation of Gonophore in Tubularia and Myriothela.**§—P. Benoit has studied this much-discussed question in *Tubularia indivisa* and *Myriothela phrygia*, and finds that the medusoid nucleus, or "Glockenkern," has an endodermic origin. The genital cells arise from the external epithelium of the manubrium, which is also, according to Benoît, endodermic.

**Structure of Eudendrium griffini.**‖—S. F. Light describes the minute structure of this very distinct new species of *Eudendrium* from the Philippines. Its most important distinguishing characters are the large number of distally-directed tentacles, the long and slender hydranth body, the small size of the hypostome, the presence of only two male gonophores to a hydranth, and the deposition of ova on the pedicels. The terminal hydranths of both male and female hydrocauli are sterile, so that there are probably two types of zooids, nutritive and sexual, or at least a distribution of function. In older colonies they are attenuated and in various stages of degeneration. As a result of the early atrophy of the female hydranths, the gonophores relax and allow the ova to hang down beside the pedicels, in which their weight makes

* Zool. Anzeig., xlii. (1913) pp. 19–20 (1 fig.).

† Siboga-Expeditie, Monogr. VIIa, Livr. lxx., pp. 1–114 (6 pls.).

‡ Biol. Results Fishing Experiments carried on by F.I.S. 'Endeavour,' ii. Part 1 (1914) pp. 1–62 (7 pls.).

§ Comptes Rendus, clviii. (1914) pp. 888–91.

‖ Philippine Journ. Sci., viii. (1913) Section D, pp. 333–56 (2 pls. and 5 figs.)

a depression, and where they become attached by their mesoglœal envelope and probably remain during their early developmental stages. Great numbers of zooxanthellæ inhabit the endoderm cells of the cœnosarc, gastric cavity, and tentacles lying in the bases of the cells next the mesoglœa. They are found in the process of division. They are not so numerous in the cœnosarc, but in the large endoderm cells of the tentacles they form a closely packed layer just within the peripheral walls, thirty or more being found in a single cell. No nuclei of included cells or pseudo-cells are found in the ova of *E. griffini*, and, inasmuch as the zooxanthellæ show a marked resemblance in form and position to the included nuclei or pseudo-cells figured by other authors, it seems very probable that the spherical bodies found in hydroid ova and described as included nuclei or pseudo-cells, were in reality zooxanthellæ taken in by the ova with absorbed endoderm cells.

**Abnormal Ephyra of Cyanea capillata.***—Joyce H. Robson describes a peculiar ephyra. Two of the eight arms had three lobes, with two sense-organs between them. There were other irregularities in the distribution of the sense-organs. The six normal arms had each one sense-organ between the lobes, as is usual; but one of them had also two sense-organs close together, about halfway between the base and apex of the arm, to one side of the middle line. The same thing was noticed in one of the two abnormal (opposite) arms, while the other arm of this pair had a single organ in the same position. The former arm had in addition two sense-organs to one side of the third lobe instead of one, making a total of five sense-organs for that arm, and three for the other.

**Histology of the Medusæ.**†—Sophie Krasinska has investigated the histological structure of the musculature and the peripheral nervous system of *Carmarina* and *Pelagia*. In the peripheral nervous system of both forms large and small ganglion-cells can be distinguished; in *Pelagia* only one kind of sense-cell occurs, while two kinds were found in *Carmarina*. The large ganglion-cells of *Pelagia* are bi-polar, and are often connected with the epithelial surface by a distal process. Those of *Carmarina* are usually multipolar and sub-epithelial. The sub-umbrella sense-cells differ considerably in the two forms. Those of *Carmarina* are highly differentiated and suggest those of higher Metazoa. In *Pelagia* the sense-cells, which bear short stiff bristles and a long flagellum, are only recognizable by their nerve processes and their connexion with ganglion-cells. The tentacles of *Carmarina* have sense-cells, but none could be found in those of *Pelagia*. The most important difference between the two forms lies in the distribution of nerve elements in the sub-umbrella and the tentacles. In *Pelagia* both large and small ganglion-cells occur on the sub-umbrella and in the tentacles: in *Carmarina* the large cells are on the sub-umbrella, the small cells in

* Rep. Dove Mar. Lab., ii. (1913) pp. 34–5 (2 pls.).
† Zeitschr. wiss. Zool., cix. (1914) 1, pp. 254–348 (2 pls. and 5 figs.).

the tentacles. Connexions between muscle and nerve could only be established with certainty in the sub-umbrella, where the myoblasts, and apparently not the muscle-fibres, are innervated. But the great numbers of ganglion-cells and nerve-fibres that occur in the muscle regions make it probable that the whole musculature is innervated. The nerve-plexus is connected on the one hand with the musculature, on the other with superficial sense-cells. Since the musculature is undoubtedly innervated and the peripheral nervous system is capable of conveying stimuli to it, Kleinenberg's theory of the direct irritability of the epithelial muscles (myoblasts) and their power of transmitting stimuli to the muscle-fibres, appears doubtful.

**Development of Thecaphore Hydroids.***—Dr. K. Müller Calé has investigated representatives of three families, Campanulariidæ, Sertulariidæ, and Plumulariidæ, with a view to finding out whether the same multiplicity of types of germinal layer formation obtains among them as among athecate forms. In three forms, *Laomedea flexuosa*, *Plumularia echinulata*, *Sertularia polyzonias*, the type of segmentation and germinal layer formation is the same as that already known for *Clava*. Development begins with total equal segmentation, and the embryo, which is solid from the first, becomes at the fifth segmentation a true multiple-layered morula. From this a planula, essentially like that of *Clava*, arises by secondary delamination. In the ova, rich in yolk, of *Aglaophenia* and *Thecocarpus*, there is, at the beginning of segmentation, a tendency to unequal division and retardation of the division of the plasma relative to the nucleus. Nevertheless, a morula like that of the previously described forms results. From that stage they follow a new path of development leading to a syncytial stage similar to that which, in some athecate forms, follows total segmentation. In the syncytium the superficial layer becomes separated by a membrane as ectoderm. One peculiarity of the Aglaopheniidæ lies in the fact that not nearly all the segmentation-nuclei take part in the building up of the embryo-cells. Many of them, both in the superficial ectodermic layer of the syncytium, and within it, become mingled with the liquefying yolk-masses, and degenerate as yolk-nuclei.

**New Actinians from British Columbia.**†—J. Playfair McMurrich gives an account of the structure of *Peachia quinquecapitata* sp. n., and *Bicidium æquoreæ* sp. n., which are of special interest because they probably represent stages of a single species (of *Peachia*?), and belong to a group that has not yet been described as occurring on the west coast of North America. The second form is not uncommon on the bell of the Leptomedusoid, *Æquorea forskalii*, which is frequent in the waters of British Columbia.

* Zool. Jahrb., xxxvii. (1913) pp. 83-107 (2 pls. and 10 figs.).
† Proc. Zool. Soc., 1913, pp. 963-72 (1 pl.).

## Protozoa.

**Latent Life in Protozoa.***—F. Noc reports on some tubes containing a little water and various Protozoa, which were hermetically sealed in 1908 and recently opened. There was no trace of anything but encysted Amœbæ, some of which revived after ten days or more. This proves survival for six years. A minute Flagellate, *Oikomonas termo*, was got from some rough Tonkin paper after desiccation for five years.

**North Sea Foraminifera.**†—Edward Heron-Allen and Arthur Earland report on Foraminifera dredged by the 'Huxley' from the North Sea. The dredgings examined consisted of loose sand with a considerable quantity of mud. The list of Foraminifera contains no fewer than 133 species and varieties, many of which have not been recorded previously from the areas in question. But it must not be concluded from the extended list that the material was rich in Foraminifera. Except in the case of a few dominant species the number of actual specimens was very small. A noticeable feature from the southern part of the area was the frequency of fossil forms.

**Clare Island Foraminifera.**‡—Edward Heron-Allen and Arthur Earland have given a beautifully illustrated account of the Foraminifera of the Clare Island area. They found no fewer than 299 species, of which 14 are new (in the genera *Planispirina*, *Bathysiphon*, *Bolivina*, *Lagena*, *Lingulina*, *Frondicularia*, *Discorbina*, and *Rotalia*). They report 32 species new to the British Isles, and 20 of which only a single previous British record exists. Of the specimens new to the British Isles, 7 are recorded for the first time as living Foraminifera, having been already recorded as British fossils, for the most part post-Pliocene or sub-recent. The paper is a model of fine workmanship.

**Pacific Ocean Species of Lagena.**§—Henry Sidebottom reports on a collection of species of *Lagena* from the south-west Pacific Ocean. They were arranged on slides by the late Mr. Thornhill, and include over 12,000 specimens. Numerous species are recorded, including a few new forms.

**Degeneration in a Parasitic Infusorian.**‖—Bernard Collin describes degenerative forms of *Chromidina elegans* from the kidneys of *Sepia elegans*. There are normal forms which fix themselves temporarily by their cilia to the outside of the fungiform bodies or swim freely in the urinary fluid, and there are the degenerate forms which traverse the epithelium of the follicles and are imprisoned in the vascular lacunæ within. They increase greatly in size; the nucleus shows

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 166–8.
† Journ. Quekett Micr. Club, 1913, pp. 121–38 (1 pl.).
‡ Proc. R. Irish Acad., xxxi. (1913) Clare Island Survey, Part 64, pp. 1–188 (13 pls., 1 map, and 1 table).
§ Journ. Quekett Micr. Club, 1913, pp. 161–210 (4 pls.).
‖ Comptes Rendus, clviii. (1914) pp. 891–2.

fragmentation: they accumulate reserve granules; they lose all trace of nucleus and chromatin; they are devoured by phagocytes; and a minute sclerotic scar is finally left.

**Encystation in Stylonichia pustulata.***—N. Fermor calls attention to the readiness with which this Infusorian forms a cyst when there is a slight change in the external conditions. He finds, however, that the encystation has more than a protective significance. By studying the condition of the nucleus during the encystment he has convinced himself that there is a process of nuclear recuperation, which gives the Infusorian a new lease of life and allows it to go on dividing. Usually this recuperation is effected by conjugation, but in Fermor's culture there was no conjugation. The exhausted nucleus was recuperated in encystation.

**Balantidium coli.**†—E. L. Walker has made a study of this parasite which is relatively common in the Philippines. The same species occurs in man and pig, and it was transferred to monkeys in 70 p.c. of the cases experimented on. The parasite can produce intestinal abscesses and dysentery. The pig is the chief source of man's infection.

**Studies of Trypanosomes.**‡—J. Firmino Sant 'And gives an account of observations on Trypanosomes in Portuguese East Africa, and deals § especially with the non-flagellate forms of *Trypanosoma rhodiense*.

**Infusorians of Peat-bogs.**‖—G. Mermod has made a careful study of the Infusorian fauna in peat-bogs on the Jura mountains above a level of 1000 metres. He found seventy-two species and varieties, and twenty-eight of these were not found elsewhere. But few of these can be regarded as special to peat-bogs.

**New Infusorians from the Lake of Geneva.**¶—E. André describes some new pelagic forms—*Belonophrya pelagica* g. et sp. n., in the vicinity of *Holophrya*: *Crobylura pelagica* g. et sp. n., which at first sight suggests *Urotricha*, but approaches in the mouth structure to *Enchelys* and *Spathidium*; and *Lionotus gandolfii* sp. n.

**Reproduction of Hypotrichous Infusorians.****—G. A. Baitsell has studied the so-called life-cycle in *Oxytricha fallax* and *Pleurotricha lanceolata*, seeking to determine if it could be eliminated by altered culture conditions. He used a "constant" medium of 0·025 p.c. solution of Liebig's beef extract, a hay infusion medium, and a "varied environment" medium. The study of the graphs in all the daily isolation cultures of both species reveals what might be termed typical "life-cycles." At the beginning the animals gave every evidence of a

* Zool. Anzeig., xlii. (1913) pp. 380–4 (4 figs.).
† Philippine Journ. Sci., viii. (1913) pp. 333–47 (7 pls.).
‡ Arquiv. Higiene Patol. Exot. Lisboa, iv. (1913) pp. 1–50 (1 map).
§ Arquiv. Higiene Patol. Exot. Lisboa, iv. (1913) pp. 77–105 (3 pls.).
‖ Rev. Suisse Zool., xxii. (1914) pp. 31–114 (2 pls.).
¶ Rev. Suisse Zool., xxii. (1914) pp. 179–93 (4 figs.).
** Journ. Exper. Zool., xvi. (1914) pp. 211–34 (1 pl. and 5 figs.).

normal structural condition, but previous to the death of a culture, atypical and degenerate individuals appeared, and these were similar to degenerate animals found by former investigators, by whom they were thought to be due to an inherent condition of senescence.

The results indicate that the dying out of some of the cultures was due, not to a condition of inherent senescence, but to the fact that the culture conditions were unfavourable. In the case of *Oxytricha*, "sister-cells" bred in a mass test-tube culture lived more than twice as long as those bred in daily isolation cultures. In the case of *Pleurotricha*, conditions have been found in which the organism will apparently live indefinitely without conjugation or artificial stimulation.

**Sporogony and Systematic Position of Aggregata.***—Helen L. M. Pixell-Goodrich describes *Aggregata eberthi*, a large Sporozoan parasite of the alimentary canal of *Sepia officinalis*, and finds that it is undoubtedly to be included among the Coccidia, the fertilization being not Gregarine in character, as described by Moroff, but typically Coccidian. The large female gamete is fertilized by the small active bi-flagellate microgamete, and the zygote so formed gives rise to a large number of sporoblasts. The polymitotic nuclear divisions giving rise to the microgametes are so similar to those giving rise to the sporoblasts that they afford some evidence in favour of the view that these stages are homologous. It is remarkable also that the microgametes further resemble the sporoblasts in being enclosed in a distinct cyst.

**New Piroplasmid in Mole.**†—B. Galli-Valerio describes a new Piroplasmid from the blood corpuscles of *Talpa europæa*, and refers it to the genus *Smithia* França. The pyriform shape and the division into four may be noted as characteristic of the genus, but the division was not observed. The name proposed is *S. talpæ*.

**New Myxobolus.**‡—S. Awerinzew describes *Myxobolus magnus* sp.n., which he found in the eye of *Acerina cernua*, as white spots embedded in the iris. These spots consisted of a mass of ripe Myxosporidian spores, referable to the genus *Myxobolus*, and marked by the relatively large size—38–45 $\mu$ in length, by 32–38 $\mu$ in breadth, by 28–35 $\mu$ in thickness. The polar capsule, the polar thread, the large vacuole, the two nuclei, and other features are described.

* Quart. Journ. Micr. Sci., lx. (1914) pp. 159–74 (1 pl.).
† Centralbl. Bakt. Parasitenk., lxxiii. (1914) 1te Abt., pp. 142–3 (1 fig.).
‡ Zool. Anzeig., xlii. (1913) pp. 75–6 (1 fig.).

# BOTANY.

## GENERAL,

### Including the Anatomy and Physiology of Seed Plants.

### Structure and Development.

#### Vegetative and Reproductive.

**Anatomy of Bud-scales.***—E. Brick has studied the details of the anatomic structure of bud-scales, and finds that both in origin and life-history they are essentially leaf-like. The innermost bud-scales may be regarded as arrested forms of foliage-leaves, but the outer scales exhibit features not found in foliage-leaves, and while resembling the latter in many respects, must be regarded as "divergent organs." The similarity of the inner scales and the foliage-leaves concerns not only the general form but also the microscopic structure of epidermis, mesophyll, inter-cellular spaces, etc. The outer scales having suffered arrest at an earlier stage of development show numerous differences both in form and structure. The difference in development of the outer scales corresponds to different morphological types, the individual types varying in the presence or absence of periderm, metacutis, metaderm, phloem, sclerenchyma, glands, etc. Their qualitative anatomy agrees with those parts of the leaves to which they are morphologically equivalent. Suberization of the scales is brought about in such a manner that the bud is enclosed in a simple or complex sheath, and the dead metacutis represents a physiological transition stage between metacutis and cork. In quantitative structure the scales resemble the leaves more closely as they approach the axis of the bud, the greatest divergence being between the outermost scales and the leaves. Thus the number and size of the tracheids of the innermost scales correspond with those of the first young leaves; the vascular bundles of the outer scales show considerable reduction, a fact playing an important part in subsequent development.

**Dehiscence of Anthers.**†—M. Schips has studied the mechanism of the opening of anthers in *Lilium*, *Tulipa*, *Digitalis*, etc. The present paper comprises an historical summary of previous work and two sections dealing with the results now obtained. The experiments of the first section relate to cohesion and to the hygroscopicity of the cell-walls of the fibrous tissues. It is proved that contraction of isolated cells and the corresponding opening of the anther are not due to cohesion but to shrinkage; the force of cohesion is both too small and unnecessary. It is also shown that the folds are entirely due to abnormal outgrowths of the fibrous tissues, and that when the force of cohesion is eliminated

* Beih. Bot. Centralbl., xxxi. (1913) pp. 209–308 (2 pls.).
† Beih. Bot. Centralbl., xxxi. (1913) pp. 119–208 (6 figs.).

the opening takes place as before. Finally, it is proved that Steinbrinck's vacuum method, and also the method involving the use of solutions for removing water, are both unsuitable for testing the force of cohesion. The second section deals with the hygroscopic mechanism for opening the anthers. It is shown that when the fibres are dried a contraction takes place in both length and breadth, the contraction being greatest in a direction perpendicular to the thin membranes; the latter are considerably more active than the fibres in bringing about the opening, which is thus primarily due to them, while the fibres form a support to the inner walls. Both the structure of the individual cells and the arrangement of the fibres favour the opening of the valves. It is thus possible to explain the dehiscence of the anthers where the fibres are arranged so as to form a support on the inner walls of the cells; but further investigations are needed to discover the cause where this is not the case, e.g. where they are arranged in an annular or spiral manner.

**Opening of Achenes in the Ligulifloræ.***—P. Lebard publishes the results of his work upon the opening of the achenes of the Liguliforæ at the time of germination. These achenes consist of two parts, viz. the true achene which encloses the seed, and the podocarp or podogyne; the latter organ is most conspicuous in *Podospermum*. less so in *Tragopogon*, and by examination of these two genera it is shown to be the morphological equivalent of the peduncle; the structure forming its axis lines a hollow cavity continuous with that of the achene, and through the walls the fibro-vascular bundles pass from the receptacle to the pericarp. In the achene itself there are several longitudinal fibrous bands alternating with bands of parenchymatous or lacunar tissue. The fibrous bands coalesce towards the apex, until in *Tragopogon pratensis* they form a continuous layer rendering dehiscence impossible in that region. There are two chief types of dehiscence. In a few genera, e.g. *Tragopogon*, *Podospermum*, etc., several slits occur at the base of the achene, frequently extending into the podogyne; in all other genera, a few slits are formed, and owing to the thrust of the radicle and the expansion of the cotyledons, one of these slits is prolonged either halfway or the entire length of the achene: dehiscence then results from the pressure of the embryo and its increase in volume consequent upon increased hygrometric condition of the atmosphere. *Podospermum laciniatum* is an exception in that the radicle has no part in the splitting of the fruit-wall, which is due solely to the action of humidity on the fibrous bands; thus, this achene forms a transition stage between dehiscent and indehiscent fruits. Finally, the form of the cotyledon varies with the method of dehiscence. Where there are several basal slits, the cotyledons are needle-like; where there is one main slit they have a broad lamina; and where the slits extend only half-way up the pericarp the cotyledons assume an intermediate form.

**Development of Xyris.†**—S. Weinzieher has studied the life-history of the development of *Xyris indica*, with the following results. The

* Rev. Gén. Bot., xxv. (1913) pp. 432-42 (1 pl. and 15 figs.).
† Flora, vi. (1914) pp. 393–432 (2 pls. and 10 figs.).

flowers are diœcious and trimerous, the outer stamens being represented by staminodes. In the prophase of the heterotypic division the chromatic threads of the pollen-mother-cell are parallel to one another; subsequently they break up to form sixteen double chromosomes. Two forms of tetrads have been observed; usually the four cells lie all in one plane; less often there is a double tier of cells with two cells in each tier. The division of the primary pollen-nucleus and the formation of the generative cell occur simultaneously in all the cells of the tetrad. The generative cell is spindle-shaped and it lies freely in the pollen-grain, where also its division takes place. The archesporial cell arises in the sub-epidermal layer of the nucellus, without any division into tapetal cells and embryo-sac-mother-cell. The antipodal cells degenerate very early, and at the same time fusion takes place between the two polar nuclei and the primary endosperm-nucleus. The egg-cell is smaller than the synergidæ. The greater part of the outer wall of the nucellus and also of the inner integument soon begins to cuticularize. Several pollen-tubes may enter one micropyle, and two have been seen to enter one embryo-sac; double fertilization takes place. The first division of the fertilized egg-cell occurs after the formation of several free endosperm-nuclei. The embryo remains undeveloped and without a distinct suspensor. The primary endosperm-nucleus divides in the middle of the embryo-sac; one daughter-nucleus gives rise to the endosperm, while the other passes to the antipodal end and forms the nucleus of a haustorium, which gradually empties before the ripening of the seed. Endosperm is the result of free nuclear division, and each cell is multinucleate, the number of nuclei varying with the size of the cell; the reserve-materials are starch and albumin. The seed-coat is formed from the cuticularized wall of the nucellus, the entire inner integument, and the inner layer of the outer integument.

**Morphology and Anatomy of Hydrostachys.***—H. Schloss has studied the vegetative organs of *H. natalensis*, a plant occurring locally and completely submerged in the mountain-waterfalls. The short fleshy rhizome bears adventitious roots on its sides and lower surface, while leaves arise among the lateral roots and from the upper surface. Each leaf has two stipules fused with one another and with the base of the petiole to form a sheath, which encloses a younger leaf. The leaves vary much in size and form; the primary leaves are 6 to 8 mm. long, and are more or less simple, while the stipules are represented by minute notches; the leaves of the full-grown plant attain a length of 35 cm. and a breadth of 8 cm., and are usually bipinnate. Similar variations occur in the petiole. The fern-like appearance of the leaf is due to a number of outgrowths occurring on the petiole and blade of even the youngest leaves. The author regards these outgrowths as emergences, a theory supporting the relationship of the Hydrostachyaceæ and the Podostemaceæ. The anatomy of the leaves resembles that found in *H. imbricata*, but in addition to the vascular bundles, isolated strands pass from the base of the petiole to the emergences. The latter consist

* SB. Akad. Wiss., cxxii. (1913) pp. 339–60 (4 pls. and 10 figs.).

of cells containing little plasma and no chlorophyll enclosed in an epidermis containing abundant chlorophyll and serving as assimilatory tisssue. An interesting feature is the intercalary growth connected with the meristematic bases of the terminal pointed emergences; by this means both the leaves and the individual pinnæ increase in length. The stem is short, of irregular form, attaining a thickness of 1·5 cm. in large plants. It has no distinct upper and lower surface, and it is impossible to distinguish between root and stem, except at those places where the remains of the old primary root are still visible. The tissues are simple, without any distinct epidermis, and foreign bodies, e.g. diatoms, are often embedded in it. Calcium oxalate glands are frequently present. The structure of the primary root is at present unknown. The functional roots are adventitious, with a smooth surface and a true root-cap. Crystal glands are absent in the root itself, but abundant in the root-cap. Chlorophyll is not present, so that these roots differ in this respect from those of the Podostemaceæ, where the roots function as assimilatory organs.

## CRYPTOGAMS.

### Pteridophyta

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

**Embryo of Helminthostachys.***—W. H. Lang publishes a study of *Helminthostachys*. 1. The embryo extends down into the prothallus before segmentation takes place. The first two walls are transverse. Of the row of three cells thus formed, the one next the archegonial neck becomes the upper tier of the suspensor, and may become further divided or not. The next cell forms the second tier of the suspensor, and becomes further divided up. The terminal cell of the row forms the embryo proper. 2. This latter is at first straight, in a line with the suspensor. It becomes differentiated into a hypobasal half giving rise to the foot, and an epibasal half giving rise to the stem-apex, first leaf, and probably the first root. The apex originates near the centre of the epibasal tier. 3. With further growth the shoot becomes vertical and the axis of the embryo curved; and later this gives rise to the hypocotyl bearing the first leaf and stem-apex. The shoot is at first vertical, though dorsiventral in construction, but later its apex bends over and growth proceeds horizontally. 4. The author compares the Marattiaceæ, Ophioglossaceæ, and seed-plants with reference to embryology, and suggests that the suspensor represents the last trace of the filamentous juvenile stage in plant history.

**Apical Growth and Branching in Selaginella.**†—A. Wand writes on the apical growth and on the branching of *Selaginella*. He studied six species, and finds that the apex of the main shoot is hemispherical, or at any rate approximately so. That of the lateral shoots is parabolic.

* Ann. of Bot., xxviii. (1914) pp. 19–37 (1 pl. and figs.).
† Flora, vi. (1914) pp. 237–63 (figs.).

Its size increases in proportion to its distance from the apex. He gives a synopsis of the six species examined according to the method of apical growth—main shoot, lateral shoots, fructification. In all *Selaginellas* the lateral shoots arise quite laterally without any connexion with a leaf rudiment. Later on, the leaf-base of a neighbouring leaf may become so strongly developed that the shoot appears to be axillary. Another synopsis is given which is based on the method of branching in the species examined. Species which grow by one initial cell branch monopodially; others with more than one initial cell show true or modified dichotomy. There are also intermediates which render it difficult to determine the mode of branching.

**Prothallus of Equisetum debile.***—S. R. Kashyap gives an account of the structure and development of the prothallus of *Equisetum debile*, an Indian species. The prothallus is remarkable thus :—1. Diversity of methods of wall-formation in early stages. 2. Lobes always erect and crowded in natural prothalli. 3. Radial symmetry of prothallus from the earliest stages. 4. Large size when mature. 5. Effect of light upon structure and colour of upper half—very compact and red in direct sunlight; spongy and green in shade. 6. Absence of purely male prothalli. 7. Protogynous condition of the prothallus, helping in cross-fertilization; but all female prothalli do not produce antheridia. 8. Resemblance of antheridia to those of *Lycopodium* in position, structure, and paraphyses. 9. The archegonium has a single neck-canal cell, another point of resemblance to *Lycopodium cernuum*.

**Mixed Pith in Osmunda regalis.**†—D. T. Gwynne-Vaughan gives an account of the structure of an anomalous stem of *Osmunda regalis*, the pith of which at certain points contains scattered medullary tracheæ. He holds that this gives support to the theory that the pith of the Osmundaceæ is phylogenetically stelar and not cortical, and that it arose by the progressive conversion of the central tracheæ of a solid xylem strand into parenchyma.

**Botrychium.**‡—I. Tidestrom discusses *Botrychium virginianum* and its forms, including the earliest records in North America. He recognizes two species—*B. cicutarium* (Savigny) Swartz, with persistent leaves and sporophyll about equal to the sterile segment; and *B. virginianum* (L.) Swartz, with leaves not persistent and sporophyll long-exserted. He regards *B. brachystachys* Kunze and *B. dichronum* Underw. as synonyms of the former.

**Corynepteris and Zygopteris.**§—P. Bertrand publishes a note on the relation of impression-fossils of *Corynepteris* to *Zygopteris*, the

* Ann. of Bot., xxviii. (1914) pp. 163–81 (figs.).
† Ann. of Bot., xxviii. (1914) pp. 351–4 (1 pl.).
‡ Contrib. U.S. Nat. Herb. Washington, xvi. (1913) pp. 299–303 (1 pl.).
§ Comptes Rendus, clviii. (1914) pp. 740–2.

structure of which has been preserved. *Corynepteris* dates from 1860, *Zygopteris* from 1845. Zeiller has insisted on the evident analogies between the two genera, in respect of both fructification and sterile frond. But there still remained the necessity to discover some clear obvious morphological character applicable to impressions and fossils alike. Such a character Bertrand discovered in a specimen of *Corynepteris coralloides* from Bruay, where the rachises of the two pinnæ are inserted at the same point on the primary rachis and are coalescent for about 0·5 cm. In other specimens from Lens the same structure was found, and it corresponds with what has been described for *Zygopteris*.

**Tree-ferns of North America.***—W. R. Maxon gives an account of the tree-ferns or North America, discussing the distribution and habitat, the dimensions and shape of trunk, resting periods, variability in rate of growth, branching of trunks, use as timber, characters of the leaves of Cyatheæ and Dicksonieæ, characters used in the classification of *Cyathea*, *Hemitelia*, *Alsophila*, *Dicksonia*, *Culcita*, *Cibotium*. Excellent distinguishing characters are afforded by the trunk and by the vascular parts of the frond, especially by the base of the stipes, which is usually armed with spines, or clothed with scales, characteristic for the several species. Yet these are the very parts usually missing in herbaria, the whole material consisting of but a portion of the lamina, or it may be a single pinna. Hence, the study of the group is very difficult. Within recent years, however, fuller data have been obtained from collections made by specialists. Sections of the trunks, stipes, lower, middle and upper pinnæ of the fronds of most species are now available for study. Excellent photographs of habit, detail, etc. are supplied.

**Tropical American Ferns.**—W. R. Maxon† publishes further studies of tropical American ferns. In No. 4 he gives an account of 19 species of the *Asplenium Trichomanes* group, with a key and figures of sori, scales, etc.; 4 species of *Dicksonia*; 10 species of *Odontosoria*; *Bommeria* (4) and allied genera, such as *Hemionitis* and *Gymnopteris*: 5 new species of *Lycopodium*; and a new *Cyathea*.

In No. 5 are the following: 11 species of *Oleandra*; *Polypodium duale* and its allies; 6 new species of *Polypodium*; *Pellæa Arsenii*; *Psilogramme*; *Hemitelia* (10); *Marattia* (2); *Lycopodium* (10). Diagnoses of several new species are included as well as keys, plates, and figures.

M. Slosson‡ describes *Trichomanes rhipidophyllum* and *Polystichum machærophyllum*, two new ferns from tropical America, giving figures of their structure.

* Smithsonian Report for 1911 (Washington, 1912) pp. 463–91 (15 pls.).

† Contrib. U.S. Nat. Herb. Washington, xvii. (1913) pp. i–x, 133–79: pp. i–x, 391–425 (23 pls. and figs.).

‡ Bull. Torrey Bot. Club, xl. (1913) pp. 687–90 (1 pl. and 1 fig.).

## Bryophyta.

(By A. Gepp.)

**Inflorescence of Cephaloziellaceæ.***—Ch. Douin, discussing the nature of the inflorescence of the Cephaloziellaceæ, maintains that the habitual sterility of certain species does not prove that they are dioicous. He explains some causes for such sterility. He finds the four following different kinds of inflorescence in the group:—synoicous, paroicous (3 sorts), autoicous, dioicous. He discusses the specific value of the inflorescence, the development of the andrœcium, and the best methods of determining the nature of the inflorescence, adding some rules for drawing conclusions from a hasty examination of the plants.

**Cephalozia.**†—V. Schiffner publishes the result of some studies on *Cephalozia*. In the first note he clears up the confusion which has haunted *Jungermannia catenulata* Hüben. An examination of the type and of numerous other specimens shows that Hübener's original diagnosis is incorrect in certain important points, and that his plant is identical with *J. reclusa* Tayl. and *Cephalozia serriflora* Lindb. *C. catenulata* Lindb. is not the same species, but equals *C. leucantha* Spruce. The complicated synonymy of these and allied species is critically discussed and set in order; and the true structure of Hübener's type is figured. The second note contains a description of *C. spiniflora*, a new species, hitherto confounded with *C. macrostachya* Kaal. The essential points of difference are made clear.

**Treubia insignis.**‡—C. Grün publishes the results of his investigation of *Treubia insignis*. In his summing up he describes the vegetative plant, and the five different sorts of tissues which compose it. Mycorhiza occurs in the layer of starchy tissue. Mucilage organs are found in the form of papillæ, as mucilage cells, and as multicellular, more highly differentiated hairs, the latter only in the archegonial inflorescence. *Treubia* possesses a three-sided pyramidal apical cell, from the right and left segments of which are formed mainly the leaf and the dorsal scale. The archegonia stand, about eight to ten in number, in the angle of the dorsal scale. Of the archegonia of a given inflorescence only one develops into a sporogonium. This is described in detail. The number of haploid chromosomes is 8, the diploid 16, thus agreeing with *Fossombronia* and *Pallavicinia*. With the latter genus there is also a similarity in the manner of division of the tetrads. The opening of the capsule apparently takes place by a dehiscence into four valves, the capsular wall being of three layers, the two inner of which are variously thickened with spiral bands, etc. Asexual reproduction is effected by means of 3- to 4-celled gemmæ.

* Rev. Bryolog., xl. (1913) pp. 81–7.
† Hedwigia, liv. (1914) pp. 311–27 (1 pl. and figs.).
‡ Flora, vi. (1914) pp. 331–92 (3 pls. and figs.).

**Grimmiaceæ.***—L. Loeske publishes the first part of a large work on the mosses of Europe, which will treat of the subject, family by family, and is being prepared by a number of leading bryologists. The mosses are considered from a systematic standpoint, special attention being given to the influence of environment upon form. The importance of studying the morphology as much as the anatomy, and the oophyte as much as the sporophyte, are principles in the preparation of the work. It is hoped that a profound study of the plants in the field will eliminate many of the false determinations made in the past upon a study of dried plants only. Keys to the species and varieties are given, and numerous figures in which the morphology and microscopic structure of the plants is made clear. The present part is concerned with the Grimmiaceæ.

**Moss-galls.**†—I. Familler describes some new galls caused by an *Anguillula* in mosses, and the deformation of leaves and leaf-structure in the species affected, especially *Plagiothecium denticulatum* and *Thuidium abietinum*.

**Influence of Water on Alicularia.**‡—A. J. M. Garjeanne has studied the effect of immersion in water on the tissues of *Alicularia scalaris*. He finds that for a few days the condition is not harmful to the plant: but after that phenomena of regeneration take place and the new growths are not normal. This is shown in (1) a swelling of the chlorophyll grains; (2) changes of the thickenings in the cell wall, and of the oil bodies; (3) degeneration of the living cell-contents; (4) regenerative phenomena; (5) Abnormal leaf forms, deformities of antheridia, formation of numerous mucilage cells on the amphigastria. These changes are described in detail.

**Exotic Mosses.**§—G. Roth publishes a second supplement to his Aussereuropäische Laubmoose, giving descriptions and figures of species in the following genera:—*Archidium* (1), *Bruchia* (1), *Pleuridium* (2), *Astomum* (2), *Acaulon*, (3), *Ephemerum* (1), *Physcomitrella* (1).

**West Indian Mosses.**‖—E. G. Britton publishes lists of West Indian mosses known to Linnæus (2) and Swartz (44), with the original and modern names, synonyms, citations, distribution, and critical notes. *Hypnum trichophyllum* Sw., which has been placed in six different genera, but not satisfactorily, is here referred to *Clastobryum* (family Entodontaceæ), and its peculiarities of structure are described and figured.

**Central American Mosses.**¶—E. G. Britton and R. S. Williams publish a list of 54 mosses of Guatemala and Costa Rica, including a new species and also a new genus, *Isodrepanium*, created for the recep-

* Die Laubmoose Europas. I. Grimmiaceæ. Berlin-Schöneberg: Max Lande (1913) 207 pp. (66 figs.). † Hedwigia, liv. (1914) pp. 264–66 (figs).

‡ Beih. Bot. Centralbl., xxxi. (1914) pp. 410–19 (2 pls.).

§ Hedwigia, liv. (1914) pp. 267–74 (1 pl).

‖ Bull. Torrey Bot. Club, xl. (1913) pp. 653–76 (1 pl.).

¶ Torreya, xiv. (1914) pp. 24–31 (1 fig.).

tion of *Homalia lentula* Wilson, a species which has a distribution extending from Jamaica to the Andes, and has been referred to four different genera. The structure of the fruit is described.

**Mosses of Japan and Corea.***—J. Cardot publishes the third and fourth instalments of diagnoses of many new species of mosses collected in Japan and Corea, mostly by the Abbé Faurie.

**European Hepatics.**†—K. Müller continues his account of the hepatics in Rabenhorst's Kryptogamen-flora, giving descriptions of the following genera with their species and varieties;—*Adelanthus* (end), *Odontoschisma* (4), *Calypogeia* (6), *Pleuroschisma* (4); with keys, figures of structure, critical notes, etc.

## Thallophyta.

### Algæ.

(By Mrs. E. S. Gepp.)

**Eyespot of Algæ and Flagellates.**‡—W. Rothert writes on the eyespots or red stigmata, which occur in almost all swarming conditions of Algæ and green Flagellates. He comes to the conclusion that it is a special form of chloroplast. He discusses the large stigma in Euglenaceæ, the usually small ones in Volvocineæ and in the zoospores of algæ and those in the gametes of *Chlorogonium*, and theirbehavour during cell-division. A peculiarity of stigmata as compared with other chromoplasts is that they are often of quite different form and size from the other plastids in a cell, which are green. As a rule a cell contains only one sort of plastid. But the author does not consider this as an argument against the chromoplast nature of stigmata. Of their origin very little is known.

**Erythropsis agilis.**§—Fauré-Frémiet writes on this organism, of which he has had the good fortune to collect a score of specimens in the Bay of Croisic. Originally it was considered a Protozoon, until Delage and Hérouard pronounced it one of the Peridinieæ allied to *Pouchetia*. Fauré-Frémiet describes its general form, recalling that of *P. cornuta*, the cytoplasm, the nucleus, the stigma, the retractile appendix, which resembles that of a tentacle of a sucking Infusorian.

**Diplopsalis and the Neighbouring Genera.**‖—J. Pavillard writes on the genus *Diplopsalis* and its allies, which have occasioned much dis-

* Bull. Soc. Bot. Genève, iii. (1911) pp. 275–94; iv. (1913) pp. 378–87.

† Leipzig: Kummer (1913) Band vi. (Die Lebermoose) Lief. 18, pp. 209–72 (figs. 61–80).

‡ Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 91–6.

§ Comptes Rendus, clvii. (1913) pp. 1019–22.

‖ Le Genre *Diplopsalis*. Montpellier: (1913) 12 pp. (2 text-figs.). See also Bot. Centralbl., cxxxv. (1914) p. 323.

cussion. He states that *D. lenticula* can be characterized with entire certainty, and has no connexion with the many specific individuals which have been classed with it by various authors. He gives a provisional table of a group of Peridinieæ disposed in a descending series, *Peridinium–Diplopsalis*, according to the progressive reduction of the number of plates of the carapace.

**Three Diatoms.***—J. Pavillard writes on three diatoms, *Schroederella delicatula* H. Perag., *Rhizosolenia fragilissima* Berg., and *Chætoceros Dadayi* a new species. The first of these has a somewhat complicated synonymy. The spine of the central valve and the presence of two marginal "baguettes" justify its position in a new genus, as distinct from *Detonula* as from *Lauderia*. *Rhizosolenia fragilissima* Ost. (non Cleve), *R. faeroensis* Ost., and *R. pellucida* Schroed., are one and the same species. As to *Chætoceros Dadayi*, it is a new species associated, like *C. tetrastichon*, with *Tintinnus inquilinus*. There is in the diatomic chains a sort of hereditary pre-adaptation to symbiosis, but the mechanism of the association with *Tintinnus* is still unknown. *Chætoceros Dadayi* is distinguished from *C. tetrastichon* by the more or less atrophied horns of the right side, while those of the left are much developed, thick, rigid, bristling with hairs, and ending in a point.

**Plankton of the Victoria Nyanza.**†—J. Virieux has studied the plankton of the Victoria Nyanza at two different times of the year, and in two distant localities, Entebbe and Kavirondo. Entebbe is very rich in algæ, with numerous individuals. Both flora and fauna are very varied. An abundance of Desmids was found in the lake. Among the diatoms, *Surirella* and *Cymatopleura* take on a limnetic character. In general there are found the usual lacustrine types, though many elements are missing: *Dinobryon*, *Mallomonas*, *Asterionella*, *Tabellaria*, *Fragilaria*. Rare are *Rhizosolenia*, *Peridinium*, and *Ceratium*. This absence and rarity can only be explained after further research.

**Plankton of the Lac des Settons.**‡—J. Virieux writes on the plankton of the Lac des Settons, which is an artificial lake, 3 km broad, 20 m. deep and situated at an altitude of 600 m. The characters of the plankton are intermediate between those of a lake and of a marsh. The eu-limnetic types are scarce (*Gomphosphæria*) The algæ consist of a mixture of forms well adapted to a plankton life (*Staurastrum*, *Cosmocladium*), and of numerous forms common to marshes. The recent age of the reservoir has not allowed the inhabitants time to take on the complete lacustrine character. The author records about 30 species, three of which are new records for France.

* Bull. Soc. Bot. France, lx. (1913) pp. 126–33 (figs. in text).

† Voyage de Ch. Alluaud and R. Jeannel en Afrique Orientale, 1911–12. Rés. Sci. Paris (1913) 20 pp. (2 pls. and 1 text-fig.). See also Bot. Centralbl., cxxv. (1914) p. 349.

‡ Feuille des jeunes naturalistes, sér. 5, xliii. (1913) pp. 14–17 (figs. in text). See also Bot. Centralbl., cxxv. (1914) p. 263.

**Phytoplankton of St. Vaast-la-Hougue.***—L. Mangin reports on the phytoplankton of the roadstead of St. Vaast, collected at the surface layers. The volume is very poor in winter, increases in March, and presents a first maximum in May or June, and a second more important one in October to November. In winter the plankton is very dense, formed of marine species. At other seasons it is flocculent, consisting of species with long spines and refractory in settling. Peridinieæ are rare, whilst diatoms are remarkable for their abundance. The plankton is homogeneous and very poor in species (May–Aug.); the rest of the year it becomes heterogeneous and varied. The flora of St. Vaast is compared with that of neighbouring regions. The great majority of the species belong to the *Didymus* plankton. No representative of *Styliplankton* of the temperate regions is found, but only of the *Trochoplankton* of the arctic and boreal regions. Of the 45 diatoms, two-thirds are neritic of the temperate regions, and the remaining third belong to the arctic regions. The prevailing ocean currents and their influence on the phytoplankton are discussed.

**Plankton of Greifensee.**†—O. Guyer has examined the plankton of the Greifensee, which he regards as possibly a former stretch of the Linth blocked by a moraine. The phytoplankton contains 40 species. Diatoms predominate in spite of the high temperature of the water. The quick changes and the enormous number of individuals of the various diatom-maxima in winter form a remarkable characteristic. The principal species of plankton is *Ceratium hirundinella*, with which were compared the *Ceratia* of fifteen other Swiss lakes. He distinguishes three different races: (1) "*typicum*," large lake type, with marked seasonal variations, from large lakes where the water is not very warm; (2) "*curtum*," small, with less marked seasonal variation, in large and small warm lakes; 3. "*palustris*," pond type, very large in summer, much reduced in winter, in ponds and very warm lakes.

**Antarctic Fresh-water Algæ.**‡—G. W. F. Carlson publishes a list of the fresh-water algæ collected by C. Skottsberg on the South Shetlands, Graham Land, South Georgia, and the Falklands. New species are described. The author criticizes former work on the Antarctic algæ, and gives a list of all fresh-water species recorded from the region, as well as a complete bibliography.

**Swedish Fresh-water Algæ.**§—O. Borge writes on the fresh-water algæ of the Torre-Träsk region in the north of Sweden. He records 442 species and varieties, some being described as new. Notes are given on points of systematic interest.

* Recueil publ. à l'occasion Jubil. Sci. Prof. Le Monnier. Nancy: 1913, pp. 141–55 (2 figs. in text). See also Bot. Centralbl., cxxv. (1914) p. 262.

† Beiträge z. Biologie des Griefensees. Stuttgart: E. Schweizerbart (1910) 96 pp. (6 pls.). See also Bot. Centralbl., cxxv. (1914) p. 185.

‡ Wiss. Ergebn. schwed. Südpol. Exp., 1901–3, von O. Nordenskjöld, iv. (1913) pp. 1–94 (3 pls.).

§ Bot. Not. Lund, 1913, pp. 1–33, 49–110 (3 pls. and 2 text-figs.).

**Fresh-water Algæ from Riga.***—O. Treboux gives a list of species of fresh-water algæ, collected by himself and others in the neighbourhood of Riga. The Desmids are principally from the marshes near Kurtenhof and Uexküll.

**The Genus Oocystis.**†—H. Printz publishes a systematic account of the genus *Oocystis*, giving new descriptions of the known species. The inner structure of the cells, the chromatophores, and the pyrenoids, is taken into account. Fourteen species are recognized, while thirteen are regarded as probably good though insufficiently described. Figures of all are given. Some new forms and varieties are described.

**Epiphyllous Algæ.**‡—N. Thomas publishes some notes on *Cephaleuros*, a genus of epiphyllous algæ. Two forms were received from Ceylon: (1) Large-celled form; (2) dark-celled form. The structure and mode of growth of these, and of a distinct species from Barbados, are described. The Ceylon plants have a characteristic mode of growth, and their radial walls have a curious loose posterior end owing to the formation of transverse septa, not at the extremity of the radial plate, but at a point slightly farther forward; and in the first form the disks are associated with fungal hyphæ. The Barbados species is distinguished by its subcuticular habit, and the development of rhizoids, the presence of barren and fertile aerial hairs and subcuticular zoosporangia, and the effect which it produces on the tissues of the host. A résumé and a bibliography of previous work on the obscure subject of epiphyllous algæ are given.

**Stigonema.**§—F. N. Blanchard describes two new species of *Stigonema*—*S. anomalum* and *S. medium*—from Essex, Massachusetts. The author compares the characters of these and related forms, and states his view that *Hapalosiphon*, *Sirosiphon*, and *Fischerella* are best regarded as subgenera of *Stigonema*. The main characters of the three subgenera are set forth in tabular form.

**Spirogyra.**‖—E. W. Schmidt describes his experiments on *Spirogyra* under strong centrifugal force. He finds that the result differs from that of many other plants, inasmuch as the chromatophores which have been thrown about, are reinstated in their normal position apparently by the cytoplasmic filaments.

**Prasiola crispa.**¶—F. Brand follows up the history of Kützing's genus *Schizogonium* and its connexion with *Prasiola* Ag. The views of previous writers are discussed, and the structure of *Prasiola crispa* is described both in its normal and abnormal forms. Finally the author gives a

* Korresp. bl. Naturf. Verein Riga, lvi. (1913) pp. 25–7.
† Nyt Mag. Natur., li. (1913) pp. 165–203.
‡ Ann. of Bot., xxvii. (1913) pp. 781–92 (1 pl.).
§ Rhodora, xv. (1913) pp. 192–200 (1 pl.).
‖ Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 35–47.
¶ Hedwigia, liv. (1914) pp. 295–310.

new and complete diagnosis of the species with synonymy, adding six forms, most of which represent species hitherto known under other names.

**Porphyridium cruentum.***—H. Kufferath writes a short preliminary paper on *Pophyridium cruentum*. He finds it can only grow in light, and he gives a list of the chemical substances which are favourable and unfavourable to its culture. He describes the thallus with its gelatinous sheath of two distinct layers, its method of multiplication, and the cell-contents, nucleus, protoplasm, and granulations. He notes as a method of reproduction hitherto unknown in this alga, the presence of two daughter-cells in one mother-cell. Experiments were made on the colouring matter. As regards the systematic position of *P. cruentum*, it approaches Florideæ in its morphological characters. In any case it must not be placed in Cyanophyceæ or Protococcaceæ. Further study of the pigment will help to elucidate the question.

**Nitophyllum punctatum.**†—N. Svedelius describes the tetrad division in the multinucleate tetrasporangium rudiments of *Nitophyllum punctatum*. In a paper on *Martensia* in 1908, he describes a similar multinucleate condition, and is able to add certain important details. He finds that in the tetrasporangium-rudiments of *Nitophyllum*, as of *Martensia*, the number of nuclei increases, though not in so great a degree. Then begins a successive degeneration, so that finally, as in *Martensia*, only one nucleus remains, which becomes the mother-nucleus of the definite tetraspore nuclei. The division of the successful nucleus is a true reduction-division, as was suspected by the author in the case of *Martensia*. The diploid chromosomes in *N. punctatum* (the tetrasporic plant) number 40, and the haploid chromosomes of the tetraspore are 20. Another point of special interest is that each nucleus of the tetrasporangium rudiments is a facultative tetraspore mother-nucleus. Some of them begin to degenerate before undergoing the earliest prophase of the reduction-division; while others go through all stages up to diakinesis. After that, as a rule, only one nucleus continues its course, and in due time produces four tetraspore nuclei. This phenomenon of the degeneration of nuclei in different stages of development is without a parallel in the plant world. The author discusses the theoretic possibility of the perfect development of more than one of the many nuclei in which case sporangia would arise containing several tetrads. In one abnormal case he found a tetrad showing three tetraspores, which he figures and discusses, pointing out that the power of forming tetrads is not confined to one nucleus, and that the multinucleate tetrasporangium rudiments in *N. punctatum* are entirely comparable with a multinucleate archesporium of the higher plants.

**Development of the Florideæ.**‡—K. Killian writes on the development of the Florideæ. He follows up the early stages of many species

* Bull. Soc. Roy. Bot Belg., lii. (1913–14) pp. 286–90.
† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 48–57 (1 pl.).
‡ Zeitschr. f. Bot., vi. (1914) pp. 209–78.

of Ceramiaceæ, Rhodomeleæ, Delesseriaceæ, Grateloupiaceæ, Nemastomaceæ, Rhizophyllideæ, *Chrysymenia*, *Chylocladia*, *Gelidium*, and *Plocamium*. Finally, he makes a general comparison of the various types and gives his conclusions. He finds unmistakable similarity between the species of the Ceramio-Rhodomeleæ-Delesseriaceæ group, as regards the development of the vegetative organs, amounting even to a progressive series. And the same may be said of the attachment-disk type. The more primitive forms develop their disk irregularly, the higher forms develop it by regular division of the spore. Again, in certain forms the upright shoot is composed of an uncertain number of filaments, and in others the number is determined. The most regular development is that in which the erect organs arise from divisions of an apical cell. These early variations are to be recognized in the later stages of the plant. In spite, however, of the facility of grouping certain types together in a phylogenetic connexion and of drawing conclusions from the study of early development, the dangers of error are great. It is difficult to determine which character is of primary, which of secondary importance—the result of adaptability. This is shown in the attachment disk, which shows great similarity in the most different germlings, while species of the same genus occur, some with, some without it. It may, indeed, be that the various types are in no way connected phylogenetically. For instance, the development of *Chrysymenia* closely resembles that of *Halymenia*, whereas the formation of the fruit in the two species, which we regard as a relatively stable character, is totally different. These points show the danger of applying the law of biogenesis. The author suggests that a comparison of the development of the Florideæ must be carried out on wide lines for a solution of phylogenetic problems; wide enough to determine the comparative value of characters. At present the principal characters considered in classification are that of Nägeli, who regarded the growth of the thallus as the most important point. The comparative development of the young and of the older vegetative organs should be included in the general survey.

**Alternation of Generations in Algæ.***—J. Bonnet writes a long treatise on the sexual reproduction and the alternation of generations in algæ. He reviews the history of the subject from Hofmeister and Sachs onwards, discussing fully the views of the various authors, and pointing out how much the algæ have been neglected in cytological work, compared with other plant groups. He then passes in review the various groups of algæ, showing what is known of each at the present time. He divides them for discussion into: (1) those algæ in which the zygote is itself the gonotokont, and the $2x$ generation is thus reduced to one cell; (2) those in which the zygote is not the gonotokont, and the $2x$ generation is consequently represented by more than one cell. Finally, he points out that a study of the alternation of the haploid and diploid phases shows us how incongruous a group is that of the algæ. From the case in which the $2x$ phase is reduced to the point of being imperceptible, to the opposite extreme in which it is much more extended than the $x$ generation, there are many

* Progressus Rei Botanicæ. Jena: Fischer (1914) v., pp. 1–128 (figs. in text).

intermediates; and the author considers that not the least interest in the algæ groups lies in the fact that they offer us forms arrested in the different stages of the evolution of generations; and that these forms indicate lines probably parallel to the evolution followed phylogentically by forms of a higher type. He points out how little the lines of our classification of the algæ follow the grouping founded on the facts of alternation. These would compel us to split up Phæophyceæ, and to divide off the diatoms of benthos from those of plankton. Since, however, the whole use of classification is to form a practical guide, it would be unwise to exaggerate the systematic importance of such characters as alternation of generations and the conclusions arising from their study. But they should be at least taken into account. And since, as the author remarks, the algæ are regarded as chaotic, why should not order be introduced by following the clue offered by the alternation of generations? This paper is a masterly exposition of the subject by a young man of two-and-twenty, who shortly after writing it was killed in a railway accident in the Alpes-Maritimes on his return from the yearly manœuvres.

## Fungi.

(By A. Lorrain Smith, F.L.S.)

**North African Laboulbeniaceæ.*** —René Maire gives descriptions of some Laboulbenias observed by himself and by Picard in Africa, and he has published a list of those recorded by Thaxter for the same region. He gives two new varieties and a new species with detailed descriptions, and with comparative and biological notes.

**Systematic Position of Microstroma and Helostroma.**†—René Maire calls attention to the confusion between these genera of Hyphomycetes. The name *Fusidium Juglandis* was first given to a fungus which covers the leaves of the walnut with a white film. It was afterwards changed to *Microstroma*. An allied species is frequent on leaves of oak in our own country, known as *Fusisporium* or *Microstroma* (*Helostroma*) *album*. Maire has examined the latter and finds that a stroma is formed within the tissue of the leaf; the conidiophores emerge through the ostiole and form conidia at the tips; after these are mature the stalk grows further and forms another head of spores, etc. Maire finds that the two genera are identical and that they are not Basidiomycetes.

**Observations on Phytophthora erythroseptica.**‡—It was in this fungus that G. H. Pethybridge found the peculiar development of the sexual organs already described. Similar processes have been discovered in *Phytophthora infestans*, and in several other species. There are five species known which belong to the restricted genus *Phytophthora*. The

* Extr. Bull. Soc. Hist. Nat. Afrique du Nord, iv. (1912) 5 pp. (1 pl.).
† Algiers (1913) 9 pp.
‡ Sci. Proc. Roy. Dublin Soc., xiv. (1914) pp. 179-97 (1 pl.).

author has made exact studies of the conidia and oospores, of their growth and germination. He finds that the walls of the hyphæ, conidia and sexual organs are largely, though not entirely, composed of cellulose; the walls of the oogonium and oospore consists of two different layers. The conidia germinate either by producing germ-tubes direct or by the formation of zoospores. The zoospores germinate after a resting period. The first change is the dissolution of the thick inner portion of the wall which has apparently served as a reserve of carbohydrate food material. These sexual organs occur in the underground stalks and rhizomes, and in one case were found in a potato tuber. The name suggested for the disease is Pink-rot wilt; it is evidently contracted from the soil, and is of serious consequence in land which has borne a crop of potatoes for several successive seasons.

**Development and Treatment of Mildew.***—H. Faes collected and preserved, during the winter season, leaves of the vine which contained abundant oospores of *Plasmopara viticola*. Some of these he kept dry in the laboratory and some on moist soil in a cold chamber. Attempts to inoculate the vine with this material in the following spring were without result, and the author thinks that even in the open field germination of oospores occurs but rarely. Other infection experiments with the mildew were carried out on buds and fruit. In the former case it was found very easy to infect the flower buds, but when the grapes had reached the size of peas, the skin was already impervious, and only the stalk took the disease.

A. Istvanffi † also records results of infection experiments with the vine mildew. As to the time required for penetration by the swarm-spores and the consequent formation of oil-spots, he found that in the beginning of June twelve to fourteen days were required, but with the advance of summer, shorter time was required, though in the beginning of July owing to the thickness of the grape skin twelve to fourteen days was again recorded as the period necessary before the fungus took effect. In excessive moisture, in the laboratory, development was more rapid.

**Germination of Teleutospores.‡**—It is well-known that the teleutospores—the resting spores—of rusts will not as a rule germinate unless they have passed the winter in the open and have been exposed to the changes of weather. Klebahn has made a special study of the conditions that prevent or induce germination, and now gives his results. He finds that recurrent moistening of the spores with fresh water is an important factor, more especially when it alternates with complete drying. Such conditions are encountered in ordinary weather changes. In a warm room these conditions can be imitated and germination even hastened by 2–3 months, as compared with germination in ordinary circumstances. Drying up is not absolutely essential, as spores on material kept continuously in water developed promycelium and sporidia in about the

* Rev. Vitic., xxxix. (1913) p. 161. See also Centralbl. Bakt., xl. (1914) pp. 322–3.

† Bot. Közlem., xvi. (1913) pp. 1–7. See also Centralbl. Bakt., xl. (1914) pp. 323–4.

‡ Zeitschr. Pflanzenkr., xxiv. (1914) pp. 1–32 (23 figs.).

usual time, though only when the water was constantly changed. Klebahn suggests that the air-content of the water might be important. Simple moistening of the spores had little effect. He also thinks that the gradual destruction of the tissues on which the spores are parasitic may be important. Cold is not necessary and may even hinder germination. Klebahn records experiments on the germination of uredospores and on the life-history of various forms. He also cites instances of rust-development that render impossible Eriksson's mycoplasm theory.

**Experiments with Puccinia malvacearum.***—J. Eriksson and C. Hammerland record the results of their effort to secure the immunization of hollyhocks against the attacks of this fungus. The disease may be carried long distances by infected plants or seeds, the fungus hibernating in the cells of the host in a condition of mycoplasma. The mycoplasmic condition becomes mycelial shortly before the erruption of pustules on the leaf. By various experiments with fungicides, they found that the attacks of the disease could be arrested, or very considerably modified, by the introduction of a fungicide solution into the roots of the plant. The experiments are to be continued.

**Uredineæ.**†—E. J. Butler describes some of the more frequent rusts in India. The common fig-rust, *Uredo Fici*, he has placed in the genus *Kuehneola*. It is usually found in the uredo stage only, with sori in great numbers on the under side of the leaf; a ring of paraphyses develops round the sorus. The teleuto-stage has hitherto been found only on *Ficus glomerata*. Butler also describes *Coleosporium Oldenlandiæ* previously recorded as a *Uredo*. Vertical septation of the teleutospore frequently occurs, and they emerge through the stomata of the leaf.

P. Dietel‡ describes a number of new species from Central and South America, and from Japan. He also gives a critical account of the rusts that are found on different species of *Baccharis*. In a few of the species there is a well developed peridium; in most of them it is absent.

**Culture of Tricholoma nudum.**§—Louis Matruchot has been studying for many years the influence of environment on the growth and characters of this fungus. He finds that when it is cultivated in a dark cellar at 11° C. in a normally hygrometric atmosphere, it grows as vigorously as in the open, retains the power of spore-formation, and, though an autumnal species, will fructify in these conditions at any season. In the end it loses the violet pigment—a specific character—and the sinus of the gills—a generic character. Basidia and spores remain normal, and the delicate taste and smell of the fungus are unaffected, showing that the chemistry of the cells is unmodified.

**Parasitism of Polyporus frondosus and Sparassis ramosa.**‖ These two fungi have been examined by H. Kirchmayr in the field.

* Comptes Rendus, clviii. (1914) pp. 420–3.
† Ann. Mycol., xii. (1914) pp. 76–82 (4 figs.).
‡ Ann. Mycol., xii. (1914) pp. 83–8.
§ Comptes Rendus, clviii. (1914) pp. 724–6.
‖ Hedwigia, liv. (1914) pp. 328–37 (2 figs.).

Underneath the fruiting body of the polyporus he found masses of earth, stones, etc., matted together by the mycelium, and mixed with these, living tree roots, the cortex and wood of which were uninjured. Further examination of a fungus at the base of a chestnut-tree convinced him of its parasitic nature. He traced the mycelium into the root which had been injured and made entirely friable. Other observations tended to verify his theory of parasitism. Kirchmayr believes that he has also established the parasitic nature of *Sparassis ramosa*, though the evidence is not so clear as in the former case.

**Polymorphism of Ganoderma lucidum.***—C. van Bambeke has collected specimens of this fungus at four different dates, and has compared the gatherings. The fungus is very variable in form: usually it is irregularly stipitate, and a dimidiate form has been considered by various mycologists sufficiently distinct to constitute a new species. Bambeke found all varieties of form, stipitate and non-stipitate, growing from the same base. In microscopic characters—tissue, spores, etc.—there is no difference. The variations in form are due to environment; in this case to the relation between the sporophore and the support.

**Poisonous Properties of Agarics.**†—G. Dittrich made enquiries into a fatal case of poisoning, and found that the fungus that was the cause of death was the green *Amanita viridis*, a variety of the well-known poisonous *Amanita phalloides*. He made experiments with a solution of the green variety and proved its hæmolytic action on the blood of man and various animals. Injection into animals caused death. Tests were made with *Amanita mappa*, which proved to be much less poisonous and sometimes quite harmless in its effects. Other species of the genus were also examined, and the results are given.

**Philippine Fungi.**‡—A second paper with descriptions of species of fungi (largely microscopic), has been published by H. and P. Sydow. A large number are new to science, and descriptive comparative notes are added in many instances to the copious diagnoses. The new genera are; *Bulgariastrum* (Bulgariaceæ), which forms roundish colonies on living leaves; *Calopeziza* (Pseudopezizæ), a vividly coloured fungus, also on living leaves; *Sorosphæra* (Sphæropsideæ), which appears as a small stroma on leaves of *Streblus asper* (the numerous pycnidia are almost superficial on the stromata); and *Lasiothyrium* (Pycnothyriaceæ), of which the pycnidia grow in groups on leaves.

**Culture of Entomophytic Fungi.**§—J. Beauverie devotes special attention to the fungus or "muscardine" that attacks the silk-worm. He gives the history of the fungus, and describes the growth on the host. He then turns his attention to some of the ways in which entomophytic fungi might become of service in destroying insect pests, and thus

* Bull. Soc. Bot. Belg., lii. (1913-14) pp. 127–32.
† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 69–76.
‡ Phil. Journ. Sci., viii. Sec. C, n. 6 (1913) pp. 475–509 (7 figs.).
§ Rev. Gén. Bot., xxvi. (1914) pp. 81-105 (13 figs.).

render considerable service to agriculture. He describes various forms of the fungus, and the cultures made by him on different media. A continuation of the paper is promised.

**Soil Fungi.***—E. Dale has continued the research on soil fungi, and now gives her results on three different types of soil :—Chalk soil from the Gog and Magog Hills near Cambridge, taken from a wheatfield to avoid recent manuring; uncultivated mountain peat from a hill 600 feet above Loch Lomond; and black-earth from reclaimed fen-land near Ely. The cultures were made on raisin extract on beer-wort in gelatin or agar, and also on sterilized bread, carrot, and potato.

From chalky soil there were obtained 16 genera and 29 species, *Mucor* and *Penicillium* having most representatives. From the peaty soil were grown 12 genera with, in addition, a bright green mycelium, and with 19 species, some of them doubtful. The "black-earth" gave 13 genera with 18 species, several being undetermined. A species of *Ozonium* was isolated from the chalk and the peat, associated in each case with *Mucor rufescens*.

Very little is known as to the part which Fungi play in the soil; probably, as is the case with Bacteria, they aid in the disintegration of dead plant tissues and make them available for growing plants. Such species as all the forms of *Scopulariopsis* and *Trichoderma album* are known to produce ammonia from gelatin, and experiments proved that they acted similarly on plant proteins.

Many species were found to grow luxuriantly, and all to some considerable extent, on media containing no nitrogen leading to the direct fixation of atmospheric nitrogen. The most active nitrogen formers were *Dematium* sp., *Fusarium Solani*, and *Mucor racemosus*—all common forms. In nearly all cases they grew best on vegetable media.

**American Gooseberry Mildew.**†—E. S. Salmon has given a record of his results in spraying for this disease, along with some observations on the life-history of the fungus. Experiments were made at various centres on many different kinds of gooseberry, and at different seasons. It has been found that sprays containing sulphur are more efficacious in dealing with the disease than those containing copper, and the former have also the advantage of being non-poisonous. Lime-sulphur wash gave the best results. Flowers-of-sulphur is useful only in dry weather; it is too easily washed away by rain.

Salmon has observed that the mature fruits of the fungus, the small brown perithecia, become very readily detached when mature, and fall to the ground where they hibernate and reinfect the bushes in spring. He therefore cautions growers against allowing diseased berries to hang on the bushes. The same caution applies to diseased leaves and stalks.

Plantations likely to prove commercially successful in withstanding the effects of mildew are those generally in an open situation with the bushes not too closely planted, and of a variety not liable to be injured by spraying. Excessive manuring encourages luscious growth of the

* Ann. Mycol., xii. (1914) pp. 33–62 (5 pls).
† Journ. Board Agric., xx. (1914) pp. 1057-79 (2 pls.).

twigs which became virulently attacked by the mildew. Early removal of shoots and berries attacked is essential, and finally spraying with lime-sulphur as a valuable aid. The names of the varieties of gooseberry not easily damaged by sprays are supplied, and information is given as to the best seasons for pruning, spraying, etc.

**Plant Diseases.***—A disease of narcissus bulbs has been described by G. Massee. It occurred in this country about three years ago and did very serious damage. The injury is due to the fungus *Fusarium bulbigenum*, first described in 1887, though not then recognized as a destructive parasite. The presence of the fungus is first indicated by the appearance of small yellowish spots on the leaves, which gradually increase in size and become brown and dry. On these spots small coloured patches of *Fusarium* spores are developed; they are dispersed by various means and infect other plants. The mycelium within the leaf can be traced passing downwards into the bulb, where it grows with great vigour in the fleshy scales. In time the whole bulb becomes diseased, the fungus forming delicate white sheets of mycelium between the scales. Massee describes two forms of spores: the characteristic elongate septate spores of *Fusarium*, which are borne in clusters at the tips of the hyphæ, and small globose chlamydospores or resting spores which are abundant in the leaf-tissues. It is recommended to avoid planting bulbs in infected soil.

An account of the ravages of wart-disease of potatoes † has been contributed by J. Eriksson. Researches and experiments have demonstrated that the disease spreads slowly but steadily; and the contagious matter preserves its virulence in the soil for years; fungicides having proved ineffectual in preventing or even diminishing the mischief. A list is given of varieties of potatoes that are immune or partially immune to the disease, and of those that are non-resistant.

An account is also given of the treatment of soil in Sweden with 1 p.c. formalin solution. The experiment proved that in soil recently infected the fungus may be destroyed. In soil which has harboured the fungus for years a much stronger solution (2 or 3 p.c.) is necessary to have any effect.

H. Zimmerman ‡ records the damage done to cherries by the fungus *Fusicladium Cerasi*, a rather rare parasite. Certain kinds of fruit only were attacked, but experiment is required to determine accurately the degree and conditions of immunity. The writer strongly urges the gathering and destroying of all diseased cherries.

Himmelbauer § has made a special study of *Fusarium* as the cause of the infolding of potato leaves. His aim was to discover in how far the plants became infected in the soil. It is only when pathogenic forms of *Fusarium* are present that there is any danger. When the

* Journ. Board. Agric., xx. (1914) pp. 1091–3 (1 pl.).
† Int. Inst. Agric. Bur. Agric. Int. and Pl. Dis. Rome, 1914, pp. 276–8.
‡ Bl. Obst.-Wein Gart. Bau (1913) p. 107. See also Bot. Centralbl., cxxv. (1914) p. 143.
§ Oest. Zeitschr. Zuckerind. Landw., xlii. 5 (1913). See also Bot. Centralbl, cxxv. (1914) p. 141.

plants are wounded, they seek to cover the wound by cork formation, and the varieties able to do this the most quickly are the most immune to the disease. The direct result of wounding is the interference with the currents, and leaf rolling follows: when the wound is healed the leaf again unfolds. The author proved that the fungus was really the cause of the leaf rolling, and not merely a weak parasite.

## Lichens.

(By A. Lorrain Smith, F.L.S.)

**Study of a Crustaceous Lichen.***—E. Claassen has made continuous observations on *Caloplaca pyracea* that appeared on sandstone. The rock was covered at first with the green cells of *Cystococcus* sp. Later there appeared greyish-white patches on the green, representing the invasion of the lichen fungus. These patches increased centrifugally, leaving in time a bare patch in the centre, which was again gradually covered with the green alga. The lichen fruited abundantly, but wherever it appeared, the green cells were more or less destroyed. Claassen considers the symbiosis to be one of parasitism of the fungus on the algæ which grew abundantly before the encroachment of the fungus, whereas the fungus died off without the nourishment furnished by the alga.

**Study of Cladonia podetia.**†—Hans Sättler concludes from an ecological study of the *Cladonia* thallus, that the podetium is not vegetative, but reproductive in origin. All the Cladoniæ develop spermogones and carpogones on the same tissue: either on the primary thallus as in *C. Floerkeana*; on the scyphus, particularly on the margin; or in ascyphous forms at the tips of the branches.

The scyphous and the ascyphous podetia are a morphological development of the spore-producing tissue to facilitate fertilization of the carpogones by the spermatia. The podetia have originally the function of aiding in spore-distribution by the elevation of the apothecia. Ascyphous podetia arise from a tendency to form spores at a very late stage; in several cases sterility has ensued, and spore-production is the rare exception.

Sättler considers that his conclusions support the theory of sexuality in the Cladoniaceæ, as he claims to have proved the true significance of spermogones and apothecia, both being sexually related. In certain cases among scyphous forms, the apothecia are asexual, though in general they are sexual. He considers that the former are derived from the latter, and that within the genus there is a progression from sexual to parthenogenetic spore-development. The assimilating elements of the podetium aid in procuring nourishment, and thus exercise some influence on the form of the podetium.

* Hedwigia, liv. (1914) pp. 219–20.
† Hedwigia, liv. (1914) pp. 226–63 (3 pls.).

**Origin of Lichen Gonidia.***—An old controversy as to the nature and origin of the green cells within the lichen thallus, has been revived by Fried. Elfving. He has made examinations of the growing areas of a number of lichens, and claims to have observed the different stages of formation of gonidia in such widely diverse "algal" forms as *Cystococcus*, *Trentepohlia*, *Stigonema*, and *Nostoc*. According to the view put forward by Elfving, the gonidium arises terminally as regards *Cystococcus*, intercalary as in *Trentepohlia* on the colourless filaments of the lichen fungus. There is first a swelling of the destined gonidial cell, and gradually a colouring and transformation of the contents to the green assimilating function. A research was also made on the formation of cephalodia. These arise, according to Elfving, by a branching and mingling of the external hairs of the thallus (in *Peltidia aphthosa*), and after the formation of a ball of tissue the differentiation begins of the central cells to *Nostoc* and subsequent growth to *Nostoc* chains.

Elfving demands a review of the theory of the dual nature of the lichen thallus, which, after the observations made by him, is no longer tenable. He allows that the gonidia mainly increase by division within the thallus, and that they also may escape and live as free organisms, and that thus "certain algæ are derivatives from lichen gonidia."

The work is richly provided with illustrations and with a copious bibliography.

**Lichen Ecology.**†—The results of some preliminary researches on the general ecology of lichens have been published by O. Gallöe. The two factors more especially studied are climate and substratum. The former is not of great importance. As concerns the latter he finds that lichens fall into six groups: viz. (1) bark lichens; (2) epiphyllous lichens: earth lichens; (4) rock lichens; (5) parasitic, and (6) saprophytic lichens. Each of these groups include crustaceous, foliose, and fructicose forms. Certain lichens are always found on the same kind of bark, but the reasons therefor are not sufficiently known. Epiphyllous lichens never grow on annual leaves; mostly, they are found on tropical plants. Earth lichens are peculiarly dependent on the nature of the substratum; lichens are never found on light humus, turf, or salt soil. The water content of the soil is also of great importance, more so than the condition of the temperature. The amount of nourishment in the soil is of little influence; but as a rule lichens are ousted from good soil by the pressure of the higher plants. The chemical reaction is of some significance, and most species grow willingly on acid soils. In rock lichens the character of the surface is of importance, as also the presence of lime.

In a separate chapter, the author discusses the biology of various fruticose lichens, such as *Cladonia*, *Stereocaulon*, *Alectoria*, *Bryopogon*, etc.

* Acta Soc. Sci. Fenn., xliv. No. 2 (1913) 71 pp. (8 pls.).

† Forbered. Unders. til en Almind. Lykenologi. Kjobenhavn: (1913) 118 pp. 240 figs. See also Bot. Centralbl., cxxv. (1914) pp. 169–70.

## Mycetozoa.

(By A. Lorrain Smith, F.L.S.)

**Myxogastres.***—Under this title Hans Schinz describes the Mycetozoa of Germany, Austria, and Switzerland. The present fascicle includes a description of the life-processes of these organisms, with explanations of the various stages and the terms applied. Distribution and culture are carefully gone into, and the methods of fixing and colouring slide specimens are given. In the systematic portion of the work Lister's monograph is general followed by Schinz, even though the division according to spore colour is considered by him to be somewhat artificial. As the larger number of Mycetozoa are ubiquitous, the author has included genera and species not yet discovered in the territory, but present in all likelihood. The Myxogastres are given as a "class" of fungi.

## Schizophyta.

### Schizomycetes.

**Staphylococcus aureus.**†—M. T. Dumas has investigated a number of strains of this organism obtained from various suppurative conditions in man and animals. He considers that all his strains belong to one true species. The common characteristics, such as the production of a haemolysin, are very constant. Minor variations in character, such as the fermentation of glycerin, are of rare occurrence. Variations are usually only quantitative, and of limited range.

M. Nicolle ‡ and E. Césari have studied further the characters of the Staphylococci described in the foregoing communication. They find that the Botryococcus obtained from Botryomycosis in horses is identical morphologically, culturally, and biologically with *Staphylococcus aureus*. This identity is confirmed by experiments on laboratory animals. All these strains grow well on artificial culture, producing pigment of varying intensity, fermenting similar sugars and causing milk to clot. All secrete a hæmolysin. Injections into mice, rabbits, and guinea-pigs of cocci or of the filtered toxin produce a well-defined type of lesion, usually causing death. *Staphylococcus citreus* differs only from the commoner type in the shade of its pigment. In general *Staphylococcus albus* shows a lower degree of virulence.

**Action of Ultra-violet Light upon Anthrax Bacilli.**§—Mdme. Victor Henri has investigated the influence of feeble irradiations with ultra-violet rays of these organisms. The fact that such rays attack only certain chemical constituents of the cell, leaving other substances unchanged, led the author to study the effect of controlled irradiation. The present is a preliminary communication on this subject. Emulsions

* Rabenhorst's Krypt.-Fl., Abt. x. Lief. 122, pp. 65–128 (figs.).
† Ann. Inst. Pasteur, xxviii. (1914) pp. 213–18.
‡ Ann. Inst. Pasteur, xxviii. (1914) pp. 219–32.
§ Comptes Rendus, clviii. (1914) pp. 1032–5.

of 24-hour sporing anthrax cultures, two milligrams per c.cm. of water, were exposed to the rays, and cultures made upon agar and broth after periods ranging from one to forty minutes. The great majority of bacilli succumbed: among the survivors many retained their original characters, but a few showed modification of type, which remained constant. Coccal forms appeared, which, at the end of two months, showed no signs of reversion. These were Gram-positive. Slender irregular Gram-negative filaments were obtained in other cases. These neither liquefied gelatin, nor clotted milk. They produced a disease completely different from anthrax. Daily replanted, they showed no tendency to revert to the original type, but it was found possible to convert them into the coccal form. Animals inoculated with the coccal type so obtained showed changes similar to those evoked by the Gram-negative filamentous type.

**Treatment of Anthrax with Pyocyaneus Cultures.***—L. and C. Fortineau, continuing the work of Woodhead and others upon the influence of the toxin of *B. pyocyaneus* upon anthrax injections in the rabbit, have studied the method of action of the soluble substances secreted by the *B. pyocyaneus*, and find that the curative substance is of a lipoid nature. They have obtained good results in cases of malignant pustule, and in other types of anthrax with injections of killed pyocyaneus cultures.

**Cultivation of Johne's Bacillus.**†—In previous papers, F. W. Twort and G. L. Y. Ingram have described their method of cultivation of this organism on media containing dead acid-fast bacilli. The substance essential for the growth of Johne's bacillus was extracted from acid-fast bacilli. The present communication describes researches undertaken in order to ascertain whether this essential substance occurs naturally in cattle-food or in other vegetable substances. Watery and alcoholic extracts were made from a large number of seeds and spices, fungi, seaweeds, fruits, and roots. Each extract was incorporated in a glycerinated egg-medium. Negative results were obtained in the great majority of cases. Some growth was obtained on media containing extracts of linseed, barley, wheat, maize, oats, dari, culinary pea, physostigma bean, fig-seeds, out of 75 varieties of seeds and spices, on extract of *Cantharellus aurantiacus* alone out of 31 fungi. Nine seaweeds were tried, but all gave negative results. In a final series extracts from a number of fruits, roots, and animal substances, twenty-two varieties in all, were tried, and positive results were obtained with alcoholic extract of tamarinds and with the chloroform soluble portion of the alcoholic extracts of figs and raisins. In no case except that of the fungus, was growth obtained comparable with that on media containing acid-fast detritus.

**Phagocytosis of Plague Bacilli.**‡—R. St.J. Brooks has carried out investigations in order to ascertain the influence of the medium on

* Comptes Rendus, clviii. (1914) pp. 1035–7.
† Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 277–83.
‡ Journ. of Hygiene, xiii. (1914) Plague Suppl. No. 3, pp. 412–17.

which the plague bacillus is propagated upon the facility with which it is ingested by human leucocytes. The work was performed with emulsions containing 2000 million organisms per c.cm. It was found that an old laboratory strain of *Bacillus pestis* grown on heated horse, rat, guinea-pig or human serum did not show any appreciable variation in the phagocytic index with human leucocytes, when compared with the original culture, but strains grown on fresh rat or horse serum showed a high degree of resistance to phagocytosis. Plague bacilli taken direct from an animal dying of plague show a marked reduction in capacity for phagocytosis, which persists for a short time after cultivation on broth agar outside the body.

**Morphology of the Plague Bacillus.***—S. Rowland discusses the pleomorphism of the plague bacillus, illustrating his article with photomicrograms which show forms simulating micrococci, streptococci, streptotricheæ, and moulds. Examination of broth cultures by transmitted light, show a delicate halo around certain bacilli. Indian ink preparations show that this halo is caused by the presence of a definite envelope. This structure differs from the true capsule possessed by certain bacteria in having no definite outer limit. Its consistence is probably viscid ; by lucky manipulation with a needle, it can be drawn out into a streaming appendage resembling the tail of a comet. The well-known stickiness of plague cultures is probably due to this structure. The presence of the envelope depends upon the nature of the culture medium and the temperature of incubation. True capsules have been observed by the author in bacilli at the site of inoculation in experimentally infected rats and in bacilli grown upon a serum medium.

The dark-ground illumination used to photograph some of the preparations was obtained by using a central stop in an aplanatic condenser. By this means a low-angled illuminating cone is produced, in contrast to the excessively high angle of the rays emerging from a paraboloid. As this eliminates light haze from small particles, it is a decided advantage. Technical data referring to the photomicrograms are given.

**Intestinal Flora of Infants.**†—E. Metchnikoff discusses the nature of infantile diarrhœa, and shows that, the views of divers clinicians notwithstanding, this is an infective disease due to a specific bacterial invasion of the same order as cholera, typhoid, dysentery, and the like. Experimental infantile diarrhœa in young rabbits produces a picture closely resembling that of Asiatic cholera. The author considers that the *B. proteus* in its many varieties is the primary causal factor in the disease.

D. M. Bertrand ‡ in work upon infantile diarrhœa carried out in London in 1912, found *B. proteus* in every one of fifty-five cases of infantile diarrhœa. In the stools of 24 healthy children, he found this organism twice only. Morgan's bacillus was not obtained from any

* Journ. of Hygiene, xiii. (1914) Plague Suppl. No. 3, pp. 418–22.
† Ann. Inst. Pasteur, xxviii. (1914) pp. 91–120.
‡ Ann. Inst. Pasteur, xxviii. (1914) pp. 121–31.

case. Other organisms, associated by sundry workers with the disease, were but rarely encountered.

H. Berthelot,* in his experimental observations upon the pathogenic properties of certain bacterial associations, regards the *B. proteus* from another aspect. In experiments on rats, he finds that this organism alone produces no ill-effects, but, if combined with *B. aminophilus intestinalis*—a close ally of *B. lactis aerogenes*—will give rise to a rapidly fatal diarrhœa. The latter organism alone is harmless. He discusses in detail the pathogenic properties of *B. proteus* and other bacteria growing in symbiosis, and concludes that various types of colitis, infantile diarrhœa, and allied conditions are due to the presence of *B. proteus* associated with one or more types of acidaminolytic organism.

**Mechanism of the Transmission of Plague by Fleas.**†—C. J. Martin and A. W. Bacot have carried out researches which throw light upon the means by which the flea may transmit plague from an infected to a healthy host. When a flea is fed upon an animal suffering from septicæmic plague, bacilli enter the alimentary canal, passing through the proventiculus into the stomach, and grow freely in this position. Plague bacilli from the flea's stomach were found to possess a diminished degree of infectivity, and were readily ingested by human leucocytes. This effect may be due to the action of the digestive juices of the flea. It would appear from this that organisms in the flea droppings may show little virulence. In some fleas it was observed that plague bacilli grew vigorously in the proventiculus, forming a solid plug of culture, obstructing the passage into the stomach. A flea so affected sucks with increased vigour, when applied to a host, and the proventiculus becomes distended with fresh blood. At the end of the act of sucking, the proventriculus contracts upon the mixture of blood and bacilli, and infective material is regurgitated upon the puncture wound of the animal attacked. It is probable that these obstructed fleas are the cause of most cases of natural infection. Further, fleas may recover from this condition when the contents of the crops autolyse, but on the other hand many individuals become desiccated in the hot weather. This may account for the interruption of plague epidemics in India when the temperature rises.

**Calymmato-bacterium granulomatis.**‡—H. De B. Aragão and G. Vianna report that they have isolated from a venereal disease endemic in Brazil, and characterized by the presence of granulomatous tissue, a bacterium, the most marked feature of which is a large well-marked capsule. The bacterium is somewhat polymorphic, both coccous and bacillous forms existing. The organism, which is Gram-negative, is best stained by Giemsa. In the tissues it is found both as an intra- and extracellular parasite; in the former the capsule is often absent, but is well marked in the extracellular tissue. Successful cultivations were

* Ann. Inst. Pasteur, xxviiii. (1914) pp. 131–48.
† Journ. of Hygiene, xiii. (1914) Plague Suppl. No. 3, pp. 423–9.
‡ Memorias do Institute Oswaldo, Cruz, v. (1913) pp. 211–38 (6 pls.).

made, the germ being first isolated on Sabouraud's medium. The morphology of the bacterium was found to vary with the nature and consistence of the medium, and also with the age of the culture. The bacterium is a potential aerobe, grows well at 37°, produces acid, ferments strongly, but does not form indol. Its vitality is considerable. Experiments showed that it was pathogenic to laboratory animals, but the post-mortem appearances were not specially characteristic. In certain features, such as its morphological aspect, the stickiness and viscidity of its growth and its Gram-negativeness, it presents likeness to the bacillus of Friedländer.

# MICROSCOPY.

## A. Instruments, Accessories, etc.*

### (1) Stands.

**Old French Microscope by Joblot.**—This curious old Microscope (fig. 29) has been acquired by the Society for its collection, and was exhibited at the Meeting on March 18. It is one of three forms invented about 1716 by L. Joblot, "Professeur Royal en Mathématiques de l'Académie Royale de Peinture et Sculpture, demeurant sur le quay de l'Horloge du Palais, au gros Raisin," and is described by him in his work, Descriptions et usages de plusieurs nouveaux Microscopes, published in Paris 1718.

Joblot states in the text that the Microscopes designed by him were made for him by M. le Febvre, Ingénieur en Instruments de Mathématiques, but the present model bears the inscription: "J. Langlois, Elève du Sieur Butterfield, aux Armes d'Angleterre, à Paris," and, moreover, is richly engraved with ornate designs on the handle and principal surfaces, which are not shown in Joblot's plates. Langlois and his master, Butterfield, are both known as noted makers of astronomical quadrants, sundials, etc., in Paris, in the early part of the eighteenth century, and it is probable that this Microscope was made by the former some years after the publication of Joblot's description, say about 1720.

The design of this old Microscope is very peculiar; it is used by holding against the sky or a candle. The handle consists of a somewhat flattened brass cylinder, octagonal in cross section, supporting a stage to which a brass-bound glass plate can be fixed. Below this is a tubular diaphragm, called "le canon" by Joblot, lined inside with black velvet, and with a stop at each end, an effective device for giving the best possible definition. (In 1831 Hugh Powell made, and probably re-invented, a similar cylinder diaphragm for the Microscope designed by Cornelius Varley.†) In front of the object-stage is the objective carrier, fixed to a movable arm actuated by a large focusing-screw; the carrier receives the brass plates in which the objectives are mounted. The objectives consist of bi-convex lenses of various focus, about $\frac{1}{4}$ in. in diameter, held between two brass plates pierced with very small holes, so that only the centre of the lens is used, thus reducing the aberration and giving a fair definition, in the same manner and on the same plan as is found in Leeuwenhoek's Microscopes; the two brass plates are not,

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

† See this Journal, 1900, p. 232, fig. 74.

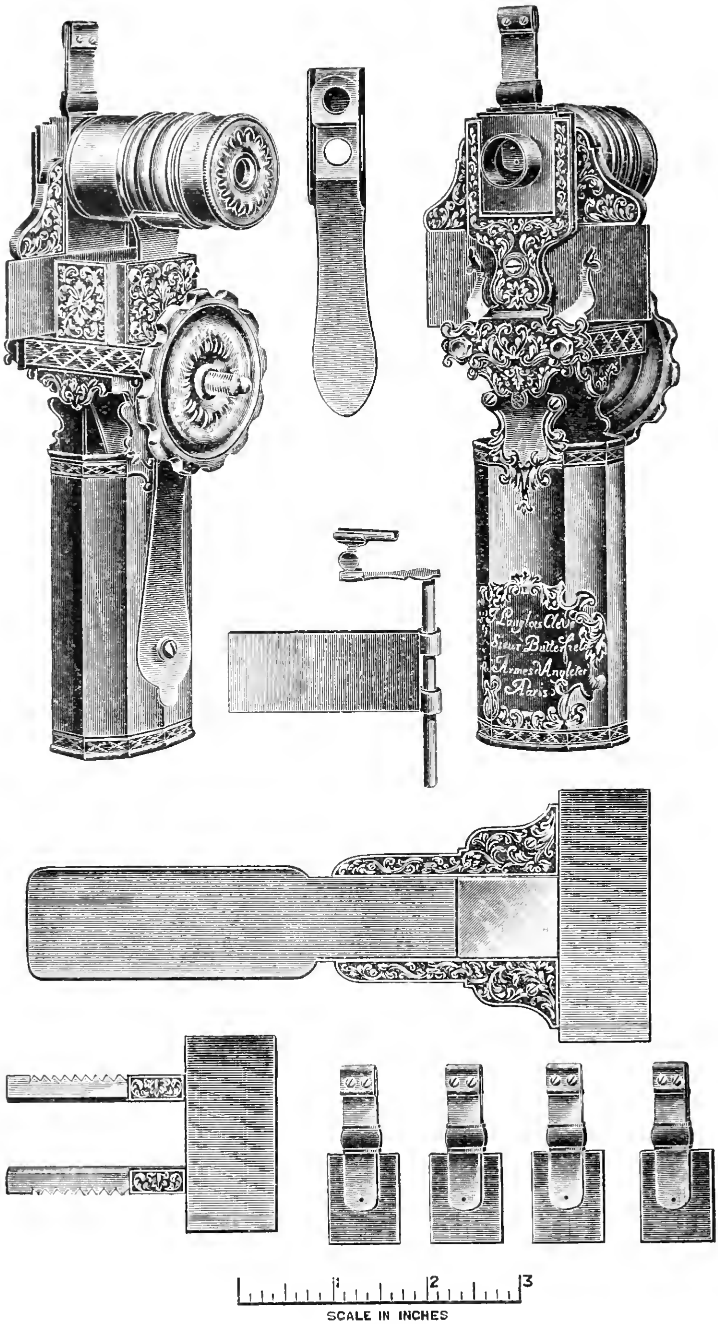


Fig. 29.

however, screwed together, but clamped and held together by a metal ring. There were six of these objectives, of various magnifying powers.

The object-stage carries, by sliding on, several devices for viewing drops of blood, of water from infusions, and also the circulation of the blood in small fishes' and tadpoles' tails. One of these devices is a brass-bound glass tube, fixed by means of a spring inside the handle of the Microscope; the small fish being held in water in the tube with its tail spread out on the glass stage-plate.

Joblot calls this instrument in the text, "Troisième et dernier nouveau Microscope universelle," and used it principally for examination of the circulation of the blood in young fishes' tails, a subject which had been discovered some years previously by the famous English "Dr. Hervée" (as Joblot calls him), but not clearly demonstrated until the advent of a suitable Microscope. He also used it for the examination of drops of water from infusions of various substances, such as hay, leaves, wood, pepper, etc., as taught by Leeuwenhoek, and judging by the figures in his book, Joblot must have seen most wondrous and extraordinary creatures in these infusions: worms with snakes' heads, Crustaceans with a human face on their back, Rotifers and Infusoria of fantastic shape—the species of which can only be vaguely guessed at. In two places Joblot figures young dragons under his Microscope, or held in forceps, unless indeed the engraver of his plates took liberties with his drawings.

In spite of these defects, Joblot's Microscopes show clearly a considerable advance over those of his contemporaries, Leeuwenhoek, Hartsoeker, Musschenbroek, Bonani, Wilson, and even John Marshall. Most of Joblot's instruments are "simple Microscopes," and possess proper focusing arrangement, with steady motion for the objective by wheel and screw, and also efficient illumination with cylindrical diaphragms for excluding all extraneous light. One of them has a rotating stage. Joblot also invented some compound Microscopes, with three and four lenses, but he does not appear to have been very satisfied with these, because, though they gave him a larger field and greater magnification, the images were less clear than those obtained with his "simple" Microscopes, which is not to be wondered at. Several of the apparatus he devised, such as forceps for holding objects, apparatus for exhibiting the circulation of the blood, hollow-ground glass slides for viewing living objects in liquids and pond-water, were very neat, efficient, and well conceived.

The objectives used by Joblot in his Microscopes were small bits of glass, ground to a curved surface on both sides, thus making rough bi-convex lenses of various foci (only one of the lens-holders now contains the lens). In his text Joblot mentions object-glasses of $\frac{1}{4}$ to 12 lines focus; the old Paris line was equal to 2·175 mm., therefore the range of his objectives appears to have been from about $\frac{1}{2}$ to 26 mm., or $\frac{1}{45}$ to $1\frac{1}{16}$ of an inch. He also describes a "Microscope à liqueurs" (that is, for the examination of liquids), by means of which "blown-glass lenses" ("lentilles soufflées et celles qui ne le sont point") can be employed, but he gives no description of these blown-glass lenses, or how they were made.

**Greenough Binocular Microscope.***—F. Emich describes a method by which he has succeeded in increasing the magnifying power of binocular Microscopes of the Greenough type without diminishing their advantages. It is well known that without the use of very strong oculars it is difficult to get a magnification with this instrument higher than 50 to 60 diam. The author, however, has designed an objective in a special mount large enough to fit over the noses of the two tubes. Although there is a certain weakening of illumination, the efficiency of the instrument is practically unimpaired, and very satisfactory results have been secured. The firm of C. Reichert have constructed the special objectives for him with focal lengths of 12 and 8 mm.

With ocular ii the magnifications respectively attained are 90 and 150 diam., and with ocular iv, 125 and 210 diam. With ocular v magnifications of 190 and 320 diam. would be reached, but the author has not, so far, had occasion to use them. The special objectives are slid on in the usual way and can be conveniently exchanged. As an example of his results, the author mentions his observations of Brownian movement obtained in a damp chamber with a drop of hydrochloric acid and piperidin. Illuminated by an arc-lamp and viewed through a dark-ground condenser, the object forms a beautiful image.

**Luminescence Microscope: its Construction and its Applications.**†—In this monograph of upwards of fifty pages H. Lehmann deals very fully with the Luminescence Microscope. The author divides his article into six chapters, and we reproduce his table of contents.

I. *The Principle of the Luminescence Microscope.*—Luminescence. Luminescence analysis. The U-V filter. The U-V filter-lamp. The Luminescence Microscope. (Pages 418–22.)

II. *The Development of the Luminescence Microscope: Historical.*—A Köhler's U-V Microscope: fluorescence observations with bright- and dark-ground illumination. The author's experiments with U-V filter and dark-ground illumination. Reichert's fluorescence Microscope. Principle of the new Luminescence Microscope and its advantages. (Pages 422–27.)

III. *Theoretical.*—On the image theories of self-luminous objects and non-self-luminous objects. Lommel's law of emergent rays. Review of refraction-polarization of luminescent light. Test of the law of emergent rays by new modes of demonstration. New theory of marine light. Discussion of the appearances in the luminescence Microscope. (Pages 427–44.)

IV. *Experimental Arrangements for Visual Observation.*—The light-source. The illumination system. The U-V filter and the supplementary filter. The euphos cover-glass. The Microscope. Arrangement for illumination with visible light. Abbe's microspectral ocular. Engelmann's microspectral photometer. Observation through the analyser. The phosphoroscope. (Pages 444–55.)

V. *Experimental Arrangements for Photography.*—Photography on

* Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 487–9 (1 fig.).

† Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 418–70 (1 pl.).

ordinary plates. Colour-photography on Lumière autochrome plates. Spectographic photography. (Pages 455–58.)

VI. *Applications of the Luminescence Microscope.*—Physics and chemistry. Luminescence spectra of very small objects. Identification of traces of mixtures. Mineralogy; luminescence of thin slices. Botany; examination of thin sections, colour-stuffs, liquors. Biology; examination of living inferior creatures. (Pages 458–70.)

### (2) Eye-pieces and Objectives.

**Zeiss' New Homogeneous Immersion 1/7.***—The firm of Carl Zeiss has recently introduced a one-seventh oil-immersion objective. This objective has a working distance of 0·35 mm., its focal length is 3·5 mm. and the N.A. is 0·9. It may be used with either Huyghenian or with compensating eye-pieces, giving with the latter a more colourless image, more noticeable towards the margin of the field. Though this novelty is of quite recent production, the idea of making homogeneous immersions of small aperture was first entertained by Abbe many years ago. The advantages claimed by the makers are that there is less trouble than is the case when examining a specimen with a dry medium power and then changing to an oil-immersion; secondly, there is more perfect correction of spherical aberration; and thirdly, that the correction of the objective is far less sensitive to variations in the thickness of cover-glass and of the embedding material.

**Healy's Comparison Ocular.†**—D. J. Healy suggested to Mr. Bausch in January 1912, the convenience of equipping a Microscope with two objectives, so that on looking through the eye-piece one would see half of the field of each objective. The Bausch and Lomb Optical Co., however, ultimately developed the idea into the use of two identical Microscopes placed side by side. After removing the draw tubes the collars of the body tubes were replaced and a comparison ocular attached by fitting a short tube snugly into the body tube of the left-hand instrument, and another short tube loosely into the right-hand body tube. The comparison ocular itself consisted of a set of reflecting prisms within a horizontal box carrying a vertical eye-piece. The author claims that his instrument does not require a specially constructed Microscope, and that it is quite satisfactory in operation. He gives several microphotographs showing comparison fields.

### (3) Illuminating and other Apparatus.

**New Electrical Heating Apparatus applicable to any Microscope.‡**—R. Brandt refers to the demand that the progress of micro-crystallography and of microchemistry have raised for instruments with heating stages. As it is not easy to adapt such stages, as have hitherto been designed, to ordinary Microscopes, special instruments are usually

* Carl. Zeiss Special Catalogue, 1914.
† Journ. Amer. Med. Assoc., lxi. (1913) pp. 1958–9 (6 figs.).
‡ Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 479–84 (1 fig.).

required for those who wish to pursue the above studies. Ordinary heating stages possess other inconveniences. They take too long in heating and cooling down, and the adjacent parts of the objective are sensibly heated, with consequent risk of damage to the optical parts. The author has endeavoured to meet all these difficulties, and has used his apparatus with satisfactory results for about two years. His stage is shown in fig. 30, which is about half size. He claims for his design the following advantages:—1. Applicability to every Microscope. 2. In spite of the insertion of an inevitably special heating stage, the preparation and condenser are a very small distance apart. 3. Analyzer, objective, object, spiral, condenser, and polarizer, fit together and are combined very compactly on the optic axis. 4. The effect is attained with small quantities of current. 5. The plane-spiral coiling of the incandescent wire guarantees a complete utilization of the heat and consequently produces its effect with high efficiency. 6. In spite of the

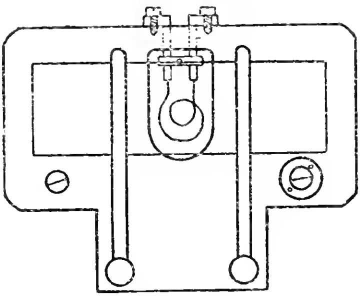

Fig. 30.

compactness (see 3) of the system, heating of the objective lenses scarcely occurs. 7. It accommodates itself instantaneously to changes of resistance, as only thin platinum wires are used. 8. Its cost is low.

The stage is made of vulcanite, 5 or 6 mm. thick, and forms the carrier for the heating wire, the electrical installation, the preparation clamp-springs, and the connecting plugs. The latter are inserted into the holes provided in every Microscope stage. The heating wire is arranged in a round-headed aperture and secured by copper plugs which are passed outwards through tubular apertures, and on their flanged or broadened extremities carry the cable connexions. The heating wire consists of thin platinum about 6 cm. long and 0·14 to 0·16 mm. thick. It takes the form of a flat spiral of about one and a half coils. Before use the spiral should be pressed downwards with thumb and forefinger until about 1 mm. distant from the object carrier, thereby securing that inner and outer winding do not short circuit. The temperature measurements were calibrated by observations on the melting of known substances previously embedded between cover-glass and object-glass. An amperemeter was introduced into the main current, and a voltmeter into the auxiliary current. About five to twenty seconds were required to raise the temperature to 200° C., at which point ordinary cover-glasses cracked.

From 200° to 450° C. quartz or thicker glass covers should be used. Above 450° the requirements of microchemistry and microcrystallography do not usually extend. But in the event of such higher temperatures being required, glass, unless made of a specially high melting-point, is useless, and recourse must be had to quartz slips and covers. A thicker platinum wire (0·2 to 0·25 mm.) is also desirable. A 6-volt accumulator-battery serves well as the source of energy. For the polarization arrangement, the author inserts an analysing Nicol in the connecting-piece between the objective and revolver. The polarizer is placed, as usual, in the diaphragm ring. The cooling of the object, in the case of over-heating, is accomplished by directing an air-current on to the cover-glass. It is remarkable how small a heating effect is produced on the Microscope itself.

**Berek and Jentzsch's Small Intense-light Monochromator.***—This auxiliary has been designed by M. Berek and F. Jentzsch

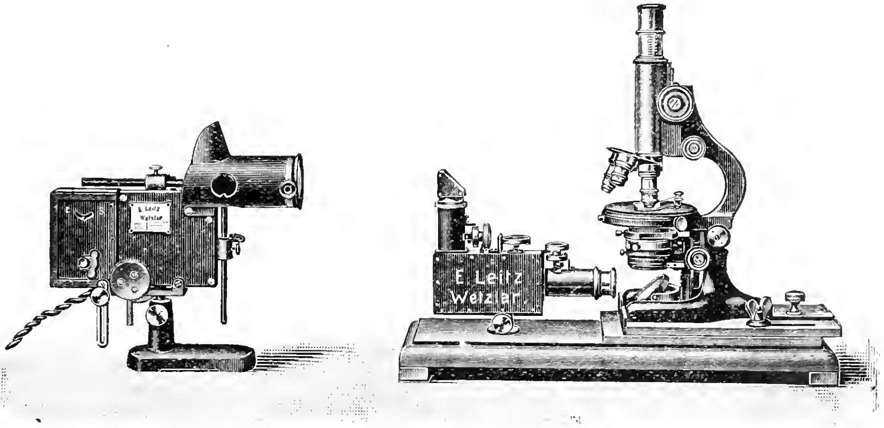


FIG. 31.

with especial reference to the needs of microscopists, although it will also be found useful in several branches of physical research. The external view is shown in fig. 31 and with the ray-path in fig. 32. It has been designed so that it may be used with any type of Microscope and with any type of lamp. The apparatus consists of a small box, adjustable in height, containing a Hilger prism, rotation arrangement and telescope objective. Two tubes mutually perpendicular contain each an illuminating lens, and a slit. The exit-slit must be directed accurately on the Microscope mirror so that the apparatus can be used as a lamp. Over the entrance-slit a small totally reflecting prism is so arranged that the rays of a light-source can be easily made parallel to the exit-tube. Both the entrance and the exit-slits are bilaterally adjustable, and can be regulated by a micrometer screw and

* Zeit. f. Instrumentenk., xxxiv. (1914) pp. 47–51 (2 figs.).

divided drum, each graduation on the drum signifying one-hundredth of a millimetre. The movement is limited by two hard stops. The beam of rays diverging from the entrance-slit is parallelized by the achromatic collimator objective inside the box and is then transmitted through the prism: these rays then pass through a telescope objective and throw a spectrum (visible length 12 mm.) in the plane of the exit-slit. By rotating the prism the whole spectrum can be made to traverse

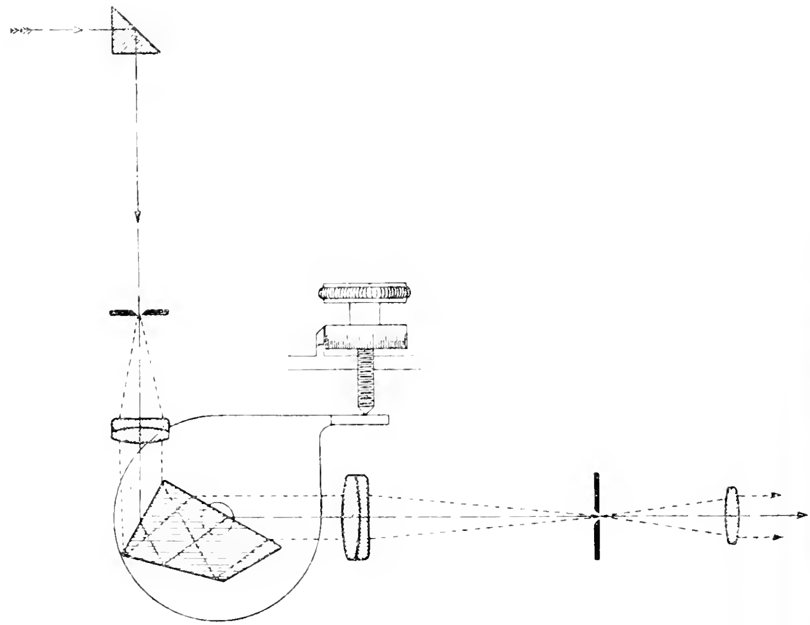

Fig. 32.

the slit so that any desired part can be brought into use. The actual position of the prism can be read off on a disk. It is possible to standardize the graduation according to the wave-length. The breadth of the exit-slit is usually twice as much as that of the entry-slit. It is very important to arrange the height of the apparatus so that the emergent rays exactly coincide with the axis of the Microscope mirror. The apparatus is mounted on a wooden base so that the Microscope can be moved in two mutually perpendicular directions.

### (5) Microscopical Optics and Manipulation.

**Demonstration Experiment on the Abbe Theory of Microscopical Perception.*** — H. Ambronn describes a series of experiments he has undertaken for the purpose of illustrating Abbe's doctrine that

* Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 289–99.

the perception of a colourless object is more distinct in proportion as the difference is greater between the refractive indices of object and embedding medium. His experiments were mainly with the cortical fibres of certain nettles (*Boehmeria tenacissima* Gaud.), and the media were a cinnamon oil of refractive index 1·597, and benzyl-alcohol sp.gr. 1·540. The following is a résumé of his conclusions.

1. An image of a colourless object can only be formed under the Microscope when there exists a difference of refractive index of object and surrounding medium. If object and medium are optically isotropic only a single value of this difference has to be considered. If the object is doubly refractive and if the actual section through the index ellipsoid in the object plane is an ellipse, then there must be two limiting values corresponding to the semi-axes of the ellipse. If these two different values vary from zero, diffraction spectra must exist which usually do not resemble each other. The interference efforts in the image plane must correspondingly vary and the microscopical image is due to their superposition.

2. If, however, one of these difference values is zero, no diffraction spectra can exist, and therefore no image of the object. If the refractive index of the isotropic embedding medium be expressed by $n_0$ and the two refractive of indices the object by $n_1$ and $n_2$, then either $n_1 - n_0$ or $n_2 - n_0$ can equal zero. In the first case the image depends on the difference $n_1 - n_0$ and in the second case on $n_2 - n_0$. The rays corresponding to the values $n_1$, $n_2$, as a result of the laws of double refraction, are polarized perpendicularly to one another.

3. If a bast-fibre of the nettle plant be chosen as object and $n_3$ corresponds to the semi-axis of the index ellipse lying parallel to the bundle-axis, and $n_2$ to the one perpendicular to it, then $n_1 > n_2$. If such a fibre be observed in benzyl-alcohol (ref. ind. = 1·540) over a polarizer, then usually no image is formed if bundle-axis and polarizing plane of the Nicol are parallel. If both directions are crossed, then a distinct image of the fibre is found by means of a ray which is polarized perpendicularly to the bundle-axis. If the observation be made in cinnamon oil (ref. ind. 1·597) the contours disappear if bundle-axis and polarizing-plane are crossed, and the image is formed, when both directions are parallel, by means of a ray polarized parallel to the bundle-axis.

4. From what has been said in (3) it follows that the fibre acts as an analyser in both cases. If between the fibre and the polarizer a selenite plate be diagonally inserted, the contours will appear in two positions, inclined at 90° to one another in the same colours.

5. Contours which in a bright field appear dark on a bright ground must in a dark field appear bright on a dark ground. The ray of the diffraction spectrum which through interference in the bright field produces a minimum of intensity must in the same position in the dark field attain a maximum of intensity. On the insertion of a selenite plate the colours in the two fields are complementary. Hence, by superposition of the images cast by the two fields combined with a little weakening of the central beam, the microscopical image can be usually made to disappear.

### (6) Miscellaneous.

**Output from Optical and Mechanical Workshops.***—Under the above title (Aus Optischen und Mechanischen Werkstätten) E. Wychgram contributes his sixth notice of the annual progress in optical work. In this case he deals with 1913, and the chief improvements in that year in German optical instruments will be found duly recorded.

**Quekett Microscopical Club.**—The 497th Ordinary Meeting was held on March 24, 1914, the President, Prof. A. Dendy, F.R.S., in the Chair. N. E. Brown, A.L.S. "Some notes on the Structure of Diatoms." This principally dealt with the observation of very minute pores having a diameter of the order of 0 1 $\mu$, through which it was considered protoplasmic filaments were protruded to about 7 $\mu$. The pores had been observed in *Nitzschia scalaris*, *Amphipleura lindheimeri*, *Stauroneis phœnicenteron*, and in a small unknown species of *Pinnularia*. The new $\frac{1}{7}$-inch oil-immersion objective, issued by Messrs. Zeiss, was described by E. M. Nelson, F.R.M.S.

The 498th Ordinary Meeting was held on April 28. E. M. Nelson, F.R.M.S., had calculated "a new low-power condenser." This, with the top on, has a focus of one inch, and with top off, two inches. A specimen was exhibited, arranged to give dark-ground illumination with a new device for centring the patch top, also designed by E. M. Nelson. N. E. Brown, A.L.S., described the structure of the flower of *Vinca minor*, with especial reference to the fertilizing devices, and metioned the extreme scarcity of the fruit of this plant both in this country and on the Continent. The Hon. Sec. (J. Burton) exhibited and described an abnormal form of *Arachnoidiscus ornatus*, from Mauritius, which had the appearance of a cylinder rather than the usual disk-like form of but slight depth. The depth of the abnormal form was from three to four times that of the normal, the diameter in both forms remaining constant.

## B. Technique.†

### (1) Collecting Objects, including Culture Processes.

**Cultivation of Gonococcus.‡**—A. Lumière and J. Chevrotier make a further communication about this method of cultivating gonococcus.§ They point out that the medium should consist of barley-malt, with or without hops, and should not contain a trace of any starchy or sugary substances. Beerwort should not contain more than from 22·5 to 55 grm. of reducing sugar per litre. The reaction of the medium should be distinctly alkaline. The addition of $\frac{1}{10}$ ass-serum is a distinct

* Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 319–48 (30 figs.).

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

‡ Comptes Rendus, clviii. (1914) pp. 1287–8.

§ See this Journal, *ante*, p. 83.

advantage. It is important to sow the medium with large drops of the suspected pus. Lastly they find that gonococcus is easily cultivable anaerobically on their medium. They do this either by covering the surface of the infected film with a layer of oil, or by cultivating in vacuo.

**Collecting Eelworms.***—M. V. Lebour and T. H. Taylor, after alluding to the damage done to rhubarb by *Tylenchus devastatrix*, and to the ordinary methods of obtaining eelworms for examination, describe a procedure for cleansing the raw material. It is based on the habit that eelworms have of climbing up capillary films. For this purpose silk threads are employed, to each of which is suspended a blob of cotton wool. The cotton wool serves as a receptacle for holding the crude material obtained from the rhubarb. The upper ends of the threads are attached to a glass ring, which is supported upon the sloping sides of a funnel-shaped vessel containing water, this shape being chosen

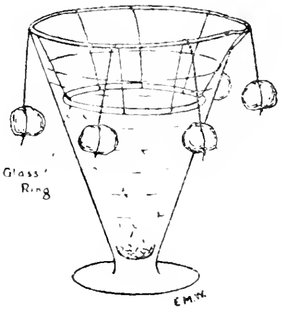


Fig. 33.

in order that the blobs may hang clear (fig. 33). As the threads become saturated the eelworms ascend along the silk strands and, passing over the brim into the water, congregate on the floor of the vessel.

**Casein as a Cultivation Medium.**†—G. Seliber has used for studying certain organisms a medium in which casein is the basis. The formula given is as follows:—$K_2HPO_4$, 1 grm.; $MgSO_4$, 0·3 grm.; NaCl, 0·1 grm.; $CaCl_3$, 0·1 grm.; distilled water, 1 litre. In certain cases it is useful to add to the foregoing a few drops of $Fe_2Cl_6$. The solution, to which 1 p.c. pepton may be added, is neutralized and then alkalinized with slight excess of NaHO. To the alkalinized medium is added 0·5 p.c. casein. The medium is heated over a water bath and shaken up in order that the ingredients may be disseminated throughout. When ready the solution is sterilized for fifteen minutes at 115° C., and then filtered. To the filtrate is added 1 p.c. sugar, and finally autoclaved previously to being distributed in test-tubes.

* Nature, May 7, 1914, p. 242.
† C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 639–41.

**Cultivation of Plasmodium vivax.*** — P. I. Pitschugin, after a review of the work of Bass and Johns, Gurko and Hamburger, and others, upon the artificial culture of the malarial parasites, give an account of their own experiments with *Plasmodium vivax*. The technique followed was that of Bass. 10 c.cm. of blood withdrawn from the ulnar vein of a patient were put into a sterile cylinder containing 0·1 c.cm. of a 50 p.c. dextrose solution. The blood was defibrinated by stirring with a glass rod and put into an incubator at 40° C. Films were prepared and examined at intervals. These films were fixed with methyl-alcohol, and stained with Argutinski's methylen-blue eosin method. By means of these procedures the authors observed two complete, and a third incomplete, cycle of development of the parasites. In the third generation, only schizonts and merozoites were found. The addition of inactivated ascitic fluid or of dextrose solution in greater quantity than that stated above, does not have any influence on the growth of the organism. In the preparation of films for observation the authors recommend that some of the clear supernatant fluid be sucked up, so that thin films may be obtained.

**Isolation of Single Trypanosomes.†**—F. Henningfeld describes his method of separating individual trypanosomes for the purpose of microscopical observation and inoculation. First he used a modification of Lindner's method, which consists essentially in the mounting of a series of minute droplets of diluted suspension of organisms on a slide. He found, however, that the capillary pipette method was better. Measurement showed the pipettes used had a lumen of about 0·018 mm. in diameter. The glass wall was 0·006 mm. in thickness. Trypanosome-infected blood was diluted with broth, saline, or serum—the latter was the most satisfactory—and drawn into the pipette. A portion of the pipette about 7 cm. in length was placed on a slide and examined in detail with a compensating ocular Zeiss 12, and an objective of medium power. The ends of the pipette were sealed with wax. If a parasite was found lying in isolation the margins of the zone containing it were marked with a Leitz object marker. Then, while the portion containing the parasite was held in position with a superposed slide, the remainder of the capillary-tube was cut away with a knife. By this means individual parasites were obtained for observation and inoculation. Successful inoculations with mice of single specimens of *Trypanosoma brucei* and *T. equiperdum* were accomplished.

**Single Cell Cultures.‡**—M. A. Barber describes his method of making a series of cultures from single cells. A large cover-glass (38 × 65 mm.) is carefully cleaned, sterilized, and placed on an isolation chamber. Cross lines are ruled on its upper surface. By means of a bent pipette, droplets of sterile broth, 2 mm. in diameter, are placed in rows on the under surface. Two larger drops are put towards the ends of the cover. By means of a pipette a small portion of actively growing

* Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 373–84.
† Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 228–39.
‡ Philippine Journ. Sci., Sect. B, viii. (1913) pp. 539–57.

culture is transferred to one of the larger drops. This drop is now brought into observation under the Microscope, and a number of bacilli in medium dilution are drawn into a fine pointed pipette. The rows of hanging drops are then brought into view, and a minute droplet, containing a single bacillus, is ejected from the pipette in the immediate neighbourhood of each drop. If a proper dilution has been used, this is not difficult, but the droplet must be very small, so that the presence of a single cell may be readily determined. When a sufficient number of these minute single-cell droplets have been placed beside hanging drops, sterile broth is taken into a second fine pipette and is added to each hanging drop so as to make it over-run and absorb the adjacent inoculated droplet. The cover is then removed from the isolation chamber and sealed over a shallow moist chamber. On the following day, inoculations may be made from the hanging drops into test-tubes.

### (2) Preparing Objects.

**New Method of Examining the Cells in the Cerebrospinal Fluid.*** B. Schlüchterer advocates the use of sublimate when examining cerebrospinal fluid. The solution is composed of sublimate, 3 grm.; acetic acid, 1 c.cm.; distilled water, 100 c.cm. To about 4 c.cm. of the fluid placed in a centrifuge tube, the solution is added drop by drop until the cerebrospinal fluid becomes milky. After shaking up, the fluid is centrifuged and then smears are made of the deposit. After the films are dried the slides are placed in iodine-alcohol for five minutes. The iodine is removed by a thorough washing with 70 p.c. alcohol. When dry the films are stained with methyl-green-pyronin solution for ten minutes: after which they are dried and examined. The chief advantages claimed for this method are that probably all the cells are deposited, that the deposit makes good films, with no tendency to wash off, and that the pictures of the cells are excellent.

**Washing Pieces of Tissue for Histological Purposes.†**—E. Beatti describes a simple method of washing pieces of tissue to get rid of fixatives, decalcifying agents, etc., the presence of which might have a harmful effect on the after-treatment of the material. Many of the apparatus devised for washing tissues are complicated and sometimes costly. The author's method, which he has used for many years, is quite cheap and simple. It consists in fitting to the nose of an ordinary watertap an "antisplash" regulator and directing the stream near to the side of an ordinary tumbler. Owing to the direction of the currents set up there is no tendency for the pieces which are being washed to escape over the edge of the tumbler, most of which margin remains quite dry.

**Demonstrating the Chromosomes of the Fowl.‡**—Alice M. Boring and R. Pearl in their investigation on the spermatogenesis of the domestic fowl, used pure barred Plymouth rock and cross-bred males, varying in age from five months to two years. Three general methods

* Neurol. Centralbl, xxxii. (1914) pp. 420–2.
† Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 485–7 (1 fig.).
‡ Journ. Exper. Zool., xxi. (1914) pp. 53–83 (91 figs.).

of technique were used in the preparations, stained sections, smears and aceto-carmine mounts. The last two gave the best results. Much difficulty was experienced owing to the stickiness of the chromosomes, and their separation was best found in smears and in aceto-carmine preparations, no matter in what they were fixed. Fixation for sections was mostly done in Gilson's, Flemmings or Hermann's solution : the first gave best results. Pieces left indefinitely in aceto-carmine gave very good results, and this led to experiments with other acids (butyric, formic), but neither was as good as acetic. Smears also were made after Guyer's method ; these were fixed in Bouin's solution and stained with iron-hæmatoxylin. These smear preparations were found to be favourable for drawing and photography and much better than sections stained in the same way. The chief object of the paper was to show that there is no valid evidence that any element which may be justly interpreted as an $x$-chromosome exists in the chicken.

**Preparing Teleost Embryos for Class Use.***—Some of the most important features of development of the Teleost egg, such as discoidal cleavage and the part played by the germ ring in the formation of the embryo, require for their satisfactory demonstration that the entire egg shall be preserved and studied as nearly as possible in the natural form. For this purpose balsam mounts are of little value, for even with the vitelline membrane removed the egg usually collapses in the higher alcohols or in xylol.

For the convenient handling of cleavage stages to be studied as opaque objects, B. G. Smith has devised the following method. Pieces of $\frac{1}{8}$ in. glass tubing are sealed at one end by holding in a flame ; a few eggs fixed in corrosive-acetic and preserved in formalin are placed in each tube and the opening plugged with cotton. For these stages it is well to choose an egg with dark yellow yolk, this will aid in the differentiation of the snowy white blasto-disk. The eggs may be studied by dropping the tube into a watch-glass filled with water and examining them with a lens ; or the tube may be held in the hand and examined with the lens. The special advantage of the tube is that of ease of manipulation : any view desired can be secured and that without injury to the egg. An additional advantage is that the method allows little trouble from the inevitable mixing of stages that occurs when the material is handled in bulk by the student.

For stages with embryonic shield and germ-ring the preceding method should be used if the yolk is opaque : but a better plan is to secure the small transparent eggs of the runner (*Ctenolabrus*) and mount them in formalin in a hollow ground slide, sealing the edges of the cover-slip with cement. Staining is not required. In this egg either the upper or under surface may be viewed simply by changing the focus.

**Preservation of Bryozoa.†**—Bessie R. Green gives the following method which was successfully used for preserving *Cristatella*, *Plumatella*,

* Trans. Amer. Micr. Soc., xxxiii. (1914) pp. 54-5.
† Trans. Amer. Micr. Soc., xxxiii. (1914) pp. 55-6.

and *Fredericella*. Chloretone was used for narcotization and 3 p.c. formalin for killing and subsequent preservation. The colony was placed in a tube or beaker of convenient size and covered completely with water. When the lophophores of the individual polypides were well extended the chloretone solutions were added in the following order :—(1) A few drops of sat. sol. chloretone in water ; (2) 1 part ditto to 4 parts water ; (3) 2 parts ditto to 3 parts water ; (4) 3 parts ditto to 2 parts water ; (5) 4 partsditto to 1 part water ; (6) saturated solution of chloretone.

The amount of each solution was equal to the amount of water containing the colony. Each solution was added drop by drop very slowly. Gradually some of the solution containing the colony was removed in order to keep the amount constant.

The time required for the application of each solution varied from 15 to 30 minutes. After the colony had been in the saturated chloretone solution for 15 minutes the killing agent was added. A 3 p.c. solution of formalin was diluted with a saturated solution of chloretone, and the following grades were used :—(1) 1 part 3 p.c. formalin to 2 parts sat. sol. chloretone ; (2) 1 part ditto to 1 part ditto ; (3) 2 parts ditto to 1 part ditto ; (4) 3 p.c. formalin.

These solutions were added drop by drop in the same manner as for narcotization, and 15 to 30 minutes were allowed for the application of each grade. Two and a half to five hours are necessary for the entire procedure. For *Cristatella* the minimum time is sufficient, but for *Plumatella* and especially for *Fredericella* the maximum time is necessary.

### (4) Staining and Injecting.

**Staining Methods for Microfilaria.***—F. Fülleborn discusses in considerable detail various methods of staining these parasites. For simple clinical diagnosis, he recommends the dry method : two or three drops of blood are spread on a clean side, dried, dehæmoglobinized with distilled water, fixed with absolute alcohol, stained with Böhmer's hæmatoxylin, differentiated with weak acid, blued in tap-water, dried and mounted in cedar-wood oil. For diagnosis between *Microfilaria bancrofti* and *M. loa*, he recommends wet-fixation. In this case, the preparation is dehæmoglobinized with saline, fixed and passed through mounting alcohols to absolute alcohol and down again to distilled water, stained with hæmatoxylin and mounted. For anatomical study, fresh-stained (vital-stained) preparations treated with azur-eosin give good results. Finally, as a simple and satisfactory method, pyronin-methyl-green is recommended. A thick film is dried and dehæmoglobinized with saline. This is stained for half-an-hour or longer with Unna-Pappenheim's carbol methyl-green-pyronin, and differentiated and dehydrated simultaneously by rapid alcohol passage. It may then be mounted and examined For many important practical details and precautions to be observed in the following of any of these procedures, the original paper should be consulted.

* Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 427-44.

**Staining Pearls in Mussels.***—F. Alverdes used the pearls found in various kinds of mussels. The pearls with the surrounding tissue were cut out and then placed in the fixative, either Zenker or Flemming. Owing to the nature of these fluids the resulting decalcification was attended with rupture of the pearly layers and distortion of the tissue. In order to avoid this, acid-free fluids were used, Müller's fluid and sublimate-alcohol (equal parts of saturated aqueous sublimate solution and absolute alcohol) for fixation, the material being afterwards decalcified with 2 p.c. nitric acid, and later embedded in celloidin or in clove-oil-collodion. The sections were stained as a rule with anilin water-safranin-water-blue. This staining solution is composed of anilin water, 200 c.cm.; absolute alcohol, 100 c.cm.; safranin, 1 grm. The water-blue was made up with either an aqueous or alcoholic solution of picric acid. The staining is done by first thoroughly treating the sections with the safranin solution and then differentiating with 96 p.c. alcohol. The sections are then placed for a few minutes in the water-blue. In this way a multiple staining is obtained, and which is most effective if the fixation has been done with Flemming. Control stainings were made with hæmatoxylin and eosin, and with anilin-water safranin. In the last case the staining is differentiated with hydrochloric-acid-alcohol (1 : 1000).

**Rapid Romanowsky Stain.**†—G. Giemsa, for the rapid staining of films, recommends the use of a staining solution containing azur-II-eosin 3 grm., azur 0·3 grm., and glycerin 25 grm. in 475 grm. of methyl-alcohol. About 15 drops of this solution are applied to the unfixed film, and left in contact for about half a minute. Then diluted stain (10 drops of stain to 10 c.cm. of distilled water) is put on the slide for a period of ten minutes. The film is then washed in distilled water, dried, and mounted.

**Studying the Musculature of Flies.**‡—J. Thulin, in studying the musculature of flies, used chiefly *Hydrophilus piceus*. For fixation the strong Flemming solution was injected into the living animal, which was thereby almost instantly killed. The material was then treated with acetum pyrolignosum rectificatum and 1 p.c. chromic acid solution, and afterwards with bichromate of potassium. The paraffin sections were made in the usual way, the preparation of the section (1 to 3 $\mu$) was aided by the use of an alcoholic mastic solution. The sections were stained with sodium alizarin sulphate and crystal-violet. Photographs were taken with the Vogel-Obernetter silver eosin plates, which are very valuable for their sensitiveness to colour.

**Modification of Pal's Method of Staining Medullated Nerves.**§ J. G. Schnitzler employs the following modification of Pal's method. The material is fixed with formalin or placed at once in 2·5 p.c.

* Zeitschr. wiss. Zool., cv. (1913) pp. 598–633 (2 pls.).
† Centralbl. Bakt., 1te Abt. Orig., lxxxiii. (1914) pp. 493–6.
‡ Anat. Hefte, xlvi. (1912) pp. 189–252 (12 pls.).
§ Neurol. Centralbl., xxxii. (1913) pp. 483–5.

bichromate of potash solution. When ready it is embedded and sections made. The sections are placed for three days in 2·5 p.c. potassium bichromate. After a wash in water they are stained for 12 to 24 hours in hæmatoxylin (10 parts of 10 p.c. alcoholic solution of hæmatoxylin to 90 parts water). After a wash in water they are treated with a freshly-made mixture of a 2 p.c. solution of red prussiate of potash, 10 parts; saturated aqueous solution of lithium carbonate, 30 parts. This preliminary differentiation is finished when the edge of the celloidin is decolorized (about 1 minute). After a thorough wash the sections are treated with 2·5 p.c. potassium bichromate for 30 seconds. After another wash the sections are further differentiated by Pal's method as follows: 30 to 60 seconds in 1 : 600 potassium permanganate, wash, and then bleach in a recently-made mixture composed of 1 p.c. oxalic acid, and 1 p.c. sulphate of soda, in equal parts. The differentiation is repeated until the tone is whitish throughout. The sections are darkened by immersion in ammonia or lithia-water.

**Demonstrating the Structure and Innervation of Dentine.***—The material used by C. Fritsch consisted chiefly of normal human teeth and also some from the calf, dog, and hedgehog. The teeth were preserved in formalin for at least 4 weeks, and were then decalcified by Schaffer's method.† Sections were prepared by the freezing method. For staining the nerves a modification of the Bielschowsky procedure was adopted.‡ The sections were taken from distilled water and placed in pyridin for 24 hours. They were then transferred to distilled water, frequently changed, for 24 hours. After this the sections were placed for 5 to 8 days in 3 to 5 p.c. silver nitrate, and then after a short wash were immersed in the following ammonia-silver oxide solution. To 5 c.cm. of 20 p.c. silver nitrate, 5 drops of 40 p.c. caustic soda were added. The resulting precipitate is then cleared up by adding, drop by drop, pure ammonia. This ammoniacal silver solution was then made up to four times its volume with distilled water, and into this solution the sections were placed for 4 to 5 minutes. After reduction with 20 p.c. formalin they were treated with distilled water acidified with 1 drop of acetic acid. After washing with distilled water the process was repeated, the best results being obtained after a repetition of ten to twelve times. After being gilded the sections are placed in a solution of gelatin, transferred to a slide, and then covered with gelatin. The slides dry in about 24 hours, and can then be examined with an oil-immersion. The gelatin solution is prepared by dissolving 10 grm. of pure gelatin in 100 distilled water, then liquefying in a water-bath at 50° and filtering in an incubator.

**Demonstrating Elastic Fibres.**§—L. Liperovsky demonstrated the presence of elastic fibres in the human mammary gland at ages of 15, 18, 20, 39, 42, 68, and 70 years, by the following procedure. The

* Arch. Mikr. Anat., lxxxiv. (1915) pp. 307–20 (2 pls.).
† See this Journal, 1903, p. 558.
‡ See this Journal, 1906, p. 735; 1907, p. 498; 1910, p. 670.
§ Anat. Anzeig., xlv. (1914) pp. 504–11 (7 figs.).

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fixative chiefly used was Flemming's fluid. Small pieces of tissue were immersed for one to two days, and after a careful washing in water were dehydrated in alcohols of increasing strength. They were then embedded in celloidin. The sections were stained in an acid solution of orcein. After a stay in the staining solution for twenty-four hours, the sections were decolorized for five minutes in 96 p.c. acid-alcohol. Novikoff's method was also used. This stain consists of 0·01 p.c. solution of triphenylrosanilnitrisulphate of sodium in saturated aqueous solution of picric acid. In this fluid the preparations remain for twenty-four hours, and then are differentiated in 45 to 50 p.c. alcohol. In these preparations the elastic fibres are yellow, connective-tissue blue, and muscle green. Another method tried was staining the celloidin sections with safranin or twenty-four hours, and then washing in water followed by weak alcohol, afterwards transferring to orcein solution for 6 hours, and finally differentiating in acid-alcohol or in picric acid.

Fixation was done with Müller's fluid, with or without addition of formalin, but the resulting pictures were not so clear or distinct.

**Staining Spirochæta pallida.***—According to C. Birt, the most effective way of staining *Spirochæta pallida* is as follows :—The films are first air-dried and then fixed in a fluid composed of acetic acid, 1 c.cm. ; formalin, 20 c.cm. ; distilled water, 100 c.cm. This must be renewed several times in the course of a minute. After washing in water the films are mordanted with 5 p.c. tannic acid in 1 p.c. carbolic acid. The slide covered with mordant is heated to vaporization, and after half a minute is washed with water. While still moist the film is stained with 0·25 p.c. silver nitrate in distilled water, to which a minute trace of ammonia is added until slight turbidity occurs. The film covered with stain is heated to vaporization and left for half a minute. It is then washed, dried, and mounted in xylol-balsam. The spirochætes are jet black, and appear to be much thicker than when stained with anilin dyes.

**Morphology of the Eye-muscle Nerves.†**—In the course of the present study H. V. Neal used different methods. Among those which have given the best results are Cajal's nitrate of silver, Paton's modification of Bielschowsky's method, Held's molybdic acid-hematoxlin stain and vom Rath's picro-acetic-osmic-platinic chloride-pyrogallic acid treatment. The Vom Rath ('95) method is as follows :—

1. Fix in the dark for one to three days in the following mixture (use plenty and change each day) : Saturated and filtered solution picric acid, 200 c.cm. ; glacial acetic acid, 2 c.cm. ; Platinic chloride (dissolve in 10 c.cm. water), 1 grm. ; osmic acid 2 p.c., 25 c.cm. Owing to the great brittleness of embryos fixed in this fluid all changes of liquid should be made with pipette in the same dish, avoiding as far as possible any movement of the embryos. 2. Stain in 0·5 p.c. pyrogallic acid in the dark for twenty-four to forty-eight hours with several changes.

* Journ. R.A.M.C., March 1914.
† Journ. Morphol., xxv. (1914) pp. 1–87 (9 pls.).

3. Grades of alcohol from 35 p.c. slowly by the siphon capillary drop method to avoid shinkage. Xylol, to which paraffin is added as it dissolves. 4. Embed in rather hard paraffin of best quality. 5. Thin sections, not over 8 $\mu$, preferably 4 to 6 $\mu$.

Vom Rath's method is not specific for the neurofibrils, which are nevertheless deeply stained. Cell boundaries are shown with special distinctness and shrinkage is slight. The process is advantageous in demonstrating cell relations in the stages when nervous connexions of tube and somite are effected.

Flemming's stronger formula gives excellent fixation of Selachian embryos, but does not allow the use of pyrogallic acid for subsequent staining. Fixation seems quite as faithful as in Vom Rath preparations, but cell boundaries are not so distinct as in the latter. Iron-hematoxylin gives the best stain, subsequent to the use of Flemming's fluid, but it is necessary to paint the sections with 0·5 p.c. celloidin in order to prevent their loss in staining on the slide.

For the specific purpose of demonstrating the neurofibrils Cajal's method has given uniformly satisfactory results, which appear somewhat less refined than those obtained by the Bielschowsky-Paton process. The Cajal method is as follows :—

1. Fix in absolute alcohol and 1 p.c. ammonia for forty-eight hours. 2. Wash for one-half to three minutes in distilled water. 3. Pyridin for twenty-four hours. 4. Distilled water—many changes—for twenty-four hours. 5. A 2 p.c. aqueous solution of silver nitrate for three days at 35° C. in the dark. 6. Rinse in distilled water. 7. Four p.c. pyrogallic acid in 5 p.c. formalin for one to two days. 8. Paraffin sections.

The Simarro-Cajal silver reduction method, following fixation in 70 p.c. pyridin, which has given such splendid results when applied to Mammal and other Amniote embryos, has proved a complete failure in the case of *Squalus* embryos.

Excellent results in the differentiation of the neurofibrils have followed the use of the molybdic-acid hematoxylin process as developed by Held (1909). Tissues may be fixed by various methods, including Zenker's fluid and Rabl's picro-sublimate. The stain is effected by a solution of molybdic acid in a 1 p.c. solution of hematoxylin in 70 p.c. alcohol. The stain is better after months or years. Immediately before use, several drops of this tincture—depending on the strength wanted—are dissolved in distilled water, and the sections are stained warm on the slide at 50° C., or for a longer time cold. The sections may be stained directly, or they may be mordanted in iron-alum.

The neurofibrils are differentiated by the Bielschowsky-Paton process, but, like the Cajal method, this does not demonstrate the fibrils within the neuroblast cell in the earliest stages of histogenesis. By this method the neurofibrils are stained a dark brown or black, while other tissues are light brown or yellowish brown. In the process only tested distilled water, and absolutely clean glass-ware and glass or bone spatulas—no metal—should be used.

1. Fix and keep embryos in 10 p.c. formalin, neutralized or made slightly alkaline with magnesium carbonate. 2. Wash in running tap-

water for twelve hours. 3. Wash in three or four changes of distilled water for a half-hour. 4. Place in pure 1 p.c. nitrate of silver for six days in the dark, at a temperature of about 70° C. Tissues must become reddish brown in colour. If they become yellowish-brown, throw away. 5. Place in a solution of silver nitrate freshly prepared as follows: 20 c.cm. of 1 p.c. silver nitrate. Add two drops of 40 p.c. caustic soda to form a grey precipitate. Then add twenty to thirty drops of strong ammonia, enough to dissolve the precipitate while stirring. Allow to remain at least forty-five minutes. 6. Wash quickly in two baths of distilled water and quickly place in distilled water to every 20 c.cm. of which five drops of glacial acetic acid have been added. Leave in this five to fifteen minutes or until the reddish-brown becomes yellowish-brown. 7. Wash quickly and place over-night in 1 p.c. hydroquinone containing 5 p.c. neutral formol. 8. Wash quickly in distilled water, run up through alcohols rapidly and embed in paraffin through benzole or chloroform. 9. Cut sections and fix on slide. Dry well, then paint slides with 0·5 p.c. celloidin. This is followed by absolute alcohol-xylol, and absolute alcohol-xylol again. Then absolute alcohol to 95 p.c. alcohol down to water (distilled). 10. Then one to two hours in 0·1 p.c. solution of gold chloride neutralized with lithium carbonate. Grubler and Hollborn's gold chloride should be used (flavum, not fuscum). 11. Rinse in distilled water and fix in 5 p.c. hyposulphite of soda for fifteen minutes. Wash in running tap-water for two hours. Then alcohols up to absolute. Then absolute and eosin for a minute. Absolute alcohol, xylol, and mount in neutral balsam.

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

**Celluloid Covers for Large Microscopical Slides.***—C. Brookover recommends tissue-celluloid sheets for covering large slides such as are necessary for serial sections of large objects, e.g. advanced embryos. These slides may be quite large, 7 × 3, and the advantage of tissue-celluloid is that high powers and oil immersion may be used. Tissue-celluloid is obtainable from dealers in photographic supplies. The writer mentions one disadvantage, which is that the celluloid cover has a tendency to squeeze the balsam out at the edges where it curls up.

**Venetian Turpentine as a Cover-glass Cement.**†—M. Plaut advocates the use of Venetian turpentine for sealing off botanical preparations and for other purposes. The resin (Venezian. terpent. rect.) obtained from Grübler, is placed in a porcelain pan and heated in a sand-bath to remove the terpene. In from 4 to 6 hours the desired consistence is attained. The mass is then dissolved in ether and placed in a metal can devised and described by the author. When required for use heat is applied to the can and the contents poured out through the spout. Turpentine prepared as above stated is of a gold yellow hue, strongly refracting, and when cold and solid is not sticky.

* Trans. Amer. Micr. Soc., xxxiii. (1914) pp. 56–7.
† Zeitschr. wiss. Mikrosk., xxx. (1914) pp. 476–8 (3 figs.).

### (6) Miscellaneous.

**Electro-chemical Disinfection.***—F. C. Lewis recommends for use in bacteriological laboratories, in place of the familiar jar of lysol for the disinfection of slides and cultures, a jar containing sodium chloride, in which, by means of an electrical current, sodium hypochlorite, a powerful disinfecting agent, is produced. He uses a glass museum jar three-quarters full of a 10–20 p.c. solution of common salt. The current is obtained from the ordinary lighting circuit, a bench-lamp providing the necessary resistance. One of the cords of the lamp is cut, the severed copper wires are bared and fixed to carbon plates. The exposed wire is thickly coated with paraffin or sealing-wax. The carbon electrodes are placed in the salt bath. The bath soon acquires high bactericidal powers: tests with anthrax spores and other organisms prove this. These powers are retained for several days after the passage of the current is discontinued. As the bactericidal power is readily regenerated, the method is economical.

**Bacteriological Examination of Food and Water.**†—The Syndics of the Cambridge University Press are publishing a series of volumes dealing with subjects connected with Public Health, and one of these, "The Bacteriological Examination of Food and Water," is written by W. G. Savage, who has had great experience in the subjects dealt with in the present volume. The work fills up a considerable gap, for most text-books which deal with the bacteriology of food and water do so in a somewhat perfunctory manner. After chapters on general considerations and methods for the isolation and identification of indicator organisms such as *B. coli*, *B. enteritidis*, sporogenes, streptococci, etc., the special subjects of water, soil and sewage, shellfish, milk and its products, meat and air, are dealt with in a luminous and practical manner. There is also a useful chapter on the determination of antiseptic and germicidal power, the volume concluding with an appendix in which are described the different media and their composition required for the examinations mentioned in the work. The methods given are those which the author has found from experience to be of practical value, and the utility of which he has personally proved.

* Journ. of Hygiene, xiv. (1914) pp. 48-51.
† Cambridge University Press, 1914, 173 pp. (16 figs.).

## Metallography, etc.

**Silver and Cuprous Oxide.***—C. H. Mathewson and C. H. Stokesbury find that cuprous oxide dissolves freely in molten silver, but is practically insoluble in the solidified metal. Thus silver and copper are alike in their behaviour towards cuprous oxide, silver and cuprous oxide forming alloys containing a eutectic. The eutectic contains 1·3 p.c. $Cu_2O$. As in the copper-cuprous oxide alloys, the cuprous oxide coalesces readily. The primary crystals of silver tend to encroach on the eutectic areas. The structure is apparent in polished sections, but a mixture of concentrated ammonia and hydrogen peroxide has been found suitable for etching.

**Alloys of Cerium with Silicon and Bismuth.**†—R. Vogel has made extensive use of microscopic examination in the determination of the equilibrium diagrams of the cerium-silicon and cerium-bismuth systems. The compound CeSi, melting above 1500° C., was observed in unetched sections as yellow rounded crystallites. The eutectic of CeSi and silicon had a well-formed lamellar structure. Free silicon was found as hard needle-shaped crystals. The cerium-bismuth alloys were polished with alumina on wet cloth, but oxidized very rapidly. The structural characteristics of the four compounds and the eutectics occurring in the cerium-bismuth system are described.

**Metallography of Electrolytically-deposited Alloys.**‡—R. Kremann, C. T. Suchy, and R. Maas find that iron-nickel alloys deposited electrolytically from a solution of ferrous and nickel-sulphates are analogous in structure to alloys prepared by fusion. A structure characteristic of the electrolytic alloys consisted of concentric layerings. Cross-sections of the deposits had a lamellar appearance.

**Protective Oxidized Coating on Sheet-iron.**§—Matweeff has examined microscopically transverse sections of thin Russian sheet-iron used for roofing; this material is remarkably resistant to corrosion. The specimens were embedded in gum-lac for polishing. The layer of oxide was not homogeneous, and consisted of compact ferrous oxide which could be polished, intermixed with friable and porous magnetic oxide. Protection against corrosion appears to be conferred by the magnetic oxide, which is retained in position by a kind of skeleton of the mechanically stronger ferrous oxide.

**Crystallizing Properties of Electro-deposited Iron.**‖—J. E. Stead and H. C. H. Carpenter have studied the structure of pure electro-deposited iron strip containing 99·967 p.c. iron, subjected to various

* Int. Zeitschr. Metallographie, v. (1914) pp. 193–212 (12 figs.).
† Zeitschr. Anorg. Chem., lxxxiv. (1913) pp. 323–39 (10 figs.)
‡ Monatsh. Chem., xxxiv. (1913) pp. 1757–1809, through Journ. Chem. Soc., cvi. (1914) pp. 96–7.
§ Rev. Métallurgie, xi. (1914) pp. 480–2 (5 figs.).
‖ Journ. Iron and Steel Inst., lxxxviii. (1913, 2) pp. 119–70 (41 figs.).

forms of heat-treatment. No marked change in crystallization occurred at temperatures below 900° C. Re-crystallization occurred at 910° to 915° C., and was complete after two or three seconds in that temperature zone. Specimens heated above 910° C. had a fine structure if quenched in water, but when any slower rate of cooling was adopted the crystals formed were relatively enormous, the resulting structure being very much coarser than that of the original strip. The first new crystals were equiaxed, but specimens which had been heated to 930° C. contained radial crystals, which increased at the expense of the equiaxed crystals with higher temperatures of treatment.

By quenching at different temperatures on cooling from above $Ac_3$, the temperature of recrystallization, it was shown that the large crystals were formed during the passage through $Ar_3$. Coarse crystals did not develop with any rate of cooling after a very prolonged heating above $Ac_3$. The large crystals, once formed, could only be destroyed by mechanical work, or by quenching from above $Ac_3$, or by prolonged heating above $Ac_3$. The formation of the excessively large crystals described did not occur in electro-deposited iron if the thickness of the strip exceeded a critical value lying between 0·011 and 0·012 inch, and did not occur at all in wrought-iron or mild steel. It is suggested that the formation of the coarse crystals may be promoted by the persistence of nuclei of crystallization when heating above $Ac_3$ is not prolonged, but that long-continued heating above $Ac_3$ destroys these crystal nuclei.

**Belaiew's Researches on the Structure of Steel.***—N. T. Belaiew's account of his studies upon the structure of steel was published in book form in the Russian language. W. Guertler now gives a summary, illustrated with 22 photomicrographs, and points out the general significance of the observations recorded and their parallels in other series of alloys. The structures described are chiefly those of specimens heated for long periods at high temperatures and very slowly cooled.

**Structural Changes of Iron during Annealing.**†—D. Ewen has studied the heat-reliefs formed on polished specimens of pure Swedish iron on heating to temperatures of 400° to 1000° C. in a high vacuum. Three distinct types of heat-relief, corresponding to (1) initial $\alpha$- and $\beta$-iron structure, (2) $\gamma$-iron structure, and (3) final $\beta$- and $\alpha$-iron structure, are described. The development of the $\alpha$-iron heat-relief on heating is ascribed to selective volatilization from the crystal boundaries, while the $\gamma$-iron and final $\beta$- and $\alpha$-iron heat-reliefs obtained on cooling are attributed to differences in dilatation of the allotropic modifications involved. An etching effect, frequently giving rise to definitely oriented pits, was obtained above $A_3$, more especially when the metal was heated by passing a heavy current through it, and is ascribed to a species of electrical disintegration.

**Damascene Steel.**‡—W. Guertler criticizes the various methods that have been proposed for preparing damascene steel. True damascene

* Int. Zeitschr. Metallographie, vi. (1914) pp. 72–89 (23 figs.).
† Int. Zeitschr. Metallographie, vi. (1914) pp. 1–17 (10 figs.).
‡ Int. Zeitschr. Metallographie, v. (1914) pp. 129–41 (9 figs.).

steel contains 1·0 to 1·6 p.c. carbon, and consists structurally of small grains of cementite embedded in ferrite. Lamellar pearlite is wholly absent. Zones rich in cementite alternate with zones containing much less cementite. It is shown that the damascene structure cannot be obtained by prolonged heating at temperatures above the critical range. Long heating below 700° C. is necessary to convert the cementite into the desired form, while some previous treatment, such as mechanical working within a particular temperature range, appears to be required to secure the remaining characteristics of damascene steel.

**Iron-carbon System.***—W. Guertler gives a critical account of the researches of Wittorf and of Hanemann on the iron-carbon system, and discusses the probability of the existence of the carbides $FeC_2$ and $Fe_4C$.

**Hyper-eutectic Iron-carbon Alloys.**†—H. Hanemann has heated pure iron-carbon melts with excess of carbon (sugar-charcoal) to temperatures ranging from 1200° to 2500° C. Most of the twenty-two melts were cooled rapidly, others slowly. The structures are described in tabular form. The maximum carbon-content, 18·5 p.c., was found in an alloy heated to 2500° C. In specimens quenched from temperatures above 1400° C., graphite was found as a primary product, and not as a decomposition-product of cementite. The so-called primary cementite could only be obtained by extremely rapid cooling. In quenched specimens the cementite crystallized radially from the centre. Wittorf's dendritic carbide, $Fe_4C$, was shown to be austenite, as it was converted into martensite by cooling in liquid air, and into pearlite by annealing.

**Ternary Alloys of Iron, Carbon, and Phosphorus.**‡—J. E. Stead gives the results of a detailed microscopic study of a number of iron-carbon-phosphorus alloys. An alloy containing 2 p.c. phosphorus and 0·12 p.c. carbon, was submitted to cementation, yielding a mass in which the central portion remained unchanged, while the carbon in the outer layer was raised to 1·3 p.c. Alloys containing 1·2 p.c. phosphorus and varying amounts of carbon were prepared by fusion. Phosphorus-rich pig irons, and an alloy containing 0·3 p.c. carbon and 0·5 p.c. phosphorus were also studied. The ternary eutectic in grey cast iron decomposes on cooling into the binary eutectic and pearlite or iron. In the solidification of a low-carbon alloy containing 2 p.c. phosphorus, crystallites free from carbon first form, and the ternary eutectic solidifies last. On slow cooling, the carbide diffuses out of the eutectic, forms a pearlite fringe round the eutectic, and throws some of the phosphide out of solid solution. This phosphide appears as fine lamellæ in juxtaposition to the pearlite carbide. A fringe having a characteristic structure and consisting of ferrite, carbide, and phosphide is thus formed. The effect of carbon in diminishing the solid solubility of iron-phosphide in iron, and the tendency of phosphorus to concentrate in segregated areas free from carbon, are discussed and copiously illustrated.

* Int. Zeitschr. Metallographie, v. (1914) pp. 239–77 (30 figs.).
† Zeitschr. Anorg. Chem., lxxxiv. (1913) pp. 1–23 (31 figs.).
‡ Journ. Soc. Chem. Ind., xxxiii. (1914) pp. 173–84 (44 figs.).

**So-called "Crystallization through Fatigue."***—F. Rogers has failed to find any experimental evidence in support of the prevalent idea that fatigue may cause a development of crystallization in iron or steel. It is probable that the only alterations in structure which repeated stress is capable of causing are destructive. Strain effects may be classified as (1) slip-bands; (2) intergranular weakness; (3) twinning, and the formation of Neumann lamellæ; (4) change of structure. Of these the first is the commonest and is almost universal. The examination of numerous samples has led to the conclusion that if a piece breaks in service with a crystalline-looking fracture, it would also have done so when new. Pieces which had broken in use, giving fractures partly crystalline and partly fibrous, were found to be heterogeneous in structure, the different types of fracture corresponding to different structures.

**Preparing Sections of Fractures of Steel for Microscopic Examination.**†—For the examination of a section through a fracture, A. Campion and J. M. Ferguson recommend the embedding of the fracture in a fusible alloy, in cases where time is not available for the lengthy process of electro-deposition of copper or iron. Suitable alloys are:—

| | A | B |
|---|---|---|
| Bismuth .. .. .. .. .. | 50 parts | 50 parts |
| Lead .. .. .. .. .. .. | 30 ,, | 30 ,, |
| Tin .. .. .. .. .. .. | 25 ,, | 10 ,, |
| Zinc .. .. . .. .. .. | 3 ,, | .. |
| Cadmium .. .. .. .. .. | .. | 10 ,, |

Both alloys melt below 100° C. A is the better alloy, but has a melting-point 25° C. above that of B. If a section through a fractured test-piece is required, the fracture is momentarily dipped in hydrochloric acid of 1·1 sp. gr., then in zinc-chloride solution, and is then plunged into a quantity of the molten alloy in a suitable mould. The alloy is re-warmed to ensure fluidity and to allow trapped air to escape. The embedded specimen, when cold, may be sawn in any required direction and polished by the usual methods.

**Transparence or Translucence of the Surface Film Produced in Polishing Metals.**‡—If a specimen of copper containing blow-holes is polished, the smaller pits in the surface become covered over by the surface skin formed by polishing. G. T. Beilby shows that the film which covers the pits is transparent, or at any rate highly translucent, and that the mobile film has been carried across the empty pit without any support from below, such as might have been given by particles filling up the pit. By carefully regulated etching of the surface with a reagent which dissolves copper, the film can be reduced to extreme thinness and finally dissolved completely, exposing the open pit. In the polished surface, under high magnification, the pits appear as blue spots on a rose-coloured ground. Some of the blue spots showed patches of red. By dissolving away the film the patches of red were shown to be due to

* Journ. Iron and Steel Inst., lxxxviii. (1913, 2) pp. 392–8 (2 figs.).
† Journ. Iron and Steel Inst., lxxxviii. (1913, 2) pp. 385–91 (5 figs.).
‡ Proc. Roy. Soc., Series A, lxxxix. (1914) pp. 593–5 (4 figs.).

red light reflected upwards from the inner concave surface of the pit, thus demonstrating the transparence of the film and the emptiness of the pit when covered by the film. The thickness of the films covering the pits is probably of the order of 10 to 20 micro-millimetres. Reproductions by the three-colour process of autochrome photomicrographs at magnifications of 800 and 1800 diameters illustrate the paper.

**Microscopic Metallography in Three Dimensions.***—A. Portevin describes the apparatus he has devised for studying the solid structure of metal specimens by the histological method of serial sections. The piece to be examined is permanently fixed, by means of gum-lac or other cement, in a specimen-holder, which is an accurately turned hollow steel cylinder. The holder fits into a recess in a bronze base-plate, which fits in turn into the stage opening of the Le Chatelier Microscope. The stage, base-plate, and specimen holder bear register marks, which are made to coincide when the specimen is re-examined after each successive polishing. The accurate replacement of the specimen in the same position in space with respect to the Microscope stage, thus rendered possible, permits the re-examination of any field, after removal of a layer of known thickness, by means of recorded readings of the micrometer heads of the mechanical stage. The thickness of the layers successively removed by re-polishing is determined by measuring the length of the specimen-holder, after each polishing, by means of a micrometer calliper with anvil of large diameter. In polishing, care must be taken to maintain the face accurately at right angles to the axis of the specimen-holder. A number of serial photomicrographs are given, of an antimony-tin-copper-lead bearing metal, and a copper-tin alloy, the distance between the successive parallel faces varying from 0·05 to 0·12 mm.

**Cohesion of Metal Masses.**†—W. Guertler agrees with Rosenhain's amorphous cement theory, provided that the thickness of the amorphous layers is not assumed to exceed molecular dimensions. The existence of independently stable amorphous masses is disputed, chiefly on the ground of the higher stability of the crystalline state.

**Colour-photomicrographs of Ores.**‡—G. Rigg has found Lumière autochrome photomicrographs useful for recording the microstructure of thin slices of ores illuminated by transmitted light. The fineness of the constituents, the shape of the different minerals, and the mode of association of the valuable minerals with the gangue, are revealed by microscopic examination.

* Int. Zeitschr. Metallographie, vi. (1914) pp. 58–71 (35 figs.).
† Int. Zeitschr. Metallographie, v. (1914) pp. 213–27 (2 figs.).
‡ Met. and Chem. Eng., xii. (1914) p. 30.

# PROCEEDINGS OF THE SOCIETY.

## MEETING

Held on the 15th April, 1914, at 20 Hanover Square, W., Professor G. Sims Woodhead, M.D., etc., President, in the Chair.

**The Minutes of the Meeting** of March 18, 1914, were read and confirmed, and were signed by the President.

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**The List of Donations** (exclusive of exchanges and reprints), received since the last Meeting was read as follows, and the thanks of the Society were accorded to the Donors :—

| | From |
|---|---|
| Chapman, F., Australasian Fossils. 1914 .. .. .. .. .. .. | *The Publishers.* |
| Johannsen, A., Manual of Petrographic Methods .. .. .. | *Ditto.* |

---

**The President** announced that the evening was to be devoted to a lecture by Mr. Frederick Enock, F.R.M.S. F.L.S., on "The Insect Pests of the Wheat Crops," and without further introduction called upon Mr. Enock to give his demonstration.

Mr. Enock, who illustrated his remarks by coloured slides, described in detail the life-history of that wheat pest known as the Hessian fly. This insect had been known in America from the time of the War of Independence, when it was supposed to have been introduced into the country in the straw mattresses of the Hessian soldiery from Germany—hence its name. There had been some discussion as to the accuracy of this supposition ; but Mr. Enock had proved by experiment that under certain conditions the larvæ might be retarded in their development for fifteen months. However the Hessian flies had effected their entrance, the Americans were well aware of the danger of their existence, and took all the means at their disposal to avert the damage done to the crops by these pests—an example which could be followed with advantage by our own country.

The first notification of the Hessian fly having invaded our own shores was on July 27, 1886—though, probably unknown to entomologists, it had been present before this time.

Somewhere about this date Mr. George Palmer, of Revells Hall, Hertford, discovered among his wheat, which was badly damaged from a cause unknown to him, a number of flax-seed-like objects, which he sent for identification to the late Professor Westwood, who pronounced them to be the puparia of the Hessian fly. Within that same week there appeared in all the newspapers long articles about the Hessian fly by those who knew little or nothing about the habits of the fly, but who merely copied what had been written, mistakes and all, in American works. At that time he (Mr. Enock) knew nothing himself about the Hessian fly, save by name, and so took the opportunity of visiting Mr. Palmer and securing permission to enter his fields for the purpose of studying the fly. It took him two years to work out the complete life-history of the Hessian fly, at the end of which time he read a paper on the subject before the Entomological Society, and, so far as he knew, that was the first complete account of the Hessian fly that had ever been given in this or any other country, though its existence had been known in America for over a hundred years.

On the conclusion of Mr. Enock's demonstration the President said he wished to take upon himself the very pleasant duty of thanking Mr. Enock for his extremely interesting lecture. He thought from the close attention with which those present had followed the lecture that Mr. Enock would readily appreciate the amount of pleasure he had given, and the interest he had aroused in a subject on which he had done such magnificent work.

Mr. Heron-Allen seconded the proposal, which was carried by acclamation.

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**The President** announced that the Roll was on the table for anyone to sign who had not yet done so.

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It was also announced that the Brass and Glass Section would meet on Wednesday, April 22, when a demonstration would be given of a new Micro-objective and various illuminating apparatus by Carl Zeiss.

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Notice was given that the next Meeting of the Biological Section would be held on Wednesday, May 6, when there would be a lecture on the "Ova and Larvæ of Water-mites."

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The President then made the following important announcement, viz :—

That in future the Proceedings of the previous Meeting, together with the Agenda for the next, would be sent early in each month to every Fellow who expressed to the Secretaries a wish to have his name placed upon the mailing list.

The Council hoped by this means to furnish Members beforehand with a little more knowledge of what was going on at the next Meeting, so that a keener interest might be taken in the work of the Society, and the discussions rendered freer and more pertinent.

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**New Fellow:** The following was elected an *Ordinary* Fellow of the Society: Wilfred E. Watson Baker.

## MEETING

HELD ON THE 20TH MAY, 1914, AT 20 HANOVER SQUARE, W., PROFESSOR G. SIMS WOODHEAD, M.A. M.D., ETC., PRESIDENT, IN THE CHAIR.

**The Minutes** of the Meeting of April 15, 1914, were read and confirmed, and were signed by the President.

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**The List of Donations** (exclusive of exchanges and reprints) received since the last Meeting was read as follows, and the thanks of the Society were accorded to the donors :—

| | From |
|---|---|
| Savage, W. G., Bacteriological Examination of Food and Water. 1914 | *The Publishers.* |
| An Old Microscope | *Mr. J. Sterry.* |
| Martin's Philosophical Grammar | *Mr. John Forgan.* |

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**The President** announced that at the next Meeting Mr. Rousselet would give a short description of the old Microscope which had been presented to the Society.

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**Mr. Watson Baker**, on behalf of Messrs. Watson and Sons, Ltd., exhibited a workshop Microscope for examination of screws. It was pointed out that the Microscope was unusual, inasmuch as it had not a foot, an attachment for a lathe bed taking its place. It was intended for the examination of screws in the course of manufacture, and when not in use it could be removed completely out of the way of the mechanician on hinged joints provided for the purpose.

In order that the diameter, the depth of the thread, the angle, and width could be exactly measured, special micrometer screws were fitted. These pushed the stage-plates forward, and as they progressed the rack-work fitted to them engaged toothed wheels. The rotation of these wheels wound springs which reacted and carried back the stage plates when the micrometer screws were reversed. The body was mounted between these plates for the purpose of moving across the screw itself, and would measure up to an inch in diameter. The body could be set at an angle by means of a tangent screw, and the position read by verniers on a circle to five minutes. The eye-piece was webbed, and could be rotated by an endless screw carrying a circle which was also read by verniers to five minutes.

The best thanks of the Society were accorded to Mr. Watson Baker for his interesting exhibit.

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**The President** said that Dr. Shillington Scales would bring to the notice of the Society the deaths of two Honorary Fellows and two Ordinary Fellows.

Dr. Shillington Scales said that hitherto it had been customary to record the death of a Fellow of the Society at Council Meetings only, but the Council had decided that in future notice should also be given at the General Meetings, and, that whenever possible, a short obituary would appear in the journal. Dr. Scales then announced the deaths of the following gentlemen :—

*Honorary Fellows—*

Dr. L. Dippel, of Darmstadt. Elected in 1882 ; died March 4, 1914.

Phillippe Van Tieghem, of Paris. Elected in 1879 ; died April 28, 1914.

*Ordinary Fellows—*

Thomas J. Barratt. Elected in 1898 ; died April 26, 1914.

John D. Siddall. Elected in 1912 ; died April 25, 1914.

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**The President** announced that the Roll was there for Fellows to sign who had not yet done so.

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It was announced that the next meeting of the Biological Section would be held on Wednesday, June 3, when a communication on Starches would be made by Mr. Ashe.

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There would be no meeting of the Brass and Glass Section.

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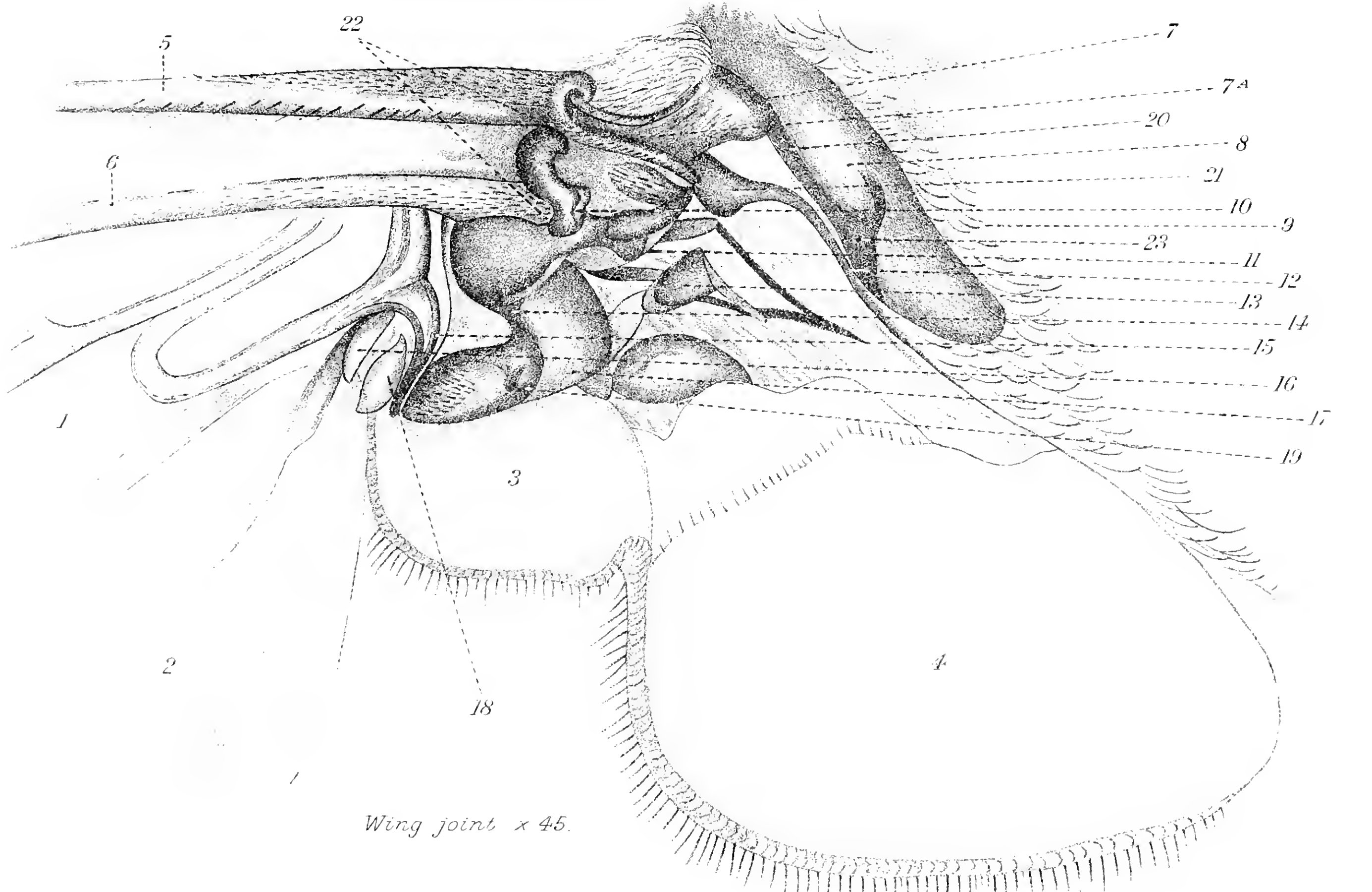
**The President** said that, in accordance with custom, and as the result of an invitation, which had been generously responded to, a number of Fellows of the Royal Microscopical Society, Members of the Quekett Club, and other friends had kindly consented to give an exhibition of Pond-life that evening, and it was therefore desirable that the Meeting should at once resolve itself into a demonstration. Before doing so, however, he would like to say how deeply indebted the Society was to those gentlemen who had so willingly and with such success brought together that splendid collection of exhibition material, and he believed all present would wish to take the opportunity of according their hearty thanks to the exhibitors.

The vote of thanks was carried with acclamation by all present.

The following Objects were exhibited :—

| | |
|---|---|
| Mr. S. C. Akehurst . . . | *Lophopus.* |
| Mr. Herbert F. Angus . . | *Arthrospira jenneri.* |
| Mr. William H. Baddeley . | Bacteria from dead larvæ, under dark-ground illumination. |
| Mr. F. W. Watson Baker . | *Acanthocystis turfacea.* |
| ,, ,, . . | *Amœba villosa.* |
| ,, ,, . . | *Conchilus volvox.* |
| ,, ,, . . | *Lophopus crystallinus.* |
| Mr. W. E. Watson Baker . | *Ouramœba vorax.* |
| Mr. E. E. Banham . . . | *Hydatina senta.* |
| Mr. F. W. Chipps. . . . | *Plumatella punctata.* |
| Mr. Thomas N. Cox . . . | *Nitella*, showing streaming of the protoplasm. |
| Mr. E. J. E. Creese . . . | *Pennaria cavolini.* |
| Mr. Edgar Cuzner . . . | *Stephanoceros Eichhornii.* |
| Mr. Danile Davies . . . | *Hydra viridis.* |
| ,, ,, . . . | Water mites. |
| Mr. A. Downs. . . . . | *Hydra viridis.* |
| Mr. Charles E. Heath . . | *Lophopus crystallinus.* |
| Mr. A. E. Hilton . . . . | Tadpole of Speckled Newt (*Molge vulgaris*), showing circulation in gills. |
| Mr. C. H. Huish . . . . | *Lophopus crystallinus.* |
| ,, ,, . . . . | *Stephanoceros Eichhornii.* |
| Mr. H. Jewell. . . . . | Circulation of the blood in the toe of a frog. |
| Mr. V. M. E. Koch . . . | *Bacillus anthracis.* |
| ,, ,, . . . | *B. tuberculosis.* |
| ,, ,, . . . | Malaria. |
| ,, ,, . . . | *Trypanosoma Nyassa.* |
| Mr. E. K. Maxwell . . . | *Melicerta tubicolaria.* |
| Mr. J. Milton Offord . . . | *Stephanoceros Eichhornii.* |
| Mr. F. J. W. Plaskitt . . | *Eudorina elegans.* |
| Mr. Thomas H. Powell . . | Cyclosis in *Vallasneria*, with $\frac{1}{40}$ apochromatic oil-immersion. |
| Mr. G. H. J. Rogers . . . | *Daphnia pulex.* |
| Mr. C. F. Rousselet . . . | *Anuræa*, *Polyarthra*, etc. |
| ,, ,, . . | *Brachionus rubens* (parasitic) on the back of *Daphnia.* |
| Messrs. D. J. Scourfield and C. J. H. Sidwell . . | *Frontonia leucas*, showing spindle-shaped trichocysts; ditto, showing contractile vesicle with radiating convoluted canals. |
| Mr. A. E. Smith . . . . | *Daphnia*, coloured by Rheinberg's colour disks. |
| Mr. T. J. Smith . . . . | *Lophopus crystallinus.* |
| Mr. Clarence Tierney. . . | *Melicerta.* |
| Mr. George Tilling . . . | *Lophopus.* |
| Mr. W. R. Traviss . . . | *Corethra plumicornis.* |
| Mr. C. Turner . . . . | Head of *Gyrinus natator.* |
| Mr. Joseph Wilson . . . | *Conochilus volvox.* |




P.A.A. del.

West, Newman lith.

Eristalis tenax.

JOURNAL

OF THE

# ROYAL MICROSCOPICAL SOCIETY.

AUGUST, 1914.

## TRANSACTIONS OF THE SOCIETY.

### VIII.—*The Buzzing of Diptera.*

By P. A. Aubin, F.R.M.S.

(*Read June* 17, 1914.)

Plates VIII, IX, X.

Throughout this paper the term "buzzing" is used to describe the high note produced by many Diptera, as distinct from the lower note or "hum" produced during flight. It would, moreover, appear desirable to limit this term to the sound produced by the Diptera, in contradistinction to the stridulations of the Orthoptera and Coleoptera, inasmuch as the organs of phonation described below are quite distinct, both in principle and action, from the stridulating organs or "strigils" of the other orders mentioned.

The origin of this sound has been controversial ground among entomologists for many years, and has been attributed to a variety of causes. Thus, it has been said to be due to (1) vibration of the wing; (2) vibration of the thorax; (3) to a special modification of the occlusor apparatus of the stigmata; (4) to the vibration of the halteres, etc.

Some of these statements are too general to be of any material assistance in elucidating the question, and no single one, taken by itself, will bear such tests as may easily be applied to living specimens.

The specialized apparatus I am about to describe in detail, will however, bear successfully all such tests as I have been able to devise, and I submit that it constitutes the real buzzing apparatus of the Diptera.

The species finally selected for close observation was *Eristalis tenax*, the common drone-fly, as it is plentiful and easily caught throughout the summer and early autumn; it is moreover a large, tough fly, easily handled without injury, and above all it is a very strong and persistent buzzer. So strongly does it buzz that, when held, the violence of the vibration will make the finger tips tingle.

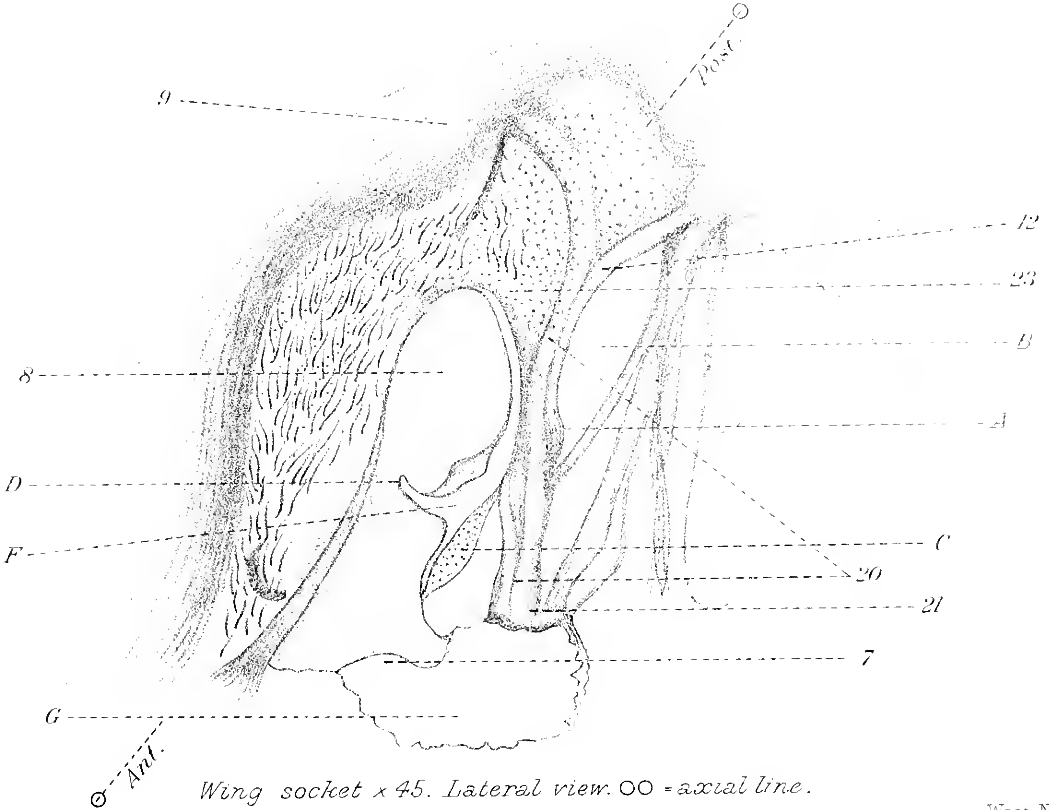
With the aid of Plates VIII and IX, I proceed to describe the complex mechanism which is to be found at the junction of wing and thorax and also such portions of the external lateral hollow of the mesothorax as are germane to my subject.

Plate VIII represents a dorso-lateral view of a specimen having the wing extended at right angles to the body with a slightly downward inclination. 1 is the wing, 2 the alulet, 3 the ante-squama, 4 the squama, 5 and 6 the anterior nervures; the part between 7 and 7*a* is the muscular attachment of the wing to the thorax 9; 12, 20, 21 are two prominent chitinous ribs which traverse diagonally the hollow in the side of the mesothorax in which the wing-joint is accommodated when the wings are closed; 8 is a broad area, which will be further described in connexion with Plate IX.

The parts 15, 16, 18 form together with 14 and 17 a very complex articulation which is brought into use when the wings are folded; 15 is a curved outgrowth from one of the nervures and bears within its curve 16 and 18, the former connected to the alulet and the latter to the ante-squama. In the act of folding the wings 16 and 18 rotate upon each other, 15 rotates upon 19, there is a flexure of the joint between 17 and 19, and the whole (15 to 19) rotates about the point 14. The result of the folding is to bring the ante-squama over the squama and the alulet above both. In this position the part 13 is in close proximity to the under side of the two ribs 20 and 21, the projection 19 lies opposite a specialized area on the lower posterior surface of the rib 21 below the point 12, and the knob-like percussor 11 lies close to and slightly in front of the upper portion of the rib 20 at the point 23. It is to be noted that when the fly is at rest, the parts of the wing are nowhere in actual contact with the thorax.

Having identified these parts and located their relative positions when the wings are folded, observation of living specimens and the application of a few simple tests will show conclusively that the buzz is produced by a rapid vibration of the muscles between 7 and 7*a*, causing the chitinous percussor 11 to strike the thorax at the point 23. The resonant apparatus consisting of the compound rib 20, 12, 21 and its attached membranes are thus thrown into a state of vibration.

The motion of 7, 7*a* being somewhat in the direction of the axis of the nervure 5, there is little visible vibration of the anterior




*Wing socket × 45. Lateral view. OO = axial line.*

F.A.A. del. West, Newman lith.

margin of the wing, except at the shoulder, but the alulet, together with the posterior margin of the wing, is vibrated through the chitinous members 14 to 19. These vibrations have an amplitude, at the tip of the wing, of approximately 1/16 of an inch, but it will be seen later that they play no appreciable part in the production of the buzz. The amplitude of the vibrations of the parts about 7*a* and 22 are so small, and their rate so rapid, that they might easily pass unnoticed: the first indication of them is the apparent impossibility of bringing the parts into focus.

It will also be observed that the halteres are thrown into a state of rapid vibration and appear to strike the inferior surface of the squama, but test 2 below disposes of them as sound producers. It may be noted that the size of the haltere bears no proportion either to the size of the insect or to the volume of sound produced: thus in *Eristalis* the haltere is many times smaller than in *Tipula*, which is silent, whilst the head of this organ is but very little larger in *Eristalis* than in *Musca domestica.*

*Test* 1.—The fly may be held in the fingers in any way but one, without appreciably affecting the buzzing; if, however, it be held with finger and thumb on opposite *sides* of the thorax so as to press the shoulders of the wings to the body, the sound at once ceases.

*Test* 2.—Each or all of the following parts may be removed without noticeably affecting the sound:—the halteres, the squama and ante-squama, the alulet, and nine-tenths of the wing. If, however, the wing be carefully dissected off, so as to ensure its removal up to the point 7, the sound ceases. Landois' observation that the thorax of a blow-fly continued to buzz *after the removal of the wings* may possibly be accounted for by the fact that if the wing be simply pulled off, the parting will in many cases take place all along the line 22, 15, and that in such cases the buzzing continues almost undiminished.

*Test* 3. If the vibrations of the alulet be checked by a needle applied at the convexity of the nervure above the point 15, the buzzing continues, though in some instances the pitch of the note is lowered. I will refer later to this alteration of pitch.

*Test* 4.—If, whilst the fly is buzzing, the point of a needle be inserted between the percussor 11 and the rib 23, without injuring the parts in any way, the buzzing at once ceases, though the impact of 11 against the needle is quite perceptible. If the needle is placed so that its side rests lightly against the rib 23, the impulses are transmitted through the neeedle and a modified buzzing is produced.

*Test* 5.—If a minute spear of tissue paper be inserted between the points 11 and 23, the sound is considerably subdued but not stopped.

*Test* 6.—If pins be so placed that, whilst not injuring the wings, they prevent the wings from closing closer than about

45 degrees with the axis of the body, no buzzing is produced, though efforts to do so are frequent as evidenced by the vibration of the wing shoulder.

Further information is obtained on reference to Plate IX. This represents an external lateral view of the wing cavity in the side of the mesothorax after removal of all muscular parts. In this figure identical numbers indicate identical parts in Plate VIII.

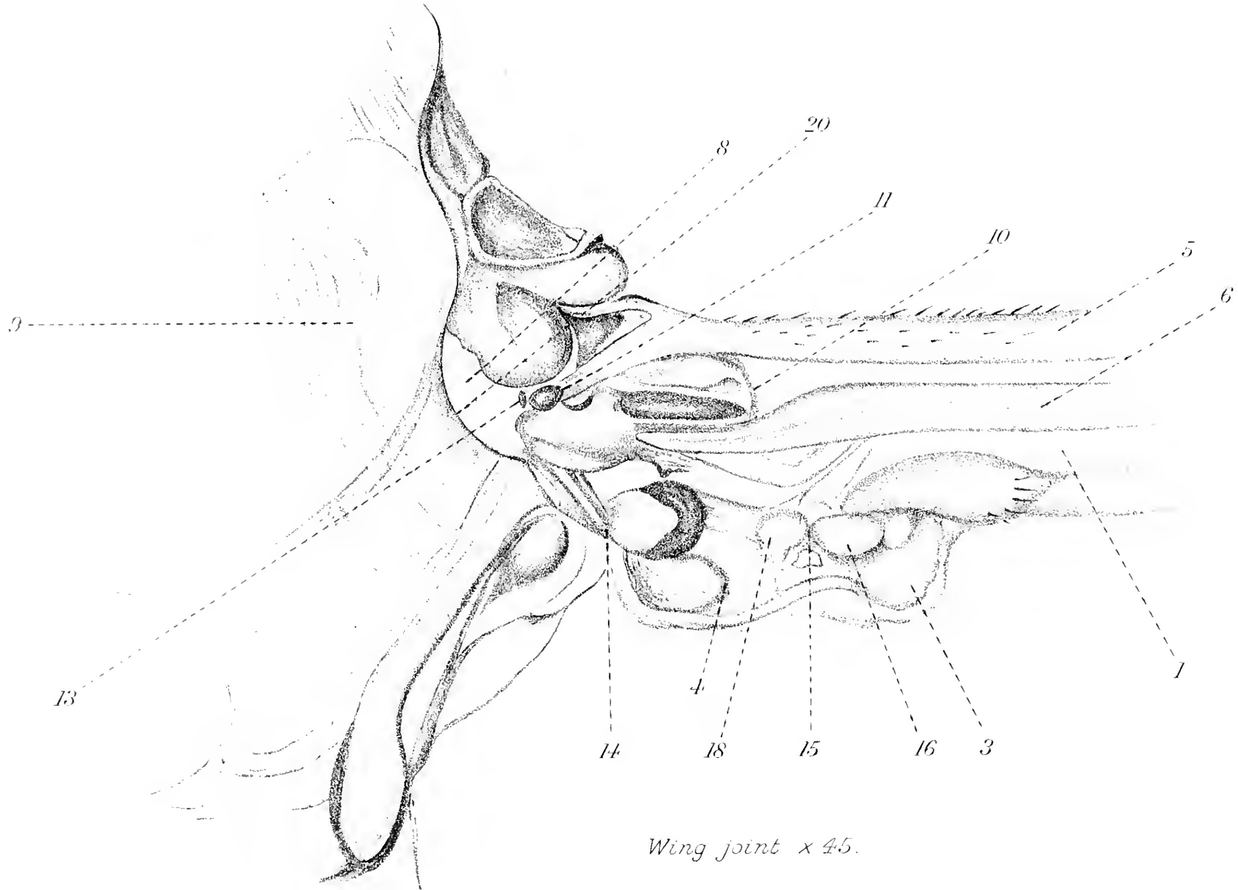
G is the insertion of the wing-muscles; the area 8 consists of a broad chitinous plate attached to the thorax by its superior edge; the lower margin is connected to the rib 20 by the clear transparent membrane F; across this membrane runs the stretching-piece or "extensor" C; this is articulated at one extremity to the rib 20, and at the other to the lower margin of the sclerite 8. At approximately the centre of 8 there is a deep indentation D, terminating at an apodeme to which a large nerve is connected.

It will be seen that the rib 12 forms the upper margin of a fenestrum B, which is covered by a tense transparent membrane at the point A. On this rib is an excrescence with an undulated surface against which the projection 19 (Plate VIII) rests when the wings are closed. The impact of the percussor 11 (Plate VIII) takes place at the point 23 on the thickened margin of the sclerite. (In *Calliphora* the point of impact is somewhat removed from the margin and there is a markedly thickened isolated area upon which the percussor strikes.)

From the undulating surface of the excrescence A and its direct connexion with B, which is virtually a tympanum, it might be supposed that the sound was produced by the movement of 19 (Plate VIII) over A, but Test 3 appears to dispose of that possibility as the pressure there applied at the point 15 (Plate VIII) has for effect to remove 19 (Plate VIII) from contact with A. On the other hand, it is obvious that owing to the arrangement of the "extensor" C, any variation of pressure at the point A has for effect to vary the tension of the membrane F, and thus modulate the note produced.

It is evident that the organs of phonation of *Eristalis* described above are of a higher order than the stridulating organs of *Coleoptera* and *Orthoptera*, and a little consideration will tend to the belief that it is not impossible that they fulfil the dual function of emitting and receiving sound. According to the laws of acoustics a stretched membrane will vibrate under the influence of external notes which are approximately in unison with the note it can itself emit; it is therefore not unreasonable to infer that the resonant areas (8, F, Plate IX) will respond to the buzz of other individuals and thus form one of the elements of an auditory apparatus.

If it be further borne in mind that, in *Eristalis* and perhaps in other genera the note is susceptible of a somewhat syren-like




*Wing joint* × 45.

modulation, it is not inconceivable that the sound produced may be the means of transmitting a variety of indications to the similarly attuned organs of other individuals.

The precise part played by buzzing in the life of the individual is somewhat obscure, but the fact that these organs are equally developed and equally efficient in both sexes of *Eristalis* would seem to indicate some function other than or in addition to a sexual one.

Such observations as I have been able make on this point are quite insufficient to justify any conclusion, but, so far as they go they indicate that the buzz serves, *inter alia*, as a warning note to aggressors.

These observations are as follow:—

(1) Several of the hover-flies, if held lightly in the fingers, will buzz for comparatively long periods, and many specimens of *Eristalis*, if held by the legs, will alternate, almost without intermission, between buzzing and attempting to fly.

(2) Most Diptera, when entangled in a spider's web, will buzz at intervals. If quiescent, the captive will almost invariably buzz if the spider, in order to ascertain the nature of its capture, touches it with an investigating claw.

(3) If a cage containing *Eristalis* be taken into a partially darkened room, they will cease flying and either remain stationary or crawl about slowly. Under such conditions, should one individual touch another, the one so touched will emit a short sharp buzz which is sometimes responded to by others in the cage.

(4) A captive, under the Microscope, can usually be made to buzz by touching it with a needle, more especially on the abdomen or wing shoulder.

The homologues of the parts shown in Plate VIII are easily found in many species of Diptera, *inter alia* in *Caliphora vomitoria*, *Musca chloris*, *M. domestica*, *Syrphus balteatus*, *Conops* (sp.), and, so far as I have been able to apply the above tests to them, the results are identical.

*Tipula oleracea*, in which the various parts can be identified without much difficulty, must be mentioned separately.

In Plate X, drawn from this insect, parts homologous with those in Plate VIII have been given the same numbers for ease of comparison.

I have been unable to detect any true buzzing in this fly, and from an examination of the parts, I would not expect to do so. Whilst the alulet and squamæ, with their articulation (15, 16, 18) are undeveloped, the articulation 14, compared with fig. 1, is very large. As a result, the wing cannot be closed sufficiently to bring 11 in contact with the thorax. The normal position of the wing, at rest, is approximately at right angles to the body, and if it be closed by pressing it inwards, there is resistance until nearly closed, when the wing closes with a "snap" and remains closed. The converse happens when pressure is applied to return the wing to its former position; it resists opening up to a certain point and then flies outward through a wide angle. This is apparently due to what may be termed a dislocation of the articulation 14.

I have been unable to observe any vibration of the wing shoulder such as is apparent in other genera, and the general arrangement of the parts makes it clear that the sound-producing apparatus I have described above cannot be brought into action.

# OBITUARY.

## Philippe Édouard Léon van Tieghem, Hon. F.R.M.S. 1839–1914.

By A. B. Rendle, M.A. D.Sc. F.R.S., etc.

By the death of Professor Van Tieghem the Society loses one of its most eminent Fellows, and the science of Botany one of its most devoted and able adherents. Van Tieghem is best known for his work on the comparative anatomy of the flowering plants, many families or smaller groups of which he studied in detail. In 1866 he published in the Annales des Sciences Naturelles an important paper on the anatomical structure of the Aroideæ, and a comparison of this family with Typhaceæ and Pandanaceæ, which he regarded as two distinct groups connected by the Aroideæ. In this connexion he writes:—"Nos observations semblent démontrer ainsi par une preuve nouvelle qu'il est indispensable de joindre l'étude anatomique comparée de l'appareil végétatif à celle de la fleur, si l'on veut construire le système idéal à liaisons fixes, qui est l'objet de la méthode naturelle." This was followed by a long and valuable series of papers dealing not only with the vegetative structure of the plant, but also with the comparative structure of the pistil and other parts of the flower, the ovule, and the seed. Perhaps the most fruitful was that entitled "Anatomie comparée de la fleur femelle et du fruit des Cycadées, des Conifères, et des Gnétacées,"* in which he attacked the problem of the morphology of the cone-scale from an anatomical point of view. Arguing from the course and orientation of the vascular bundles, he explained the seed-scale as the first leaf of an axillary branch, and demonstrated the existence of a common anatomical plan in the cone-scale throughout the Pinaceæ. In the application of the results of his investigations to a system of classification, Van Tieghem was less successful. He suggested the subdivision of the Angiosperms into three groups, based on the development of the growing-point of the root, as follows:—1. Liorhizeæ Monocotyleæ, including Monocotyledons without the Grasses. 2. Liorhizeæ Dicotyleæ, comprising Grasses and Nymphæaceæ. 3. Climacorhizeæ or Dicotyledons, including Dicotyledons except Nymphæaceæ. For further subdivisions he relied primarily on

* Ann. Sci. Nat., ser. 5, x. (1869) pp. 269–304.

characters of the ovule, such as absence or presence of integuments, and their number when present.

In a more recent paper, entitled "The Egg of Plants considered as a basis of Classification,"* he suggested a system of arrangement of the whole plant-world, in which, as before, the details of the structure and development of the ovule are regarded as supplying the most important characters for the subdivision of the groups of Angiosperms. But his system was far too rigid, and indicated a want of appreciation of the relative value of characters: moreover they were hampered by a novel and difficult terminology.

Much of Van Tieghem's work was published in the Annales des Sciences Naturelles, in the botanical editorship of which he succeeded Decaisne in 1882, continuing up till the time of his death, and the long series of volumes, rich in the results of his own work and that of his pupils, will form a lasting monument of his services to botanical science. His versatility is shown by several papers of fundamental importance in a very different field, the morphology and physiology of the phycomycetous Fungi. In 1873, with his pupil, G. Le Monnier, he published a lengthy communication entitled "Recherches sur les Mucorinées," a monographic account of a little-known group; this was followed by two other papers on the same subject in 1875 and 1876. Among his services to general botany were his Traité de Botanique, which appeared in 1884, and in an enlarged edition, containing 1885 pages (1891), and the smaller Elements de Botanique (1886–88), which also passed through several editions.

Van Tieghem had been for many years Professor at the Paris Museum of Natural History and a Member of the Institute; he was also one of the most long-standing foreign Members of our own Linnean Society, having been elected in 1885. He was elected to the honorary fellowship of the Royal Microscopical Society in 1879.

* Ann. Sci. Nat., ser. 8, xiv. (1901) pp. 213–390.

# SUMMARY OF CURRENT RESEARCHES

RELATING TO

# ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

# MICROSCOPY, ETC.*

## ZOOLOGY.

### VERTEBRATA.

#### a. Embryology.†

**Blastocyst and Placenta of Beaver.**‡—Arthur Willey describes the pre-placental blastocyst, the maternal trophospongia, the discoplacental adhesion, and the established placenta. He calls attention to the significance of the obplacental implantation with differentiation of erythrocytophagous and leucocytophagous megalokaryocytes, and of the placental keel.

In one respect, the euplacental blastocyst of the beaver is the most primitive known among existing Rodents, by reason of the persistence of the umbilico-uterine connecting membrane, which is a consequence of the periplacental implantation of the trophoblast.

The keel extends from end to end of the elongated balloon-shaped blastocyst, along its superior or mesometric side, dipping into the deep placental groove. It probably represents an ancient or primitive mechanism. It is argued that the exserted mesoblastic keel of the beaver is comparable to the "Haftstiel" of *Tarsius*, monkeys, and man.

**Reproduction in Domestic Fowl.**§—M. R. Curtis gives an account of a study of the occurrence of double and triple-yolked eggs and discusses the physiological bearing of the facts established. During six years only three triple-yolked eggs were procured from more than three thousand fowls. Each was laid by a different individual, and each was the first egg of a young pullet. Twenty per cent of pullets beginning to lay before they are seven months old lay among their first eggs one or more with two yolks, but in no bird has the laying of double-yolked eggs been found to be "habitual." An egg with two or three yolks

* 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. Micr. Sci., lx. (1914) pp. 175-259 (8 pls. and 6 figs.).

§ Biol. Bull., xxvi. (1914) pp. 55-83 (4 figs.).

represents the extreme of rapid egg production, other forms of which are found in the production of two eggs united by a membranous tube: two eggs at the same time; two eggs at different times on the same day, and a daily egg-production where the eggs are laid earlier on each successive day. The two yolks of a double-yolked egg may have all the envelopes in common, or each may possess one or more separate envelopes. All possible intermediate forms were found, indicating that the two yolks may come together at any point between the mouth of the funnel and the isthmus. Various disturbances of the normal processes of egg production may bring two yolks together in the oviduct. Double-yolked eggs evidently do not always represent simultaneous ovulations. The double-yolked eggs contain more albumen and have a heavier shell than single-yolked eggs, and in triple-yolked eggs these parts are heavier still, but in neither case is the increase in direct proportion to the increase in the weight of yolk. Multiple-yolked eggs are longer in proportion to their breadth than the normal eggs of the same individual. A series of tables showing the relation of multiple-yolked eggs to the age of the bird is given, and the different stages of union are illustrated by diagrams.

**Development of Columella auris in Chrysemys marginata.***—Lucy W. Smith has made a study of the origin and development of the columella auris in *Chrysemys marginata.* She finds that in an early pre-cartilage stage the condensations of the skeletal elements (hyoid cornu, interhyal, and columella auris) of the hyoid arch are continuous. The columella auris represents the dorsal portion of the hyoid arch, and originates as a single element. In the adult the columella proper ossifies and closes the fenestra ovalis. The extra-columella always remains in a cartilaginous condition. The interhyal represents, ontogenetically, the upper extremity of the hyoid cornu. The tympanic cavity is formed from the hyomandibular cleft. The columella has no distinct ligamentous or muscular attachments of morphological value, such as the ligamentum hyo-columellare, or mandibulo-hyoidale.

**Development of Lungs in Bombinator igneus.**†—M. Makuschok describes the early development of the lungs in this Amphibian, and compares it in detail with that of the gill-pouches. Differing from Greil, who has been over the same ground, Makuschok finds that the facts support the view that lungs and gill-pouches are homologous.

**Development of Vascular System of Lamprey.**‡—W. Keiser has proved for *Petromyzon planeri* the mesodermic origin of the heart, the two main longitudinal vessels, and the first embryonic blood. The endocardium is formed by the combination of a group of free mesenchyme cells into a loose tissue which gradually assumes a tubular form. The endothelium of the vessels is likewise due to a combination of free mesenchyme cells. There is thus a close resemblance between the development of the vascular system in the lamprey and that in Dipnoi and Amphibians.

* Anat. Anzeig., xlvi. (1914) pp. 547–60 (9 figs.).
† Anat. Anzeig., xlvi. (1914) pp. 293–309 (9 figs.).
‡ Jen. Zeitschr. Naturw., li. (1914) pp. 579–626 (5 pls. and 30 figs.).

**Development of Chelonia.***—A. Brachet follows up his earlier work on development of the head in Amphibians, with an account of acrogenesis, cephalogenesis, and cormogenesis in *Chrysemys marginata*. His general conclusions, which differ in many respects from those of other investigators, are as follows: The cephalic prolongation of the primitive plate, after it has insinuated itself between the embryonic ectoblast and the vitelline endoblast, and after the blastoporal canal has opened into the sub-germinal cavity, constitutes an extended cephalic endoblast circumscribed laterally and anteriorly by the vitelline endoblast arising from the gastrular cleavage.

The ectoblastic plate is at first much more extended than the cephalic endoblast, but the ectoblast soon contracts: it thickens, glides over the surface of the vitelline endoblast, and re-forms exclusively above the cephalic endoblast and at the periphery of the embryonic shield where the protochordal or prechordal plate persists. The cephalic endoblast, which is vacuolar, and at first considerable in extent, becomes reduced and more compact as a result of a contraction analogous to, but less marked than that of the ectoblast, and of the proliferation of its cellular elements. It thus takes on the aspect of a cylindrical epithelium in which the nuclei are stratified in two or three layers. When this concentration has taken place the blastoporal region contracts in the same directions as the rest of the blastoderm, and the dorsal lip recedes slightly. A zone is thus formed between the cephalic endoblast and the blastopore and it immediately proliferates intensely, behaving as a zone of growth which will elongate the part of the body in front of it.

As soon as the zone of growth has become active, it is possible to distinguish in the endoblast of the embryo of *Chrysemys* three zones: (*a*) an anterior narrow band of vitelline endoblast corresponding topographically to Hubrecht's "protochordal plate; (*b*) the cephalic endoblast which arises from the cephalic prolongation of the primitive plate; and (*c*) the internal layer of the zone of growth which is contiguous to the blastopore and surrounds what is left of the blastoporal canal. It elongates rapidly and is from the beginning a very active mesoblastogenic centre. Its formation is secondary and follows that of the cephalic endoblast.

When the anterior extremity of the body is defined, the protochordal plate is in part left out of the embryo; the remainder invests the lower part of the anterior cul-de-sac of the alimentary canal, and forms a part of its ventral wall. It does not share in the formation of the notochord, but it may play a rôle in the formation of the premandibular mesoblast, and thus take part only in acrogenesis.

In the region of the cephalic endoblast the two primary layers develop in a very characteristic manner. The ectoblast differentiates into medullary plate and epiblast. But the latter is not a mere investing layer, for from the very first it possesses neural characters, evidently associated with the sensory elements it is called upon to form. The endoblast subdivides into three zones—a median, which will become the notochord, and two lateral zones; the internal part of these latter gives rise by proliferation to all the mesoblast of the head (except the pre-

* Arch. Biol., xxix. (1914) pp. 500-77 (3 pls.).

mandibular cavities) as far as and including the post-otic somite. The external part becomes, without undergoing structural change, the hypoblast defining the walls of the pharyngeal portion of the alimentary canal. It is from this hypoblast that the endodermic gill-pouches and their derivatives arise. In ultimate analysis all this arises from the cephalic prolongation, and the formation of this prolongation is therefore the initial and fundamental process of cephalogenesis.

The zone of growth plays the essential part in cormogenesis. To its development and differentiation are due the trunk and the tail. As in the head, the ectoblast divides into a medullary plate and an epiblast. The notochord and the mesoblast become defined antero-posteriorly as the embryo elongates. Throughout the whole trunk the hypoblast of the alimentary canal is derived directly from the vitelline endoblast, which arose from the gastrular cleavage. The segmentation of the body begins at the anterior extremity, and proceeds towards the posterior. But after six somites have been thus formed a seventh becomes defined, anterior to the first, in the mesoblast of the head. Behind this cephalic somite the ganglionic crest of the vagus terminates.

The author believes that he has succeeded in establishing for Reptiles the three great stages—acrogenesis, cephalogenesis, and cormogenesis—which have already been established for Amphibians, and that this justifies the conception of a general and fundamental law dominating the ontogenesis of all the Craniota.

**Development of Caudal Skeleton in Pleuragramma antarcticum.*** A. Knyvett Totton finds that the development of the vertebral column in this Teleostean begins at the caudal end, the hypaxial elements being the first to appear. This coincides with a down-bending of the notochord, as in Ichthyosaurians. Epaxial elements do not appear until this condition has given way to the straight condition again. Arches appear as paired cartilages at the sides of the caudal artery and vein, and of the nerve cord. They are separated from the notochord by connective-tissue.

The notochord is of a relatively enormous size, and persists with only slight constriction throughout life. The centra consists of thin papery lamellæ of membrane-bone. Ossification is generally weak.

The neural and hæmal arches of the penultimate centrum are double, owing to the splitting of single rudiments. Similar phenomena are to be observed in other fishes. They may be produced by splitting of an originally single rudiment (as in *Pleuragramma*), by crowding of two arches on to one centrum, by fusion of the first epiural apophysis with the last neural arch, by exceptional equal development of both arch and intercalary, or by secondary diplospondyly, i.e. fusion of two centra.

Large cartilages are present above and below the last two centra in the adult, which support a dorsal and a ventral series of procurrent fin-rays. Their great size is probably connected with the weakness of general ossification. The hypural bones of the adult are formed by a fusion of hæmal arches and radials. This compound nature of the hypurals may be seen anteriorly in adult Selachians and in the sturgeon; but it has not been shown before in Teleosts.

* Proc. Zool. Soc., 1914, pp. 251–61 (2 pls.).

**Reproductive System of Female Mole.***—F. Wood-Jones calls attention to the remarkable state of affairs in the female mole which passes from an apparently male arrangement of external genitalia into one that is obviously female, and develops in post-natal stages an entirely new genital orifice. Although the peculiarities of the female reproductive system appear at first sight to be extremely anomalous, they are seen to have, for the most part, some foreshadowing in the normal processes of development of other mammals. Everything that is unusual in the female reproductive system is initiated in the early stages of embryonic development when, between the 9 mm. and 18 mm. stages, the labio-scrotal folds begin to grow towards the middle line over the closed urethra in the base of the genital tubercle. In the method of development of the external genitalia the male mole falls into line with some other members of the Insectivora, the Rodentia, Ungulata, and some other orders. The female alone is anomalous, and that in following from the first a male type of formation of the external genitalia. This state of affairs seems to occur again in *Hyæna crocuta.*

There is a shifting of the site of opening of the Müllerian ducts; and they end in solid epithelial prolongations. But both these phases occur in the normal development of other animals, and both are stages in the normal formation of the female genital system in *Homo*. The imperforate vagina is a normal stage in the female human embryo, and this solid vagina becomes patent in very much the same way as does that of the mole—by desquamation of its central cells. What is exceptional in the mole is that the opening up of the solid vagina is so long delayed. Again, it is not without parallel that a vagina once formed should become occluded again, as happens in the mole, and be re-opened when functional activity next demands a passage. These phases have been established by Hill with regard to the median vagina of *Perameles*.

**Seasonal Changes in Testes and Plumage in Wild Duck.**†—C. G. Seligmann and S. G. Shattock have enquired into the reality of a correlation between seasonal changes in the testes and the "eclipse" plumage of the mallard. As in many other birds, the testes of the mallard undergo a series of seasonal changes, and are spermatogenic only during the winter months and early spring. But the two periods of activity and non-activity do not coincide with the two seasonal changes in the plumage.

The normal passage of the bird from full winter (breeding) plumage to its dusky summer (eclipse) plumage is, however, delayed if castration is effected during the months whilst the gonads are assuming or have attained activity. One bird which was castrated in the winter, and in which the advent of the succeeding eclipse was delayed the following summer, was kept until the summer of the next year. The second eclipse occurred at the normal period, but nodules of regenerated testicular tissue were found. It is a remarkable fact that the grafts were fully spermatogenic in the month of September, an occurrence altogether abnormal in the testicle of the entire bird. The delay above

* Proc. Zool. Soc., 1914, pp. 191–216 (3 pls. and 13 figs.).
† Proc. Zool. Soc., 1914, pp. 23–43.

referred to has its parallel in the well-established fact that if a colt is castrated when shedding its winter coat, the shedding is for a time arrested and then proceeds only very slowly. When wild ducks assume the drake plumage the spurious males undergo the seasonal eclipse, but this is somewhat incomplete and aberrant.

Removal of the testes during the eclipse does not produce any constant appreciable effect upon the next passage of the bird into winter plumage. It would appear that the seasonal change of plumage in the mallard is not connected with the spermatogenic function of the testicle, but the influence of a hormone was not excluded since the castration never prevented some re-growth of testicular tissue.

### *b.* Histology.

**Connective-tissue of Umbilical Cord of Torpedo.*** — E. Laguesse has studied the minute structure of the stalk of the yolk-sac in *Torpedo ocellata*, which consists internally of a vitelline pedicle and externally of a prolongation of the body-wall. The latter consists almost exclusively of a thick layer of soft gelatinous connective-tissue covered externally by the epidermis, internally by the peritoneal endothelium. The connective-tissue shows radiating lamellæ, comparable to those which lie parallel to the surface in the ordinary subcutaneous tissue. They retain their primitive character as a cellular network in process of exoplasmic transformation. The interlamellar spaces, which are much reduced in the subcutaneous tissue, are much enlarged in the umbilical cord, and contain an abundant amorphous coagulation of lymph and albuminoids. This is probably a secreted product, and it is quite distinct from the hyaline substance of the lamellæ.

**Primary Marrow-cell.†** — Stanislaus Klein describes from the normal bony marrow of man a distinctive element which he calls the "Myelogonie" or primary marrow cell. It is distinct from myeloblasts and erythroblasts. It is a new kind of leucocyte. It is the mother-cell of all the myeloblasts, megaloblasts, magakaryocytes, and polykaryocytes —perhaps also of the lymphocytes. It may be identical with the "large embryonic lymphocyte" of Maximow and with the "Hæmogonie" of Molliers.

**Plastosomes in Epithelial Cells of Trachea and Lungs.‡**—Fr. Meves and R. Tsukaguchi have studied the epithelium lining the trachea and lungs (in the rat and cat), and find that there are plastosomes in the form of threads. In the ciliated cells there is a coil-like aggregation of wavy or sharply-bent plastokonts below the fringe of cilia, and from this coil a few straighter threads run past the nucleus to the base of the cell. In some other cases, e.g. the nucleated epithelium of the alveoli, the plastosomes are abundant, sometimes as granules, sometimes as rods, sometimes as threads, and usually diffused through the whole cell.

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 800–1.
† Die Myelogonie als Stammzelle der Knochenmarkszellen. Berlin: 1914, 140 pp. (10 pls.).
‡ Anat. Anzeig., xlvi. (1914) pp. 289–92 (6 figs.).

**Lateral Sense-organs of the Head in Macruridæ.***—Albert Pfüller has made a study of these structures, which are usually well-developed in deep-sea fishes. Especially is this the case with the supra-orbital, the infra-orbital, and the operculo-mandibular canals. In all the ten forms examined there are thirty-three sensory prominences, which consist of pear-shaped sensory cells with large nuclei and sensory "hairs" which penetrate the membrana limitans. Between these sensory cells are cylindrical supporting cells. The innervation of the sensory structure is very carefully described.

The lateral sense-organs of the Macruridæ are not luminous organs nor electric organs. They are exquisite sensory organs, which detect slight changes in pressure. The membranes within the sensory canals probably increase the sensitiveness. A new organ, the occipital organ, occurs in all Macruridæ just in front of the first dorsal fin. Its function is obscure. In *Macrurus cavernosus* there is a peculiar sucker-like structure.

**Penis of Duck.**†—Walther Liebe has made a detailed study of the penis of the domestic duck. It is a spirally twisted unpaired structure. It consists of a paired lymphatic space with vascular bodies at its base, and of an unpaired free portion with a glandular sac in its interior. The basal portion is supported by a fibrous body and with this is associated an elastic body which extends in the wall of the glandular sac to the tip of the penis. The erection is due to lymph secreted in the cavities of the vascular bodies. The sperm passes from the urodæum into the external seminal groove of the penis—a groove which becomes a tube during erection. The anterior pair of penis muscles is connected with the pelvis, the posterior pair with the skin. The surface of the penis is without glands or touch-spots.

### c. General.

**Lateral Muscle in Teleostei.**‡—E. W. Shann has studied this in a variety of types. The body-wall is composed on either side of a series of transverse muscles (myomeres) divided from one another by fasciæ of connective-tissue (myocommata). For practical purposes these may be regarded collectively as forming a single lateral muscle, composed of a single layer, varying considerably in thickness.

In its primary condition, such as obtains in the caudal region, it is divided into two symmetrical longitudinal moieties, which are separated by a horizontal septum passing from beneath the lateral line to the vertebral column. For descriptive purposes, the dorsal moiety may be divided into a (dorsal) mesio-dorsal portion and a (ventral) latero-dorsal portion. In the mesio-dorsal portion the fibres run from above anteriorly to below posteriorly; in the latero-dorsal portion they take the opposite inclination. The ventral moiety is likewise divided into a (dorsal) latero-ventral portion and a (ventral) mesio-lateral portion. The fibres

* Jen. Zeitschr. Naturw., lii. (1914) pp. 1–134 (2 pls. and 38 figs.).
† Jen. Zeitschr. Naturw., li. (1914) pp. 626–96 (2 pls. and 19 figs.).
‡ Proc. Zool. Soc., 1914, pp. 312–37 (3 figs.).

of the latter, at first oblique, become straight as they approach the middle line, and resemble a rectus.

Small cylindrical longitudinal muscles are frequently cut off from the mesio-dorsal portion, along the mid-dorsal line in the interspaces of the dorsal fins. These are the supracarinales of Owen. Similar muscles are frequently cut off from the mesio-ventral portion along the mid-ventral line. These are the infracarinales of Owen. A small muscle, whose fibres are usually distinguished by their red colour, is cut off from the latero-dorsal portion and occupies the slope of the furrow in which the lateral nerve is situated. A corresponding muscle is cut off from the latero-ventral portion immediately below the lateral line.

**Relict Fauna.**—Esben Petersen* discusses the Trichoptera, Ephemerida, and Plecoptera of the cold streams and wells of Jutland, and calls attention to those forms which become sexually mature at a low temperature, and are relics of colder ages.

Sig Thor† deals with probable remains of a glacial Hydracarine fauna persisting in Danish streams, viz. *Sperchon* (*Hispidosperchon*) *elegans* Sig Thor, *Megapus nodipalpis* Sig Thor, *Hygrobates naïvus* (Johnston), *Lebertia* (*Pilolebertia*) *inæqualis* (Koch), and *Aturus scaber* Kramer.

O. Pesta ‡ protests against regarding *Nephrops norvegicus* in the Adriatic as a "glacial relict." Its distribution is probably determined by the occurrence of a sandy and muddy bottom as much as by temperature and depth. It occurs in the Bay of Biscay, on the coasts of Morocco and Algiers, at Genoa and Naples.

**Plankton of Southern Alpine Lakes.**§—G. Burckhardt has made a systematic comparison of the plankton from Lakes Lugano, Como, and Maggiore and that of Northern Alpine lakes. The general result is to show a very striking resemblance both in composition and in distribution.

**Toothlessness of Myrmecophagidæ.**‖—P. Adloff has cut sections of two embryos of *Cyclothurus didactylus*, 6 cm. and 12 cm. in length, and has found no trace of tooth-primordia or of a dental ridge. Thus the investigations of Röse and Leche are confirmed—there is no evidence that the Myrmecophagidæ are other than quite edentulous. It is possible, however, that younger embryos may show traces of teeth.

**Ciliary Mechanisms in Various Types.**¶—J. H. Orton describes the ciliary mechanisms in Brachiopods and some Polychætes, and gives a comparative account of the ciliary mechanisms on the gills of Molluscs, Protochordata, Brachiopods, and cryptocephalous Polychætes, and of the endostyle of *Crepidula* and its allies. Brachiopods feed in the same way as some Gastropods, most Lamellibranchs, *Amphioxus*, and Ascidians,

* Internat. Rev. Hydrobiol., vi. (1914) Biolog. Suppl. No. 3, pp. 1–9.
† Internat. Rev. Hydrobiol., vi. (1914) Biolog. Suppl. No. 3, pp. 1–14 (10 figs.).
‡ Internat. Rev. Hydrobiol., vi. (1914) Biolog. Suppl. No. 3, pp. 1–6 (1 map).
§ Internat. Rev. Hydrobiol., vi. (1914) Biolog. Suppl. No. 3, pp. 1–30 (14 figs.).
‖ Anat. Anzeig., xlvi. (1914) pp. 309–10.
¶ Journ. Marine Biol. Assoc., x. (1914) pp. 283–311 (12 figs.).

by establishing a current of water through certain spaces in the body, and sieving off the food-particles in the current by means of the lophophore and its cirri. The cilia on the gill filaments are differentiated in Brachiopods into lateral and frontal cilia in essentially the same way and with the same functions as in Lamellibranchs, etc. The main current through the mantle-cavity is produced chiefly by rows of lateral cilia on the cirri. The mantle-cavity in Brachiopods is divided physiologically into two compartments, corresponding to the bilateral symmetry of the lophophoral spirals. In some forms it is also divided morphologically either by septa or by bifurcation of the whole shell. Food collection is effected mainly by the frontal cilia on the gill-filaments, but tracts of cilia on the filamental side of the lophophore assist in capturing food-particles. For the capture of food-particles mucus is secreted on the frontal epithelium, at the bases of the gill-filaments and on the body of the lophophore. Some of the characters of the shells of many fossil and recent Brachiopods can be partially explained in relation to the physiological subdivision of the mantle-cavity.

The cephalic gills of cryptocephalous Polychætes have current-producing lateral cilia and frontal food-collecting cilia essentially similar to those of the other groups under discussion. Thus the ciliary mechanisms on the gills of many Gastropods, most Lamellibranchs, *Amphioxus*, Ascidians, Brachiopods, and the cryptocephalous Polychætes are essentially similar, and in the three groups to which these animals belong the same mechanism, and similar gill-filament supports have arisen independently to meet similar requirements. An endostyle present at the base of the gill in *Crepidula*, *Calyptræa*, and probably in *Capulus*, shows a remarkable resemblance to that of Ascidians and *Amphioxus* and serves the same purpose. The adaptations in Brachiopods and Lamellibranchs to the process of feeding are compared, and the author suggests that the present decadent condition of the former group is due to the absence of that consolidation of the gill, and correlated modification of the mantle, which appear to have conduced to the present relatively flourishing condition of the Lamellibranchs.

## INVERTEBRATA.

### Mollusca.

#### γ. Gastropoda.

**Structure of Helix barbara.***—T. Rzymowska has made an anatomical and histological study of this small snail, which is common on the sea-holly on the shores of the Mediterranean and on the European Atlantic coast. He deals in particular with the nervous system, and contributes some interesting data in regard to the dimensions of the nerve-cells at different ages. The nerve-cells increase in size as the animal grows older. Rzymowska deals also with the reproductive system, which closely resembles that of *Helix pomatia*, and calls attention to the prismatic cells of the prostatic part of the oviduct, the calcareous

* Rev. Suisse Zool., xxii. (1914) No. 10, pp. 277–319 (2 pls.).

and mucous glands of the infra-prostatic part of the oviduct, the two kinds of glandular cells in the prostate covering the external margin of the sperm-duct, and other details.

**Alleged Nematocysts of Pleurophyllidiæ.***—L. Cuénot refers to the fact that the supposed nematocysts of Æolids are due to the Cœlenterates which the molluscs eat. In *Pleurophyllidia*, however, there are dorsal sacs containing filaments which are expelled when the Nudibranch is violently excited, and these sacs have no communication with the hepatic ramifications. Moreover, the Nudibranchs in question seem to feed on organic particles and diatoms, not on Cœlentera as Æolids do. The sacs are peculiar glands, and the elongated (possibly offensive) filaments they form have nothing to do with nematocysts. The sacs may be compared to the sub-epidermic "phylacoblasts" described by André in *Hyalinia*, but it is a remote resemblance. The sacs of *Pleurophyllia* are epidermic invaginations; the cytoplasm of the component cells is turned into a filament; the sac becomes a pouch full of filaments; after expulsion occurs the sac disappears, its place is invaded by connective-tissue, and young sacs are formed.

### δ. Lamellibranchiata.

**Structure of Bivalve Shell.**†—H. Karny has investigated the structure and composition of the calcareous shell in Aviculidæ and Unionidæ. It consists of a prismatic and a nacreous layer. The prismatic layer of *Pinna* consists of calcite: each prism is comparable to single crystal, with its axis at right angles to the surface of the shell. In Aviculidæ the prismatic layer is also of calcite, but there is no radial structure. Each prism is made up of pieces, which are not regularly arranged in relation to the surface. The first condition may be called orthoprismatic, the second klinoprismatic. In Unionidæ the prisms consist of aragonite, and the structure is "radio-sphærolithic," only the middle lines of the median portions of the prisms being at right angles to the surface. The nacreous layer also consists of aragonite. Its structure is described in detail.

**Structure of Kidney of Anodonta.**‡—Wilhelm Fernau publishes the first—the morphological—part of a study of the kidney of *Anodonta cellensis* Schröt. He finds that the kidney—the so-called organ of Bojanus—is a paired nephridium. Each nephridial tube is connected by a specially differentiated canal, the nephridial funnel, with the pericardium, and thence it extends as a much folded sac (proximal loop) directly towards the anus as far as the posterior adductor; there it turns, at first in winding coils and then straight, dorsally over the sac, as the nephridial duct (distal loop), towards the mouth, and opens into the mantle cavity by a special ureter quite close to the nephridial funnel. The two ducts communicate with one another and surround the sacs

* Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 1, pp. 14–18 (3 figs.).
† SB. Akad. wiss. Wien. Math. Nat. Klasse, cxxii. (1913) pp. 207–59.
‡ Zeitschr. wiss. Zool., cx. (1914) pp. 253–301 (24 figs.).

dorsally, and in part laterally. The kidney as a whole lies in the median dorsal part of the mussel wedged in between the insertion of the foot and gills and the floor of the pericardium in the form of a club, which widens and thickens from its oral tips towards the anus; and, in the space between the pericardium and the posterior adductor, stretches, as the nephridial coil, from one half of the mantle to the other. The two nephridial loops are separated by the sinus venosus and the retractor pedis. The length of the whole organ is about a third of the length of the animal. Its perfectly straight longitudinal axis lies obliquely to the longitudinal axis of the mussel.

The various parts of the organ are described in detail. The author considers that the smooth communicating duct enclosed by the elastic renopericardial wall, forms, in constrast to the much folded coils and sacs, a morphological unit which may be distinguished as the "excretory bladder."

## Arthropoda.

### α. Insecta.

**Respiratory System in Water-beetles.***—Frank Brocher describes two types of tracheæ in adult water-beetles. Besides the ordinary tubular forms there are others with a slightly developed spiral thread. They are not to be confused with vesicular tracheæ which have no chitinous thread. In *Dytiscus* and *Hydrophilus* the lumen of the large longitudinal tracheæ is not continuous. There is a large air-chamber on each side of the body between the mesothorax and the metathorax, which is in close association with the yellowish muscles of flight. In the tetanic vibratory contraction of these muscles, the tracheæ among the fibrils are subject to continuous compression and relaxation, and the reservoir may have to do with the regulation of the pressure.

Brocher confirms Camerano's statement that there are respiratory movements in the metathorax, and gives full details proving this. In *Hydrophilus* and *Dytiscus* the main respiratory movements are localized in the metathorax. In *Hydrophilus* inspiration appears to be as active as expiration, and the inspiratory muscles are stronger than those concerned in expiration.

**Tracheo-parenchymatous Organ of Aquatic Hemiptera.**†—Ch. Ferrière has studied this peculiar whitish organ which occurs in the thorax of some aquatic Hemiptera, such as *Nepa*, *Ranatra*, and *Naucoris*. It is a paired structure, disposed on each side of the dorsal vessel: it is formed of a peculiar fibrous tissue, and is penetrated by a number of small tracheæ given off from the chief trachea of the thorax. They seem to be transformed longitudinal flight-muscles in process of atrophy. They appear at the last moult at the same time as the wings and elytra, and they show in the different types different degrees of degeneration. Flight is occasional in *Ranatra*: it does not seem to have been observed in *Nepa*; it does not occur in *Naucoris*.

* Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 3, pp. 58–73 (3 figs.).
† Rev. Suisse Zool., xxii. (1914) pp. 121–45 (2 pls.).

**Reproductive Organs and Larvæ of Warble Fly.*** — G. H. Carpenter and Thomas R. Hewitt describe the ovaries and oviducts, the accessory glands and spermathecæ, the ovipositor, and the male genital aperture in *Hypoderma bovis*. The ovaries are remarkable on account of the arrangement of the ovarioles. Each is made up of more than a hundred ovarioles, e.g. 120 in the right ovary and 110 in the left, and three or four eggs may be developed in each. A single female would thus produce about 800 eggs. There is definite specific difference between the male genital aperture in *H. bovis* and *H. lineatum*. The authors induced a captive female to lay eggs on a calf's hairs in a glass tube. Eggs kept in an incubator at 40° C. hatched in four and a half days.

Independently of Gläser the authors have described the newly hatched maggot of *Hypoderma bovis*—a very interesting type of insect larva with formidable mouth-hooks and strong spiny armature. There are seven or eight irregularly arranged rows of spines around most of the segments, two or three series of strong spines being found close to the front edge of each segment, those behind being feebler, and the posterior margin of each segment showing a strip free from spines.

**Spermatogenesis in Lepidoptera.†**—L. Verlaine has investigated the origin of the different intrafollicular cells and their mutual relations in Lepidoptera, and especially in *Arctia caja*. The testicular follicles exhibit three kinds of cellular elements well-defined by their form and function: Verson's cells, the sex-cells, and the cells of the cyst membranes. At the moment of division of the capsule into four follicles a Verson's cell appears in each follicle: it is therefore not a mother-cell of the sex-cells and it does not arise from a cell of the testicular envelope. It is a primordial spermatogonium which is modified synchronously in the four chambers of the two testicular capsules of a caterpillar by the influence of factors still unknown. The Verson's cell elongates and becomes pedunculated in such a way as to be isolated in the centre of the mass of primordial spermatogonia, while remaining fixed by its stalk to the testicular envelope for a relatively long period. This giant cell is of very variable outline; it takes the form of the space in which it rests. It is always separated by membranes from the living sex-cells which surround it, but in the later stages degenerating sex-cells or clusters of these are engulfed and assimilated by its cytoplasm. Its nucleus does not divide by karyokinesis. During the stalked stage the giant cell rarely shows peripheral cytoplasmic granules; these only appear when the absorption of disintegrating cells has begun. These granules, which are thus cellular in origin, are destined to dissolve, and they never pass directly into the sex-cells, which are everywhere enclosed by a membrane. The giant cell finally disintegrates and its remains mingle with the intrafollicular liquid.

In the early stages the primordial spermatogonia are few in number, but they multiply rapidly and crush each other. They elongate or become pear-shaped and form a more or less regular layer surrounding

* Sci. Proc. Roy. Dublin Soc., xiv. (1914) pp. 268–89 (6 pls.).
† Bull. Acad. Belgique, Classe Sci., 1913, pp. 701–54 (5 pls. and 2 figs.).

the giant cell. There is no plasmodial communication between the sex-cells and the Verson's cell; nutrition takes place by diffusion through the membranes. The pear-shaped appearance is due not to the giant cell but to the mutual crushing of the cells. After maturation each of the "primordial spermatogonia" divides into a certain number of spermatogonia which give rise to spermatozoa. The cyst cells appear soon after the Verson's cells. They are spermatogonia which do not receive from the giant cell the same nourishment as the sex-cells. They divide by karyokinesis, and for lack of nourishment cannot recuperate the original volume in the period between two divisions. Some of them surround the primordial spermatogonia and form a multicellular membrane which stretches and becomes thinner as these increase in size. One of the cells situated in front of the heads of the spermatic elements increases greatly in size and appears to play a nutritive role.

**Hymenopterous Parasites of Aphis evonymi.***—A. Malaquin and A. Moitié have studied the Hymenopterous larvæ which infest this black blight. No fewer than seventeen different species were found, of which *Trioxys auctus* and *Aphidius crepidis* were the commonest. The infected wingless Aphides pass into a characteristic cystic condition. Reference is made to experiments which show the great effectiveness of the Hymenoptera (Aphidiidæ, Proctotrupidæ, Cynipidæ, and Chalcididæ) as checks on the Aphides.

### δ. Arachnida.

**Eyes of Arachnoids.**†—Ludwig Scheuring describes the minute structure of the eyes of Phalangidæ (*Phalangium*) and Araneidæ (many types of spiders). He deals with the structure of the main eyes and the lateral eyes of spiders, with their function, and with the movements of the retinal pigment. After a careful comparison of the various kinds of Arachnoid eyes, Scheuring comes to the conclusion that the main eyes of Scorpionidæ are homologous with the main eyes of Pedipalpi and the lateral eyes of Araneidæ; that the lateral eyes of Scorpionidæ are homologous with the eyes of Hydrachnids; that the lateral eyes of Pedipalpi are homologous with the eyes of Pseudoscorpionidæ; and that the main and lateral eyes of Solifugæ are homologous.

**Reproduction in Acercus.**‡—Karl Viets has made careful observations on the behaviour of the males of species of the water-mite, *Acercus*, when brought into the vicinity of the females. The third appendage is applied to the genital aperture and loaded with a sperm-packet. A small clump is seen at the tip of the appendage, consisting of a number of straight spines surrounded by a glutinous material. Below the apex of the spines the club-shaped spermatophores are attached by a thin stalk. The sperm-packet is pushed into the female genital aperture.

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 803–5.
† Zool. Jahrb. Abth. Anat., xxxvii. (1914) pp. 369–464 (4 pls. and 16 figs.).
‡ Internat. Rev. ges. Hydrobiol., vi. (1914) Biolog. Suppl. No. 3, pp. 1–10 (4 figs.).

### ε. Crustacea.

**Gall-forming Crab.***—F. A. Potts discusses the genus *Hapalocarcinus*, which includes crabs very small in size and profoundly modified, owing to the fact that they pass the greater part of their lives confined in small cavities in coral colonies. At an early age the crab settles between two branchlets, usually terminal, and so influences their further growth that they broaden, and, later, unite to form the so-called gall, about the size of a hazel-nut. In all cases (on *Pocillopora*) the gall appears to be formed and inhabited by a solitary female individual. At first she is little more than a millimetre in carapace length.

After opening a hundred galls without success, Potts at length found the male, which is about 1 mm. in carapace length. He is free-living and visits the females while the gall is still open. After fertilization, the gall closes up so far that the visits of other males are prevented.

The crab is not a parasite on the corals. It must live on small organisms drawn in with the respiratory current. It is probable that the organisms of the "nanno-plankton" (less than 3–4 $\mu$ in measurement) are collected in the first place by the close-set combs of setæ springing from the interior of the palps of the maxillipedes which cover the whole of the buccal area.

**Process of Fertilization in a Crab.**†—R. Binford describes the germ-cells and the process of fertilization in the edible crab, *Menippe mercenaria*, found along the southern part of the Atlantic coast of the United States. The seminal elements arise from a single row of spermatogonial cells, which persist along one side of the testicular tubule. The tubule is divided into three or four regions by longitudinal partitions of epithelial cells. The seminal elements in one end of a given division are more mature than those in the other end. The spermatogonial nuclei lie in a common cytoplasmic mass, and multiply irregularly without the formation of a spireme. A spireme and synapsis occur in connexion with the first mitotic division. The second mitotic division follows soon after the first. In the mature spermatozoon the protoplasmic portion containing the nucleus is cup-shaped. From the rim of the cup pseudopodia project like the rays of a star. There is a capsule half embedded in the cup. An inturned tubule is connected with an opening in the distal portion of the capsular wall, and a rod-like central body arises from the proximal side of the capsule and projects into the inner tubule. In the transformation of the spermatid the nucleus becomes uniform in consistence, reduced in size, and cup-shaped. A mitochondrial ring is formed between the nucleus and the capsule. The capsule arises as a vacuole in the cytoplasm. The central body develops from a granule which appears on the proximal side of the capsule. The inner tubule is formed from two vesicles which arise at the distal end of the central body. Certain stimuli, such as hypotonic solutions of various salts, cause a lengthening of the central body, an eversion of the tubule, and an inversion of the wall of the capsule. When

* Proc. Cambridge Phil. Soc., xvii. (1914) pp. 463–5 (3 figs.).
† Journn. Morphol., xxiv. (1914) pp. 147–81 (9 pls.).

the spermatozoa come in contact with the ova under normal conditions, the capsule is usually applied to the shell of the egg and the nuclear cup is directed away from the egg. In this position eversion takes place and the ejected central body, the inner tubule and the capsule with its contents are turned through the shell into the egg. The nuclear cup is left on the outside and soon falls off. The wall of the capsule, together with its everted contents, which forms the sperm-vesicle, sinks into the cystoplasm of the ovum, where it is enlarged and transformed into the male pronucleus. The substance within the capsule may be derived from the nucleus of the spermatid and is probably oxychromatin which deposits basichromatin after it enters the egg, and so gives rise to the chromosomes in the male pronucleus.

**Development of Caridea.***—E. Sollaud notes that in most Caridea the ova are small, the larva is a nauplius, and in subsequent development the uropods appear before the pleopods. In many species, however, the ova are large and rich in yolk, the larva emerges at an advanced stage, and the uropods appear after the pleopods. The author argues that the early appearance of the uropods in the forms with small ova is not an hereditarily fixed character, but is conditioned by an actual factor in larval life—the incessant movements of the telson in the very active free-swimming larva.

**Thompsonia.†** — F. A. Potts discusses this little-known Rhizocephalian, first noted by Kossmann in 1874 as a parasite upon the small crab *Melia tesselata*, from the Philippines. Superficially, the parasite consists of a number of small external sacs, sometimes 200 on one host, which spring from the limbs of the host. Unlike Coutière and Häfele, who regarded each sac as a separate individual, Potts maintains that they are budded off from one root system. The external sacs are probably homologous with the visceral mass of the typical Rhizocephalian. It seems, then, that nerve-ganglion, reproductive ducts, and muscular tissue have been lost, and probably the testis as well. Only the ovary is left, and reproduction appears to be parthenogenetic. The larvæ develop in the sacs and are liberated by a moult.

By observations on infected specimens of a species of *Synalpheus*, Potts has shown that after the moulting of the host another crop of sacs are produced by the root system.

It seems probable that *Thompsonia* is not primitive but highly specialized. The external sacs are little more than ovaries placed externally to allow of the escape of the larvæ. The adoption of parthenogenesis, as in *Sylon* and *Mycetomorpha*, has made it possible to dispense with testes and gonadial ducts. In may be that in *Peltogaster socialis* the hundred or more sacs are not due to a simultaneous fixation of gregarious larvæ, but to internal budding, as in *Thompsonia*.

**New Parasitic Copepod.‡** — R. Dollfus describes *Trochicola enterica* g. et sp. n., the female of which occurs in the rectum of *Zizyphinus*

* Comptes Rendus, clviii. (1914) pp. 971–3.
† Proc. Cambridge Phil. Soc., xvii. (1914) pp. 453–9 (2 figs.).
‡ Comptes Rendus, clviii. (1914) pp. 1528–31.

*zizyphinus* and *Gibbula cineraria*, two common Trochidæ. The parasite is elongated, vermiform, and almost cylindrical; it almost fills up the rectum, and only one occurs in each host. The colour is bright red, and can be seen through the skin of the Trochid. Many specimens were 8 mm. in length, including the ovigerous sacs, and some were longer. The head-region is well-marked and bears antennules, hooked antennæ, reduced mandibles, and vestigial maxillæ. The thorax bears four pairs of biramose pereiopods with hooked exopodites, and a vestigial fifth pair. The first abdominal segment bears the genital apertures and the ovigerous sacs. There is a resemblance of convergence between this new form and *Mytilicola intestinalis* Steuer from the mussel.

**Germinal Layers in Cyclops viridis.***—Karl Fuchs has studied the cleavage and gastrulation in this Copepod. His results confirm the conclusion that the endoderm in Entomostraca arises from a single quadrant or octant, and that the mesoderm arises from the portions of the vegetative quadrants or octants which adjoin the pole. The mesoderm forms an arch around the primitive endoderm-cell (and an apposed primitive germ-cell or "Urmesodermzelle"). This arch afterwards closes to form a ring. The numerical strength of the mesoderm ring varies with the disposition and division-direction of the polar octant portion.

In a number of types (*Moina*, *Polyphemus*, *Cyclops*), a primitive germ-cell arises in a polar position along with the primitive endoderm-cell. In some other types (*Cetochilus*, *Lepas*) a primitive mesoderm-cell is constricted off on the equatorial side from the primitive endoderm-cell.

### Annulata.

**Japanese Aquatic Oligochæta.**†—Ekitaro Nomura describes *Limnodrilus gotoi* Hatai and *L. willeyi* sp. n., which he compares very carefully. The former species also occurs in Ceylon. Details are given of the minute structure of the body-wall; the setæ and the setigerous sacs; the alimentary canal; the septa and septal sacs; the amœbocytes; the nephridia; the central nervous system; and so on.

**New Myzostomid.**‡—D. Fedotov describes *Protomyzostomum polynephris* Fedotov, a new genus which he found in the gonads of *Gorgonocephalus eucnemis* in the Kola Fjord. It is a flat, Planarian-like worm up to 3 cm. in length, orange-coloured or sometimes reddish. The margin is without cirri and somewhat thickened. There are five pairs of weakly developed almost rudimentary parapodia, and corresponding to these, on the back or on the margin, there are five pairs of lateral organs. There is a thin cuticle, the body-epithelium is sunk in below the sub-cuticular musculature, and there are no cilia; the position of both mouth and anus is terminal. There is no proboscis. The muscular pharynx is short; the intestine has 8 to 13 pairs of lateral main branches; the rectum is very short, and the cloaca is rather long.

* Zool. Jahrb. Abth. Anat., xxxviii. (1914) pp. 103–56 (3 pls. and 6 figs.).
† Journ. Coll. Sci Tokyo, xxxv. (1913) pp. 1–49 (34 figs.).
‡ Zeitschr. wiss. Zool., cix. (1914) pp. 631–96 (4 pls. and 2 figs.).

The body-cavity or "uterus" is strongly developed. The number of lateral branches from its median portion (over the intestine) does not correspond to the number of intestinal branches, and the arrangement is not symmetrical. It opens into the extreme end of the cloaca. The two ovaries, lying one behind the other, and really unpaired, are situated in the middle third of the body above the intestine. The much branched testes are distributed over the ovaries and intestine. The anterior and posterior branches of the vas deferens open on each side in the seminal vesicle. The male genital openings lie between the third pairs of parapodia and the corresponding lateral organs. There is a weakly developed penis.

The nervous system is ladder-like, with eight pairs of lateral nerves and an unpaired posterior nerve. The pair of nerves farthest forward form the œsophageal nerve-ring. The musculature is weakly developed. There are several pairs of nephridia, and the number on the two sides is not always the same. The animal is an endoparasite, and as such it shows in comparison with other Myzostomidæ a number of retrogressive characters.

Fedotov makes a careful comparison of the three genera—*Myzostomum*, *Protomyzostomum*, and *Stelechopus*, and comes to the conclusion that *Protomyzostomum* is nearer to Nereidomorph Polychæts than are the others. It shows primitiveness in its ladder-like nervous system, in the position of its lateral organs, in the several pairs of nephridia, in the elongated stomach with numerous main branches, in the absence of sharp localization of the ovaries, and in the terminal position of the oral and cloacal openings. It shows secondary adaptations to endoparasitic life in the absence of cilia on the somatic epithelium and the insinking of that epithelium, in the great reduction of parapodia and musculature, and in the Planarian-like shape. It is also distinctively marked by the absence of marginal cirri, radial muscle-septa, and proboscis, and in the very weak development of a penis.

**New Sagitta.***—Ellis L. Michael describes *Sagitta californica* sp. n., and sets a good example by giving a table based on micrometer measurements of fourteen structural features observed on a hundred of the best specimens. The number of teeth and seizing jaws possessed by each individual is recorded, and the state of maturity of the ovary and seminal vesicle. The new form is readily recognized from all other species by its massive and very long collarette, extending from the head to the tail-septum, and thence to the seminal vesicles.

In animals between 12 and 26 mm. in length, variation in the ratio between the length of the animal and the length of the tail, the interval from tail to ventral ganglion, the length and width of anterior fin, the interval from anterior fin to ventral ganglion, and the length and width of the posterior fin—is approximately constant, irrespective of the length of the animal. Of all proportional measurements these are, therefore, the safest for the identification of *S. californica*, and this is especially true of the proportional length of the tail.

* Univ. Californian Publications (Zool.) xi. (1913) pp. 89–126 (1 pl.).

In animals between 12 and 26 mm., the width of the body, the interval between anterior and posterior fins, the interval from posterior fin to seminal vesicle, and the length of the ovary, increase *more* rapidly than the animal increases in size, while the ventral ganglion increases *less* rapidly than the animal does. Therefore, the ratio between these various measurements and length of animal is of certain specific value only for animals of definite lengths.

The number of anterior and posterior teeth and seizing jaws increases as the animal grows larger, the rate of increase being greatest in the posterior teeth and smallest in the seizing jaws. Therefore the specific value in number of these structures depends not only on the extremes of variation, but, quite as definitely, on the amount of variation in the rates of increase.

### Nematohelminthes.

**New Species of Tropidocerca.***—L. G. Seurat describes *Tropidocerca nouveli* sp. n. from the viscera of a stilt (*Himantopus himantopus*). The median part of the female is extraordinarily swollen and pyriform and of a carmine colour. The ovijector is of the type of *T. inermis*. The male is marked by the possession of a single delicate spicule.

### Platyhelminthes.

**Two Ceylonese Temnocephalidæ.**†—L. Plate describes *Caridinicola indica* Annandale from *Caridina simoni* and *Monodiscus parvus* sp. n. from the same prawn. Both forms especially frequent the gill-chamber, but they creep about on other parts of the body. A third symbiotic form, a Rotifer, also occurs in abundance, especially about the mouth, and is eaten by the Temnocephalids. It appears that *Caridinicola indica* is a protandrous hermaphrodite.

**Ichthyotænia filicollis.**‡—F. J. Meggitt describes this tapeworm from the stickleback (*Gasterosteus aculeatus*), giving an account of the general and minute structure. Evidence is given that the intermediate host is *Cyclops varius*, successful experiments having been made in infecting the *Cyclops* with the tapeworm egg and the stickleback with the larva in the *Cyclops*. The fertilized ovum divides into a vitelline cell crowded with yolk-granules and a "Keimzelle" with nucleus and nucleolus. The "Keimzelle" divides into two and each of these into two again, four cells of equal size being formed. In subsequent divisions the nuclei are of two sizes, and the cells containing the larger nuclei surround the others. A split appears between the two, and this gradually widens until the first cells form a definite coat—the second oncospheric membrane—around the smaller ones. The vitelline cell does not last long, but degenerates into a mass of yolk-follicles.

* C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 778–81 (8 figs.).
† Jen. Zeitschr. Naturw., li. (1914) pp. 707–22 (2 pls.).
‡ Proc. Zool. Soc., 1914, pp. 113–38 (4 pls. and 5 figs.).

**New Species of Cittotænia from a Wallaby.*** — R. C. Lewis describes *Cittotænia lagorchestis* sp. n. and *C. villosa* sp. n. from the stomach and small intestine of *Lagorchestes conspicillatus* from Monte Bello Islands. Both species are characterized by the presence of two sets of genital organs and two lateral genital pores to each segment. The first species is nearest *C. zschokkei* von Janicki, e.g. in having a projecting sheath, which is fimbriated, at the posterior border of each segment, overlapping the next segment. But the two differ in their reproductive and excretory systems. The second new species, *C. villosa*, is marked by the extraordinary development of the fimbriations of the projecting sheath at the posterior border of each proglottis, the presence of two large testicular sacs instead of, as in other species, numerous small testicular sacs, and by other features.

**Urocystidium.†**—F. E. Beddard discusses the remarkable tapeworm *Urocystidium gemmiparum*, which he found in sexual and asexual states in cavities of the liver of the musquash (*Fiber zibethicus*). The asexual stage is not referable exactly to any type of asexual tapeworm as yet described. In spite of its external and internal (transverse water-vascular vessels) segmentation, it is essentally a bladderworm, but, as it appears, without a scolex. In complexity of structure and in details, this asexual stage is not far different from the sexual stage. The sexual worm which occurs in the same cavities of the liver is roughly of the same size as the fully developed asexual stage. It has a strongly muscular rostellum, two rows of hooks, large oval calcareous bodies, gonads about the centre of the proglottides, and the ducts all to one side.

It is suggested that from the egg there arises a plerocercoid larva; that this gives rise by budding to many larvæ which differ in several structural features from the asexual parent, and that these, perhaps, give rise to the sexual worm.

**Viviparous Distome.‡**—Edwin Linton describes *Parorchis avitus* sp. n. from the cloaca of a herring gull (*Larus argentatus*), unique in having miracidia in the uterus, and a well-developed redia within each. Miracidia in the ova of Distomes have been recorded, and larvæ containing rediæ have been noted in certain Monostomidæ; but this seems to be the first record of a Distome whose uterus showed ova with ciliated larvæ containing rediæ.

**New Trematodes.§**—W. Nicoll describes a number of new parasites from animals dying in the Zoological Society's Gardens in London. The list of new forms includes *Mediorima propria* g. et sp. n. (from the intestine of a striped snake, *Tropidonotus ordinatus*), closely resembling *Lechriorchis* but distinguished from it by the median position of the genital aperture and the shape of the cirrus-pouch; *Ommatobrephus singularis* g. et sp. n. (from the intestine of the spiny-tailed mastigure,

* Proc. Zool. Soc., 1914, pp. 419–33 (10 pls. and 3 figs.).
† Proc. Zool. Soc., 1914, pp. 1–22 (9 figs.).
‡ Proc. U.S. Nat. Museum, xlvi. (1913) pp. 551–5 (1 pl.).
§ Proc. Zool. Soc., 1914, pp. 139–54 (3 pls.).

*Uromastix acanthinurus*) with large eggs most of which contain a precociously developed miracidium: *Opisthogenes interrogativus* g. et sp. n. (from the intestine of Schott's snake, *Philodryas schotti*), distinguished by the position of the genital aperture, the shape and structure of the cirrus-pouch, and the position of the yolk-glands; and *Harmotrema infecundum* g. et sp. n. (from the intestine of Smyth's water-snake, *Grayia smythii*) with an extremely short uterus which does not usually contain more than two—relatively huge—eggs.

**Didymozoon scombri.***—Jas. Johnstone has some notes on this interesting Trematode, parasitic on the roof of the mouth and about the gill-region of the mackerel. In some of the cysts two worms were found, coiled together inseparably, with apparent fusion in places. The male organs are greatly reduced. There is a very fine efferent duct opening close to the female genital orifice on the tip of the genital papilla. There are no traces of prostate gland or intromittent organ.

**Proboscidian System in Nemertines.**†—Gerarda Wijnhoff discusses this system, which is characteristic of all Nemertines. It includes three parts—the proboscis, its sheath, and the rhynchodæum. The proboscis is an introvertible tube which is fastened to the body wall at the anterior end of the rhynchocœl, and is connected posteriorly by a retractor muscle to the wall of the sheath. The rhynchodæum is a kind of porch or atrium, through which the proboscis is everted. Both in the proboscis and in the proboscis-sheath there is a muscular wall, and the lumen of the sheath is lined by an endothelium. The cavity of both rhynchodæum and proboscis is lined by continuous epithelium that shows a differentiation of glandular elements in different parts of the system. The proboscis, therefore, consists of three layers—an epithelium, a muscular coat, and an endothelial layer. The wall of the proboscis-sheath consists of an endothelium and a muscular coat. The whole system is embedded in the body-parenchyma.

It has for a long time been assumed that the proboscis is a structure *per se*, and Hubrecht supported this view. Salensky, however, founded on certain embryological facts the theory that the proboscidean system was comparable to the proboscis of Rhabdocœlida proboscida. Wijnhoff has gone carefully into the matter, and has studied the state of affairs in many types, and is led to the conclusion that the proboscis and the rhynchocœlom are both derived from the body-wall, a separation being effected in the musculature. Support is thus given to Salensky's theory that the proboscis of Nemerteans is homologous with that of Rhabdocœlida proboscida.

### Incertæ Sedis.

**New Variety of Rhopalura pelseneeri.**‡—M. Caullery describes a new variety (*vermiculicola*) of this Orthonectid, which he found within the common Nemertean *Tetrastemma vermiculus* in large numbers. It is a

* Rep. Lancashire Sea Fisheries Laboratory, No. xxii. (1914) pp. 37–40 (2 pls.).
† Quart. Journ. Micr. Sci., lx. (1914) pp. 273–312 (36 figs.).
‡ Bull. Soc. Zool. France, xxxix. (1914) pp. 121–4 (2 figs.).

cylindrical form, about 105 $\mu$ in length by 25 $\mu$ in breadth; it is completely covered with cilia: the ectoderm cells are disposed in regular annuli and enclose whitish refractive granules; the interior is filled with a genital mass containing embryos at different stages of development. The species is hermaphrodite and autogamous, and the same is probably true of the new variety, which differs from the type in the number of rings and the dimensions of parent and embryos.

**Development of Tardigrada.***—Wanda von Wenck has studied the embryonic and post-embryonic development of *Macrobiotus lacustris* Duj. The segmentation is total and approximately equal. The result is a morula. The endoderm is formed by delamination from the morula. The blastopore is formed later and with it the lumen of the archenteron. Just in front of the blastopore the primary germ-cells arise from the outer layer and pass into the ventral wall of the archenteron. The post-embryonic development is very simple: there are successive moults without metamorphosis. The tooth apparatus may be renewed at a moult, as Reukauf observed. The chitinous parts of the tooth apparatus are formed by the paired organs called "salivary glands" which lie on the sides of the œsophagus. Encystation may occur at various ages. The organs do not undergo histolysis in the encystation, as Murray supposed. The possible affinities of Tardigrada are discussed, but no definite conclusion is arrived at.

### Echinoderma.

**Artificial Parthenogenesis in Sea-urchin Ova.**†—M. Herlant has experimented with *Paracentrotus lividus*, and follows Loeb in recognizing the operation of two successive factors, the first a fatty acid, which determines the activation of the ovum and the appearance of a strong irradiation around the female pronucleus; the second a hypertonic solution which induces the appearance of accessory asters. Herlant finds that the activation brings about the development of at least two successive cycles of irradiations, formed around the female pronucleus by the rhythmic activity of its centrosome. The essential action of the hypertonic solution is to bring about the formation of one to three accessory asters. This depends not only on the duration of the hypertonic treatment, but also on a special aptitude which the ovum acquires progressively during its activation. This aptitude reaches a maximum and then wanes and disappears.

### Cœlentera.

**Hydrozoa benthonica.**‡—Hjalmar Broch reports on a collection of benthonic Hydrozoa from the West African coast, from Cape Verde to the mouth of the Orange River. The collection includes two new species of *Hydractinia*, *Hebella michaelseni* sp. n., *Sertularia hupferi* sp. n.,

* Zool. Jahrb. Abth. Anat., xxvii. (1914) pp. 465–514 (4 pls. and 10 figs.).
† Comptes Rendus, clviii. (1914) pp. 1531–3.
‡ Beiträge zur Kenntniss der Meeresfauna Westafrikas, Hamburg, 1914, pp. 21–50 (1 pl. and 12 figs.).

*Allopora rosacea* Greef, and *A. subviolacea* W. S. Kent. An enquiry into the geographical distribution leads to the conclusion that the origin of the phenomenon of bipolarity is due to the splitting up of widely distributed parent-species by biophysically determined variation.

**Symbiosis in Hydroids.***—H. C. Müller makes a note on symbiotic algæ found by him in various hydroids in the Bay of Naples, especially in *Sertularella polyzonias* L., *Aglaophenia pluma* L., and *Pachycordyle fusca*, a species discovered by him. In the last named form symbiotic algæ were found in the endoderm throughout the whole hydrocaulus. These zooxanthellæ are not distinguishable in appearance from those of other animals. They occur in such numbers that the soft white plasma of the hydroid is coloured yellow or brown. They are never found in the egg-cells of *Pachycordyle fusca*, so that infection of each new generation must take place. The investigator gives an interesting account of the movements of the xanthellæ outside of the animal tissue.

**Alcyonarian with Simple Tentacles.**†—Gilbert C. Bourne describes *Acrossota liposclera* g. et sp. n. from British New Guinea, unique among Alcyonarians in having simple digitiform tentacles without pinnules. It requires a new family among the Stolonifera, in close juxtaposition to Cornularidæ and Clavularidæ. The translucent zooids occur at intervals on a simple sparingly branched radiciform adherent stolon. There was no trace of spicules. The tentacles are eight in number, and the structure of the polyp, in almost all respects except the absence of pinnules and spicules, presents characteristic Alcyonarian features.

## Protozoa.

**Structure and Division of the Amœba Nucleus.**‡—Th. v. Wasielewski and Alfred Kühn have made a study of the structure and division of the nucleus of the Amœba. They find that the nucleus consists of an "outer nucleus" and a central corpuscle, which are morphologically independent. The outer portion contains the chromatin of the nucleus. In the resting-nucleus the chromatin substance forms an alveolar layer round the central corpuscle, and during division is transformed into a series of chromatin threads disposed in an equatorial plate. The daughter plates arise by stretching and constriction of the nuclear threads, and the daughter plates, by the dissolution of the threads, form the outer nuclear mass of the daughter nuclei arise. The central corpuscle has no chromatin; it contains, perhaps constantly, a central granule (centriole ?); on division its mass yields the polar bodies and the spindle of the central corpuscle. At the end of the division process the remains of the spindle and the polar bodies fuse to become the daughter central corpuscles. The central corpuscle may therefore be regarded as the division apparatus of the nucleus. In *Vahlkampfia mutabilis* sp. n. the outer nucleus layer always contains a chromatin body

* Zool. Jahrb., Abth. Syst., xxxvii. (1914) pp. 267-82.
† Quart. Journ. Micr. Sci., lx. (1914) pp. 261-72 (1 pl.).
‡ Zool. Jahrb., Abth. Anat., xxxviii. (1914) pp. 253-326 (3 pls. and 8 figs.).

(the "marginal corpuscle") which during division disposes itself in the equatorial plate with the nuclear threads and divides there; its halves move behind the daughter plates towards the poles and form the marginal corpuscles of the daughter nuclei.

**Cnidocysts of Peridinids.***—E. Chatton gives an account of these structures in *Polykrikos schwarzi* Bütschli. He finds that this form, occurring on the European shores of the Atlantic, is specifically distinct from that described by Kofoid for the American coast of the Pacific, and he therefore names the latter *P. kofoidi*. The Atlantic species *P. schwarzi* is found also in the Mediterranean. Its cytoplasm has trichocysts which are inconstant, and cnidocysts which are constant. The cnidocysts are fundamentally similar in structure to those of Cœlenterates, and they are discharged by a similar mechanism, with the difference that the filament does not uncoil as it is evaginated. The cnidocysts are not discharged by the intact *Polykrikos*, which does not appear able to control their explosion. In the *Polykrikos* the cnidocysts go through a series of stages which constitute a true developmental cycle. They multiply by autogenesis; a cnidoplast differentiates into a cnidogen, which reproduces a cnidoplast, which, by chitinization, becomes a cnidocyst. The element thus exhibits a phase in its development in which it grows and reproduces (cnidoplast—cnidogen), and a phase in which it simply undergoes chitinization. The finished cnidocyst is nothing more than an inert mechanism. The nuclei of the *Polykrikos* take no share, direct or indirect, in the formation of the cnidocyst. The ampulla (corresponding to the spiral tube of the nematocyst of Cœlenterates) is formed independently of and before the capsule. The filament grows, like a flagellum, in a vacuole starting from a chromatophilous granule which may be centrosomic. The cnidocysts of *P. schwarzi* are intrinsic; they are not of alimentary origin, nor are they parasitic. There is nothing to show that they are genetically allied to the trichocysts of *Polykrikos*, but their power of exploding from the cnidoplast stage onwards, and their structure at that stage, are strong arguments in favour of the cytological homology of the two. The structure of the cnidogen and the mode of origin of the filament seem to show that the stinging element represents a much modified kineto-flagellar apparatus.

**New Schizogregarine.**†—D. Keilin describes *Caulleryella aphiochætæ* g. et sp. n., from the intestine of a Dipterous larva (*Aphiochæta rufipes* Meig.). The schizogony is extracellular, and occurs in the form of little barrel-like groups of sixteen merozoites. Each gamont produces eight gametes. There are eight sporocysts, each giving rise to eight sporozoites. The type requires a new family (with eight spores) between Monosporea and Polysporea. In its extracellular schizont it approaches Ophryocystidæ or Schizocystidæ. In its grouping of merozoites it approaches Selenidiidæ or Merogregarinidæ.

* Arch. Zool. Expér., liv. (1914) pp. 157–94 (1 pl.).
† C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 768–71 (12 figs.).

**Peculiarities of Metamera schubergi.***—Emile Regnard calls attention to some of the peculiarities of this Gregarine, described by Bolsius, Castle, and Duke, from the intestine of the brook-leech, *Glossiphonia complanata*, where it occurs in the posterior diverticula. Besides epi-, proto-, and deuto-merite, the Gregarine may have another segment, or other two. The nucleus has a variable position. and the ectoplasmic partitions are weak. The segmentation of Gregarines is not of much morphological importance. Prolongations of the Gregarine pass into the cells of the intestine and induce a remarkable karyomyxis. Its secretion is probably digestive, cell boundaries break down, a syncytium is formed, and there is a more or less mechanical agglutination and confluence of nuclei. Siedlecki has described similar phenomena in the spermatogonia of a Polychæte, *Polymnia*, parasitized by *Caryotropha*, a Coccidian.

* Arch. Zool. Expér. liv. (1914) Notes et Revue, No. 1, pp. 1–13 (12 figs.).

# BOTANY.

## GENERAL.

### Including the Anatomy and Physiology of Seed Plants.

#### Cytology,

##### including Cell-Contents.

**Cytology of Œnothera in Relation to Mutation.***—R. R. Gates and N. Thomas publish a paper dealing with mutation-series in *Œnothera lata* and *Œ. semilata*. The twenty-one plants examined had 15 chromosomes, although the mutants were derived from 14-chromosome races. Two of the mutants give strong confirmation to previous work, which indicated that the peculiar characters of *Œ. lata* and *Œ. semilata* are constantly associated with the presence of fifteen chromosomes, even when combined with other characters derived by inheritance from 14-chromosome individuals. The extra pair of chromosomes is the result of the distribution of two chromosomes of a pair to the same daughter-nucleus in the reduction-division. The inconstancy of *Œ. lata* and *Œ. semilata* is due to the extra chromosome, and probably the variability of the *lata-semilata* series has a similar cause. The environmental conditions of the germ-cell and the physiological condition of the mother-plant probably determine the ratio of descendants resembling each parent. The extra chromosome associated with the foliage and habit of *Œ. lata* and *Œ. semilata* appears to resemble the sex-chromosome in such insects as *Anasa*, and the initial nuclear difference determines the external characters of the series of mutants derived from them. The different types of meiotic irregularity, such as the division of a chromosome on the heterotypic spindle, must be regarded as germinal changes. The facts set out in this and previous papers show that mutations and Mendelian hybrids have their origin in different causes; the former are due to a germinal change, the latter to a redistribution of the parental characters.

#### Physiology.

##### Nutrition and Growth.

**Nitrogen-assimilation by Plant-hairs.**†—F. Köressi publishes the concluding paper dealing with a series of experiments performed in order to test the truth of a statement made by certain modern investigators, who assert that newly-formed hairs contain no albumin, and that this substance only appears after the hair has been in contact with the

* Quart. Journ. Micr. Sci., lix., (1914) pp. 523–71 (3 pls. and 4 figs.).
† Rev. Gen. Bot., xxvi. (1914) pp. 106–28 (1 pl. and 2 figs.).

atmosphere. The present experiments deal with species of *Robinia*, *Ribes*, *Æsculus*, and *Acer*, and they prove conclusively that the hairs of plants cultivated in the open air develop in exactly the same manner as those grown in an atmosphere from which nitrogen has been removed. Hairs taken from organs of the same age and in the same stage of development, give similar microchemical reactions, and it is shown that the nitrogen of albuminoid substances demonstrated by these reactions, is not derived from the atmosphere. The author shows that since all living cells contain protoplasm, they must of necessity respond to albumin tests, and therefore these tests are no criterion for proving the assimilation of nitrogen. Consequently the opinion that plant-hairs have the power of assimilating free nitrogen from the atmosphere, which is based upon the results of these tests, must be regarded as erroneous and without foundation.

## CRYPTOGAMS.

### Pteridophyta.

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

**Bothrodendron kiltorkense.***—T. Johnson publishes a further account of the fossil plant *Bothrodendron kiltorkense*, in which he describes and figures its stigmaria and cone from recent specimens obtained at Kiltorcan. The cone was borne on a well-developed stalk with ordinary leaf-scars continued up to the very base of the cone. The sporophylls are many and close-set, and consist of a broad fertile proximal portion and an upturned awl-shaped distal portion. The cone is heterosporous, while the lower sporophylls are female, each with a large sessile megasporangium containing numerous megaspores. The upper sporophylls are male-bearing microsporangia. The cone resembles that of *Lepidostrobus*, not *Selaginella*. It is a highly specialized structure.

**Phyllitis.**†—F. Morton publishes two studies on the genus *Phyllitis*. The first is entitled "The Finding of *Phyllitis hemionitis* (Lag.) O. Kuntze, in the Quarnero region," and deals with questions of distribution. The second treats of the "Systematic Position, Distribution, and Ecology of *Phyllitis hybrida* (Milde) Christensen." The relationship between that species and *Ceterach*, as well as its connexion with *P. scolopendrium* and *P. hemionitis*, is shown by a comparison of the respective structures, the points being: (1) the endings of the vascular bundles in the frond-lobes; (2) the position of the sori; (3) the indusium; (4) the layers of tissue from which the indusium arises. *P. hybrida* is shown to be an independent species, not of hybrid origin, occupying a systematic position between *Ceterach* and *P. scolopendrium*, similar to that of *P. hemionitis*, which in its anatomy and morphology it most closely resembles. The distribution of *P. hybrida* is discussed, and its synonymy is given.

* Sci. Proc. Roy. Dublin Soc., xiv. (1914) pp. 211–14 (5 pls.).
† Oesterr. Bot. Zeitschr., 1914, pp. 19–36 (5 pls. and 2 maps).

**Azolla in British Isles.***—A. S. Marsh gives the history of the occurrence of *Azolla* in the British Isles and in Europe generally. Two species—*A. caroliniana* and *A. filiculoides*—have been introduced into Europe. *A. filiculoides* is a hardy South American species, distinguished by its dense tufted habit and by its shoots often protruding above the surface and not lying flat. It is much larger and thicker than *A. caroliniana*, with a more compound and denser ramification. The upper lobes of the leaves have a broad distinct margin and bear unicellular trichomes. The reproductive organs ripen in November and afford the most distinctive characters, the glochidia of the massulæ of microspores having non-septate stalks, and the macrospore-wall being marked with large deep circular pits.

*A. caroliniana*, on the other hand, is a half-hardy species, ranging from Lake Ontario to Brazil. It is smaller, lies flat on the surface of the water, is less branched, has fewer rootlets, and the margin of the upper leaf-lobe is not as broad as in *A. filiculoides*. The glochidia have 3–5 transverse septa in the stalk, and the macrospore-wall is only finely granulate, but the fructification is very rare indeed. *A. caroliniana* was first recorded in Europe in 1872, and in England in 1883. It has been recorded from the Thames Valley, the Norfolk Broads, etc. But Ostenfeld pointed out in 1912 the second species, so all records need revision. Marsh says *A. filiculoides* is much the commoner species, and he has seen true *A. caroliniana* from Enfield and Godalming only. *A. filiculoides* was introduced into Europe in 1880.

**New Papuan Ferns.**†—E. B. Copeland publishes descriptions of seventeen new species of ferns collected by the Rev. C. King, of Ambasi, Papua, showing the points of morphology and structure by which they are characterized. He also defines *Holostachyum*, a new subgenus of *Aglaomorpha*, to receive a few New Guinea species in which the fronds are completely dimorphous and not simply provided with a specialized fertile upper portion.

## Bryophyta.

(By A. Gepp.)

**Fruit-bearing Receptacle of Marchantieæ.**‡—R. Douin describes the development of the fruit-bearing receptacle of the Marchantieæ, of which there are two quite different types. 1. The receptacle with a furrowed or canaliculate peduncle, as in *Reboulia*, *Grimaldia*, *Fimbriaria*, *Peltolepis*, *Fegatella*. This arises from the apical point of the thallus and prevents further growth of the main axis. 2. The receptacle with peduncle not canaliculate, which either (1) arises from a special vegetative point immediately behind the apex of the thallus, as in *Clevea* and *Plagiochasma*; or (2) from one branch of the bifurcating apex, as in *Lunularia*. The Marchantieæ may thus be divided into two groups analogous to those of the Jungermannieæ, namely (1) anacrogynous

* Proc. Cambridge Phil. Soc., xvii. (1914) pp. 383–6.
† Philippine Journ. Sci., ix. (1914) (Bot.) pp. 1–9.
‡ Comptes Rendus, clviii. (1914) pp. 1435–8.

(2) acrogynous. To the former group the Targionieæ are referred, to the second the Corsinieæ. The difference of origin of the female receptacle in the two groups might serve as the basis of a new classification.

**Corsinia marchantioides.***—K. Meyer describes the development of the sporogonium of *Corsinia marchantioides*, which undergoes a period of rest before dehiscence. Another characteristic is the presence of short spindle-shaped sterile cells among the spores. He regards these cells as serving in the early stages to supply nutrition to the spore-mother-cells; and in later stages, after the isolation of the spore-mother-cells, as being (like the cells of the capsule-wall) storehouses for the starch which, after the resting period, is converted into glycose, leading to the growth of the capsule, the bursting of the calyptra and the capsule, and the dissemination of the spores. These sterile cells appear to be true rudimentary (not reduced) elaters.

**Life-history of Porella.**†—F. L. Manning gives an account of the life-history of *Porella platyphylla*. Some of the material used had been dry for many years, but, upon being soaked in water at about 31° C., it revived and afforded excellent microtome-material. The author describes and figures the three-sided pyramidal apical cell: the development of the archegonium, which is sometimes abnormal in having two rows of axial cells, each consisting of four to six neck canal cells, a ventral canal cell, and an egg-cell; the development of the antheridium, the stalk of which when mature is long and slender, two cells thick; the sporophyte.

**European Hepaticæ.**‡—K. Müller continues his account of the Hepaticæ in Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz, and treats of *Lepidozia* (6 species), and of the following genera of the sub-family Ptilidioideæ—*Blepharostoma* (1), *Chandonanthus* (1), *Anthelia* (2), *Schisma* (2), *Mastigophora* (1), *Ptilidium* (part)—giving adequate descriptions of genera and species, with keys, critical notes, and figures of morphology and structure.

**Peruvian Hepaticæ.**§—A. W. Evans gives an account of the Hepaticæ gathered by the Yale Peruvian Exploring Expedition of 1911, under Hiram Bingham. The main work of the expedition was geology and archæology; but animals and plants were collected by H. W. Foote, and among them 31 species of Hepaticæ from seven different localities lying between 3000 and 12,000 feet. Eight new species are described in detail, and figured to show the areolation, shape of leaf, etc.; the genus *Dicranolejeunea* is discussed at some length, as also are *Frullania gibbosa* and *F. hians*, figures of their structure being added.

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 262–6.

† Bot. Gaz., lvii. (1914) pp. 320–3 (2 pls.).

‡ Die Lebermoose. Leipzig: Kummer, 1914, Lief. 19, pp. 261–2, 273–336 (figs. 81–98).

§ Trans. Connecticut Acad., xviii. (1914) pp. 291–345 (11 figs.).

**South African Mosses.***—H. A. Wager publishes an account of eleven South African mosses, mostly from Natal, described as new to science, with figures of structural detail.

**Ephemerum intermedium.**†—R. Douin describes and figures the structural features of the minute moss *Ephemerum intermedium* Mitt. which are essential for discriminating it from the allied species, *E. stellatum*, *E. serratum*, and *E. minutissimum*, and he comes to the conclusion that *E. intermedium* should be regarded as a secondary species attached to *E. serratum*.

**Philonotis seriata.**‡—G. Dismier records the occurrence of *Philonotis seriata* in Asia, and cites three N.W. Indian examples found in herbaria under the names *Bartramia falcata* and *B. subulosa*. *Philonotis seriata* is characterized by having the leaves wide at base, oblong, acute at apex, margin geminately dentate throughout; cells quadrate or shortly rectangular, with papilla central; nerve strong, ferrugineous. *P. falcata* has leaves oblong lanceolate, with margin serrate throughout, cells with the papilla at their upper angle, nerve narrow, yellowish and more or less excurrent. It is an interesting fact that in Asia the species with geminate teeth are very few, while those with simple acute teeth are in the majority. However, in Europe the contrary holds good. Further, the great variability of structure of the species of *Philonotis* argues in favour of the greatest prudence in the creation of new species.

**Philonotis falcata and P. Turneriana.**§—G. Dismier has closely studied the polymorphic *Philonotis falcata* and *P. Turneriana* which have a distribution extending from the Himalayas to Corea and the Philippine Islands; and comes to the conclusion that many new species have been unadvisedly created out of them. He would therefore reduce the following into synonyms of *P. falcata* Brid., *P. macrocarpa* C.M., *P. carinata* Mitt., *P. ruficuspis* Besch., *P. japonica* Besch., *P. Giraldii* C.M., *P. angularis* C.M., *P. Tsanii* C.M., *P. tomentosula* C.M., *P. Bodinieri* Card. et Thér., *P. laxiretis* Card., *P. orthostichacea* C.M., *P. mutica* C.M. Also to *P. Turneriana* Mitt. he would reduce *P. laxifolia* Broth., *P. simlaensis* Schimp., *P. pilicalyx* C.M. And further he would regard *P. Turneriana* as but a sub-species of *P. falcata*, differing only in the possession of a nerve longly attenuated into a piliform acumen. *P. falcata* and its sub-species have leaves oval-lanceolate, acuminate, spirally arranged, carinate, concave, with margins flat and simply dentate all round, with cells quadrate or shortly rectangular and papillose above, and with the nerve moderately thick and percurrent or excurrent in *P. falcata*, but longly piliform in *P. Turneriana*.

* Trans. Roy. Soc. South Africa, iv. (1914) pp. 1–6 (2 pls.).
† Bull. Soc. Bot. France, lix. (1912) pp. 731–6 (figs.).
‡ Bull. Soc. Bot. France, lix. (1912) pp. 175–7.
§ Bull. Soc. Bot. France, lix. (1912) pp. 482–9, 555–9.

## Thallophyta.

### Algæ.

(By Mrs. E. S. Gepp.)

**Flagellates and Algæ.***—A. Pascher gives his views on the connexion between Flagellates and Algæ. He has studied the subject for ten years, and he finds as his most important result that algæ are linked on to almost all the series of coloured flagellates—or, from the point of view of the phylogenetic origin of algæ from flagellates, that all the series of coloured flagellates (with two exceptions) lead in an absolutely parallel manner to forms of cellular algæ. We have thus several phylogenetically different series of brown algæ and of green algæ. It does not, however, follow from this conclusion that all the differently organized types in all these series of algæ were developed simultaneously. Speaking generally, the following possibilities of development in all the series of coloured flagellates have been realized: 1. The further development as a flagellate. 2. The development to rhizopodial forms (Rhizopod-organization). 3. The formation of principally palmelloid forms (Tetrasporal organization). 4. The formation of cellular forms (Protococcal organization), which in time attains the power of cell-division; and finally (*a*) nuclear-division goes mainly hand in hand with cell-division (monergid series, Ulotrichadæ-organization), or (*b*) nuclear-division is not coupled mainly with cell-division (polyenergid, Siphonales-organization). This conclusion of the author is elaborated, and explained by tables.

**Vegetation of the Adriatic.**†—J. Schiller writes a general account of the vegetation of the Adriatic, having been official botanist to the Austrian-Italian Investigation. Below 200 m. there is no sessile algal flora, but on surfaces above that depth vegetation fastens itself wherever it is possible. The author defines three regions according to depth. 1. The littoral zone from high tide to the ebb line. 2. The sublittoral zone from the ebb line to a depth of 40 m. 3. Deep water. Though there are certain algæ which last throughout the year, most species are limited to a few months. Two main periods of growth occur, the larger from the beginning of February to the end of May, the second from the beginning of October to the middle of November. The intervals are resting periods. The reasons for this are uncertain. Diatoms predominate down to 200 m. Phytoplankton also reach to 200 m., but are most abundant down to 75 m.—Peridinieæ, Coccolithophoridæ, Diatoms, Flagellates, and Silicoflagellates. The growth-periods and the depressions of the pelagic flora correspond with those of the stationary flora. In quantity the pelagic is only about half as great as that of the Baltic near Kiel. On the other hand, the quantity of organisms is very large near Sebenico and in the regions influenced by the Po.

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 136–60.
† Urania, Wien, vi. (1913) pp. 382–6 (figs.).

**Plankton of St. Vaast-la-Hogue.***—L. Mangin writes a report on the plankton of the roadstead of St. Vaast-la-Hogue, which, with the already published report of the algæ of the locality by M. Hariot, completes the marine flora for the district. The plankton was examined continually during five consecutive years, 1908–1912. The method of examination has been described in a previous paper, but in the present report the author corrects an error. He was led to believe that Peridinieæ were very rare at St. Vaast, but owing to improved methods of examination he has now arrived at a more just estimate of their proportion. Lists of species collected in the different months of each year are given, with indications as to their number, the time of collecting, temperature of air and water, weather, etc. Then follows a section devoted to special observations on the different species, critical notes on structure, form, distribution, etc. Almost all the hauls were made on the surface, since the sea-bottom lies at a depth of not more than 15–20 m. below low tide, and the author did not consider that a regular investigation of that depth was worth making. A chapter on general observations and conclusions deals with the annual variations of the volume of plankton, the variations of the succession of species, etc. The volume of plankton is very poor in winter, from the end of November to March or April. It then increases and reaches a first maximum in May or June. A decrease takes place between June and September, followed by the most important maximum in October and November. The details of volume and of variation are shown by means of charts, as also the occurrence of each species with its volume in the different years. The author concludes that the plankton flora of St. Vaast is a neritic one, formed by the invasion of oceanic forms and open to the penetration of arctic or boreal species. It is a flora of bays, which comprises some neritic temperate species and some arctic ones, narrowly localized and become endemic, apart from any irregular additions by means of currents from the North Sea.

**Microfauna of the Plitvic Lakes.**†—I. Krmpotic made an examination of the plankton of the Plitvic lakes in September and October, 1912. The phytoplankton predominated over the zooplankton. In the Proscansko Lake, *Fragilaria crotonensis* predominated markedly over all other species. In the month of June only is *Asterionella formosa* var. *gracillima* the most abundant. The author noticed two types, 105 $\mu$ and 70 $\mu$ respectively, the latter being commoner in October. *Dinobryon* and *Cyclotella* occurred in large quantities in October. The winter form of *Ceratium cornutum*, with three horns, was not so frequent as the four-horned summer form. The number of Chroococcaceæ is not inconsiderable. Enough work has not yet been done to make a biological classification of the lakes possible. The paper is in the Croat language.

**Colouring of Fresh-water by Algæ.**‡—E. Naumann writes of a water bloom, caused by masses of *Trachelomonas volvocina* Ehr., which

* Nouv. Arch. Mus. Hist. Nat. Paris, 5 sér., v. (1913) pp. 147–241 (figs. and charts).

† Glasnik Hrvatskoga prirodosl. drustva xxv. No. 1 (1913) pp. 1–29.

‡ Bot. Notiser, 1913, pp. 249–63.

colours the water a yellow chocolate-brown. He gives the quantitative analysis according to Kolkwitz's methods. In some water in the Botanical Garden at Lund, he records plankton-formation of about 500,000 per c.cm., of which *T. volvocina* was present in a proportion of 160,000 per c.cm., and *Chrysococcus porifer* Lemm. was twice as plentiful. The other organisms were in smaller quantity. The principal colouring agent was *T. volvocina.*

**Algal Flora of Traunstein and the Chiemgau.***—P. E. Kaiser publishes an account of the algal flora in the neighbourhood of Traunstein and the Chiemgau in south-east Bavaria. This first list records 173 species and varieties, of which 44 are new for Bavaria. Very little has been known of the algæ and plankton of that district.

**Diatoms of Surian.**†—P. Greguss describes the diatoms from two mountain tarns, the "Meeraugen," of the Siebenburg Alps of Kudsir. They lie at a height of 1800 m. and 1900 m. respectively. Some years ago 156 species, including three new ones, were collected from one of the tarns and worked out by Quint; they are published for the first time in the present paper. From the other 187 species are recorded, 67 being new. Of these two collections only 19·2 p.c. are common to the two tarns. The species are principally Alpine in character. It is an interesting fact that 95 p.c. of the bottom of one tarn consists of diatomaceous material, considered by J. Pantocsek to be fossil. An opinion of Scherffel's is quoted to the effect that the Echinopyxa are probably cysts of Chrysomonads.

**Tetracyclus.**‡—F. Hustedt writes some critical studies on the structure and systematic arrangement of known forms of the genus *Tetracyclus*. In the first part he gives the history of the genus, with its synonyms and the diagnostic characters. The second part contains the systematic account. The species have great power of variation, especially *T. ellipticus* Grun., to which the author pays special attention. Diagnoses of the species are given, with complete synonymy, habitat, and distribution; also a key for the determination of the species.

**Russian Desmids.**§—A. J. Lobik records fifty-two species, with varieties, of Desmidiaceæ from the district of Cholm in the government Pskow. Two new forms of species are described. The paper is in Russian, with a German résumé.

**New Oscillariaceæ.**‖—G. Schmid writes on three new species of Oscillariaceæ, giving full accounts of their structure and comparing them with already known species. Important notes on other species are also given, and a figure of *Oscillatoria numidica*, hitherto unfigured.

* Ber. Bayer. Bot. Gesell. z. Erforsch. d. Heim. Flora, xiv. (1914) pp. 145–55.
† Bot. Közlemenyek, 1913, pp. 202–25 (with German abstract in Mitteil. f.d. Ausland, p. 61) (2 pls.).
‡ Abh. Nat. Ver. Bremen, xxiii. (1914) pp. 90–107 (1 table and 1 text-fig.).
§ Bull. Jard. Imp. Bot. St. Pétersbourg, xiii. (1913) pp. 65–86.
‖ Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 122–30 (figs.).

**Fresh-water Algæ in Culture.***—R. Chodat publishes a full account of his researches into the life-history and polymorphism of many species of fresh-water algæ, thus supplementing his "Étude Critique" which appeared in 1909. In an Introduction he gives a definition of a species of the lower algæ, pointing out the frequent impossibility of identification, the physiological and morphological characters to be taken into account, and the changes which take place in the cells and cell-colonies under cultivation. The author then describes in detail the behaviour of many and various species when cultivated. In another section a large number of different lichen gonidia and allied species under culture are described. A special chapter treats of the gonidia of *Verrucaria*, which do not belong to *Pleurococcus*, but to a new genus, *Coccobotrys*. *Protococcus viridis* is discussed, and other species. Finally the author offers certain criticisms to Wille's systematic arrangement of the Green Algæ, as published in Engler and Prantl's Naturlichen Pflanzenfamilien, as a result of his studies.

**Unicellular Algæ.**†—Amélie Hoffmann-Grobéty describes her experiments in the culture of certain small green algæ. *Raphidium minutum* and *Botrydiopsis minor* were examined in regard to the effect on them of various culture-media. *Chlorella cœlastroides* Chod. and *C. rubescens* Chod. were cultivated in order to watch their behaviour and to establish the differences between them. The results are described.

**Red Snow.**‡—L. Wittmack drew attention at a meeting of the Deutscher Botanischer Gesellschaft in 1913 to a loose plate in his possession representing rocks in Baffin's Bay covered with red snow. It was shown to be a plate from a child's book copied from the original of Captain John Ross. The description from Ross's "Voyage of discovery made in H.M. ships 'Isabella' and 'Alexandra,'" London 1819, is quoted in the words of the German translation, Leipzig 1820. Ross recognized the minute red bodies as being a vegetable product, formerly named *Uredo nivalis*.

**Gonidia of Cladonia.**§—M. Korniloff has grown under culture the gonidia of *Cladonia pyxidata* and *C. furcata*, and establishes their identity as two different species of *Cystococcus*. Details of both are given.

**Chloronium mirabile.**‖—J. Buder describes a new and peculiar organism found by him in the water tanks of the Leipzig Botanic Garden and other similar localities. These small green bodies resemble small forms of *Chromatium*, with which indeed they are often found. They have the shape of a fairly thick cylinder, with rounded ends which

* Beitr. z. Kryptog. der Schweiz. Bern: Wyss, 1913, Band iv. Heft 2, 266 pp. (9 pls. and 201 figs.).
† Bull. Soc. Bot. Genève, sér. 2, iv. (1912) pp. 73–110.
‡ Ber. Deutsch. Bot. Gesell., xxxi. (1914) Suppl. pp. (35)-(37).
§ Bull. Soc. Bot. Genève, 2 sér., v. (1913) pp. 114–32.
‖ Ber. Deutsch. Bot. Gesell., xxxi. (1914) Suppl. pp. (80)–(97) (1 pl.).

are sometimes slightly curved. The length of a medium-sized specimen is 5 $\mu$, the breadth 2–2·5 $\mu$. It is possible in longer specimens to distinguish a slight constriction in the middle, standing out as a light cross-line, and this indicates the beginning of cross-division. Sometimes two halves are found which have parted from one another but are still not wholly disconnected. A further likeness to *Chromatium* is found in the granular contents, and in the manner of movement, which is lengthwise and accompanied by continual revolution round the axis. Other analogies with *Chromatium* are described. A detailed account is given of *Chloronium mirabile* both on a light and on a dark field, and as a stained object. The result of these investigations shows that *Chloronium* is not a one- but a many-celled organism, consisting of a colourless central cell with polar cilia and numerous green peripheral cells. Various experiments were made to determine the relationship of these two component parts of the organism, and the possibility of their separate existence. The author found that the green cells are capable of living for some time separately, and the central cell for a short period. He therefore concludes that *Chloronium* represents a new type of symbiotic connexion. Finally, the author gives information as to its habitat and distribution. It is fairly common in suitable localities and conditions.

**The Genus Cylindrocystis.***—J. Lütkemüller publishes a revision of the genus *Cylindrocystis*. It has no special and exclusive characteristic. The structure of the cell membrane and its behaviour during cell-division and conjugation decide whether a species belongs to the placoderm or saccoderm Desmidiaceæ, and in the latter case, again whether it belongs to the Gonatozygeæ or to the Spirotænieæ. The chlorophores of *Cylindrocystis* resembles those of *Netrium*, but are smaller and less regular. *Cylindrocystis* has a gelatinous sheath, which in *Netrium* is wanting. No placoderm species can be placed in *Cylindrocystis*, therefore, only *Penium* and *Cosmarium* are left to be considered; and the author points out the distinguishing characters which separate these genera from *Cylindrocystis*. He considers that it contains fourteen good species, and he transfers five other species to *Cosmarium*.

**Stigonema.**†—F. N. Blanchard describes in detail a new species of *Stigonema*, *S. anomalum*, from Massachusetts. It is a typical *Stigonema*; and it is allied to *Fischerella* and *Hapalosiphon* by certain characters set forth by the author. It is sufficiently like *Stigonema ocellatum* to be confused with that species, but can be distinguished from it by seven different characters, which are given Another new species of *Stigonema* is here described, *S. medium*, from the same locality. This plant shows characteristics of *Hapalosiphon* as well as of *Stigonema*. A table of comparison showing the chief characteristics of these two genera and *Fischerella* is given, founded on reproduction, width of filament, length of hormogones, number of rows in filaments, style of branching, sheath, cells, heterocysts. *Hapalosiphon* grows free-floating

* Verh. k.k. Zool. Bot. Ges. Wien, lxiii. (1913) pp. 212–30.
† Tuft's Coll. Studies, iii. (1914) pp. 117–24 (1 pl.).

in fresh-water. *Fischerella* grows in moist earth, on wet stones, and in hot springs. *Stigonema* grows free-floating or on wet stones. It is usually much wider than either of the other two genera; and is often composed of several rows of cells, which are usually more rounded than in *Hapalosiphon*.

**Gonium pectorale.***—O. Plümecke discusses the nutrition of the Volvocaceæ, and describes the water-bloom of *Gonium pectorale*. The latter occurred in an aquarium at Neukölln, and showed 300–400 colonies in 1 c.cm. of water. The local conditions and the accompanying organisms lead to the conclusion that *G. pectorale* when developed in masses, absorbs organic substances for its nutrition, and is therefore "mesosaprob." The decline of *Gonium* was accompanied by a decrease in the other organisms. Myxotrophy is a widely distributed mode of nutrition among many of the Volvocaceæ in a natural state, as has been shown by ecological investigations as well as by laboratory experiments.

**Eudorina elegans.†**—W. Conrad writes on *Eudorina elegans* Ehr., and gives details of its structure which have been hitherto unknown. The cœnobium possesses a marked longitudinal axis; it is ellipsoidal and slightly truncate at the farther end. Its thirty-two cells lie in five series across the axis of the cœnobium, consisting of four at each of the two poles and eight at the equator. The size of the eye-spot decreases greatly from the near to the farther cell-series. At the base of the flagellum was observed a common membrane-funnel, but no thickening. The structure of the sheaths strongly resembles that of *Volvox*; it is composed principally of pectin compounds. The single cells are connected with one another by 2–4 delicate strands of protoplasm, which are only visible after staining.

**Cladostephus.‡**—C. Sauvageau publishes the third and last volume of his great work on the Sphacelariaceæ. In it he deals with the genus *Cladostephus*, its morphology, structure, distribution, with the same detail as was shown in the two previous volumes. The European species *C. verticillatus* and *C. spongiosus* are first discussed, and then the exotic species, of which the author recognizes three as being good, and two as "species inquirendæ." The remaining published names are regarded as synonyms and placed accordingly. Diagnoses are given. The last chapter discusses the different groups of Sphacelariaceæ, as defined and treated in the body of the work. They are founded on the mode of origin of the branches and the presence of secondary growth, a system which conforms to the affinities of the species among themselves. The whole work is fully illustrated by text-figures. The various chapters have appeared from time to time in the *Journal de Botanique* in much the same form as here published.

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 131–6.
† Recueil Inst. Bot. L. Errera, ix. (1913) pp. 321–43.
‡ Remarques sur les Sphacelariacées. Bordeaux: 1914, fasc. iii. pp. i xii, 481–634 (figs.).

**Spores on Sexual Plants of Nitophyllum punctatum.***—N. Svedelius writes on a specimen of *Nitophyllum punctatum*, which is interesting in connexion with his own and Yamanouchi's investigations as to alternation of generations in Florideæ. On the material in question he found non-sexual spores growing on the same plant as the cystocarps, and from their respective positions he considers it clear that a distinct correlation exists between cystocarps and spores. They arise always in proximity to each other, but if the cystocarps develop the asexual spores are not formed completely; if the trichogynes remain unfertilized the asexual spores develop. An examination of the asexual spores shows that they agree absolutely in their histological development with normal tetraspores. They also behave like those bodies in forming a number of nuclei, of which all but one degenerate in the course of development. In spite of the material having been unsatisfactorily fixed, the author was able to determine that no reduction by division takes place. The spore remains undivided, has one nucleus and constitutes a monospore. It has the same number of chromosomes as a tetraspore. The author concludes, after examining the cystocarps, that the plant in question is a haploid female plant with normal cystocarp development and fertilization, and the spore formation occurring on a female plant takes place without reduction by division. The spores are therefore haploid monospores. In the normal tetrasporangium four haploid tetraspore-nuclei arise from the one successful and conquering nucleus. In the monospores here described the conquering nucleus is itself haploid and therefore remains undivided. The views on alternation of generation in Florideæ are therefore unaffected by the phenomenon here described. The author discusses possible cytological conditions in plants which bear cystocarps and tetraspores, and he finally says a few words on the "paraspores" of Florideæ.

**Delesseria sanguinea.**†—N. Svedelius discusses the development of the cystocarp in *Delesseria sanguinea*. He sums up his results as follows: An examination of the histological development of the carpogonial branch shows that its position, as also that of the trichogyne, is determined as soon as the first division in the carpogonial leaf takes place, after the differentiation of the first pericentral cells. The carpogonial branch is sometimes almost intercalary, since its second and incomparably largest cell is the first formed. This cell then cuts off the first, third and fourth cells fairly quickly, sometimes almost simultaneously. The cell-nuclei of the carpogonial branch have generally twenty chromosomes. This can be most clearly distinguished in the second cell, which possesses the largest nucleus. The carpogonium has originally one nucleus. This divides then into the definite carpogonium nucleus, or egg nucleus, and the trichogyne nucleus. The latter wanders out into the trichogyne and dissolves. The auxiliary cell is formed from the "stalk"-cell after fertilization. Before fertilization a few "sterile" cells are formed from the "stalk"-cell, which immediately after fertiliza-

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 106–16 (1 pl. and 1 fig. in text).
† Svensk. Bot. Tidsskr., viii. No. 1 (1914) 32 pp. (2 pls. and figs. in text).

tion grow quickly, fill up the young cytsocarp cavity, and become mucilaginous and dissolve. The nuclei of these cells are haploid with twenty chromosomes. The work of the sterile cells is probably to form room for the young gonimoblast, and then to protect it by the formation of mucilage. The gonimoblast has nuclei with forty chromosomes, which is therefore the same number as the chromosomes of the carpospores. They are consequently diploid. The same number of chromosomes has been demonstrated before by the author in the somatic nuclei of the tetraspore-plant, and he therefore infers from cytological reasons that tetraspore-individuals arise from the carpospores. The view concerning alternation of generations in *D. sanguinea* already arrived at by the author, which agrees with the theory set forth by Yamanouchi for *Polysiphonia*, thus finds further confirmation as a result of a complete examination of the entire developmental cycle.

**Marine Algæ.***—A. Mazza continues his critical notes on the species of *Grateloupia*, and gives descriptions of the morphology and finer structure of five typical species.

## Fungi.

(By A. Lorrain Smith, F.L.S.)

**Study of Nectriella.**†—Josef Weese discusses the place and the limitation of this genus. He recognizes as belonging to it species with perithecia sunk at first in the tissue and then emergent and with two-celled spores. It thus includes the forms placed by Saccardo in *Charonectria*. Weese then proceeds to give detailed descriptions and microscopic characters of the species that show the above characters, with a discussion of the synonymy and of allied forms or of species that have been confused with them. He contrasts, for instance, *Nectriella luteola* with *Nectria graminicola*. Recent discoveries have proved that the latter is the perfect fruiting stage of *Fusarium nivale*, a destructive parasite of winter wheat and rye. Some *Nectriæ* that are parasitic on *Peltigera canina* are discussed and compared, with which is associated the conidial form genus *Illosporium*. Weese has established and described very fully fifteen species of *Nectriella*.

**New Endomycete.**‡—P. C. van der Wolk has studied the disease of "yellow-grains" in rice, and he succeeding in isolating a fungus which he has determined as *Protascus colorans* g. et sp. n. It has the property of changing the grains to a yellow, orange, or brown colour. The fungus forms globose asci containing two to many irregularly shaped brown spores, which are either one septate or many celled. No sexual fertilization was observed. Wolk was successful in reinfecting

* Nuova Notarisia, xxv. (1914) pp. 57–77.
† Ann. Mycol., xii. (1914) pp. 128–57 (figs.).
‡ Mycol. Centralbl., iii. (1913) pp. 153–7 (1 pl.). See also Bot. Centralbl., cxxv. (1914) pp. 564–5.

sound grains with the organisms and reproducing "yellow-grains." He recommends care in keeping rice dry as a protection against the disease.

**Studies of Dothideaceæ.***—F. Theissen and H. Sydow have made a study of the published genera and species of this family of Pyrenomycetes. Many imperfectly developed species have been deleted and others have been placed in new genera: (1) *Trichodothis*, the first new genus, has a superficial stroma. The terminal cells of the hyphæ on the margins of the perithecia grow out and form a crown of radiating filaments. One species only, *T. comata*, is placed in the genus; (2) *Phragmodothis* is also a new genus with an erumpent stroma, the spores are dark brown and 3-septate: (3) *Trabutiella* is similar to *Trabutia*, but without paraphyses; (4) *Pyrenobotrys* is without a stroma, or reduced to a loose mycelium which traverses the matrix: (5) *Stalagmites*, based on *Dothidea tumefaciens*; (6) *Rehmiodothis*, which is similar to *Trabutia*, but with hyaline spores; (7) *Phæodothiopsis*, based on *Dothidea Zollingeri*; and (8) *Parmulina*, very like *Parmularia*, but the stroma attached at the centre.

**Relationships of Florideæ and Ascomycetes.**†—A long discussion of the different modes of sexual development in Florideæ, Ascomycetes, and Lichens, is published by B. O. Dodge. The paper is well illustrated by figures in the text, either original or taken from the publications quoted. Dodge gives in detail the history of the discoveries already made in connexion with the reproductive organs of Ascomycetes, laying emphasis on the formation and function of a trichogyne; he includes lichens in the survey. He cites the instances in which the trichogyne is branched: in Laboulbeniaceæ, in *Collema microphyllum*, in *Lecanora subfusca*, and in *Pyronema*. This trichogyne is contrasted with that of the red algæ which is a simple structure of constant type, being merely a prolongation of the egg-cell. The formation of the ascus is next discussed, and its morphological characters which constitute a difficulty in all attempts to derive the Ascomycetes from the Florideæ. Dodge, however, considers that the "Ascogenous hyphæ of fungi and lichens, gonimoblasts of the *Batrachospermum* type, ooblastema filaments, and even those fusions between cells of the ascogonium are all to be considered morphological equivalents." The form of the fruit is also considered, and Dodge suggests that the Discomycetes with an exposed hymenium may be more primitive than the Pyrenomycetes, which are permanently closed. The various types of formation are fully described and compared.

In conclusion, he looks to the future for further evidence, since "new data as to the morphology of the ascogonium and trichogyne are accumulating rapidly. Many lichens are provided with trichogynes, and where no such structure has been found, an ascogonium has generally been more or less clearly recognized. It is not improbable that further research will disclose many other interesting forms such as we now find in *Collema pulposum*, *Ascobolus carbonarius*, and *A. magnificus*."

A complete bibliography of the works consulted is added to the paper.

* Ann. Mycol., xii. (1914) pp. 176–94.
† Bull. Torrey Bot. Club, xli. (1914) pp. 157–202 (13 figs.).

**British Discomycetes.***—J. Ramsbottom has compiled a list of British Discomycetes, with a synoptic key of families and genera, on the lines of Boudier's work on this great sub-class of Fungi. The same writer has also published some notes on the History of the Classification of the Discomycetes. He gives the first records of the group which date back to very early times. Pliny speaks of a plant belonging to the mushroom genus which was known to the Greeks as *Pezica*. That name was given again by Colonna to cup fungi in 1606. It was altered to *Peziza*, the present rendering of the name, by Dillenius. Other forms were noted by successive botanists and new genera established. The present nomenclature of the group dates from Persoon. The modern systems of classification, of which there are a number, are passed in review down to the recent work of Boudier, who bases his two great divisions of Discomycetes on the mode of dehiscence of the ascus. The work of British authors is also described.

**Wintering of Mildews.**†—N. Van Poeteren has studied two diseases of mildew with reference to the carrying over of infection to a new year. The oak mildew, *Oidium quercinum*, he found, persisted as *Oidium* mycelium at the base of the new shoots where these were still enclosed in the bud scales. Poeteren was associated with Neger in this research, and they made use of potted plants of *Quercus pubescens*, but also in the open they found the bases of new shoots and leaves of *Q. pedunculata* densely infected. After a certain advance in growth, the leaves on these shoots are covered with new conidia and serve as centres of further infection. The apple mildew, *Podosphæra leucotricha*, also winters in the same way. The removal and destruction of the first infected leaves and shoots has given good results in the stamping out of the disease.

**Recent Researches on Laboulbeniaceæ.**‡—C. C. Tonghini gives an account of work done on the present state of our knowledge of this group of fungi. He gives an account of the workers in different countries who have devoted themselves to the study of these insect fungi, and gives a detailed description of their structure and mode of insertion in the host, discussing fully the question of parasitism, whether the fungus draws nourishment from the insect or is simply associated with it.

**Oidium of Ruta graveolens.**§—G. B. Traverso describes a mildew he found on *Ruta* in Italy, which differed very considerably from other species of the genus *Oidium*. The conidiophores are slender, occasionally branched, slightly asperulate, and bear conidia of varying form, either ovoid or ellipsoid, and truncate or acuminate at one or both extremities. They are of large size, and the terminal conidium is usually fully developed before the others are differentiated. The fungus was found to

* Trans. Brit. Mycol. Soc., iv. (1914) pp. 343–404.
† Tijdschr. Plantenz., xviii. (1913) pp. 85–95. See also Bot. Centralbl., cxxv (1914) pp. 299–300. ‡ Malpighia, xxvi. (1913) pp. 329–44.
§ Atti Accad. Sci. Ven.-Trent.-Istr., vi. (1914) pp. 18–22.

be identical with *Oidium haplophylli* P. Magn. recorded from Palestine. From the characters given, Traverso concludes that the species belongs to the genus *Ovulariopsis*, and represents the conidial stage of *Erysiphe taurica*, which grows on plants of several different families.

**Development of Polystigma rubrum.***—The material on which this research was made by Wilhelm Nienburg was collected and fixed at intervals of fourteen days from the middle of July onwards to the middle of March. Many diseased leaves were kept under observation during the winter. During the autumn the leaves attacked by the fungus were plucked and destroyed before falling, and the disease by this means was stamped out, proving that infection was carried on by means of the ascospores and did not winter in the buds.

The archicarp begins to develop when the stroma has reached a considerable thickness. At that stage the cells of the plum-leaf are pushed apart by the hyphæ; the upper and lower epidermis are still intact, but the cells of the mesophyll are mostly killed. The archicarp forms a coil of darker coloured hyphæ rich in plasma contents. Certain hyphæ, sometimes considered as trichogynes, emerge from the stomata to the outer surface, but they are purely vegetative. The "coil" is formed of (1) a cell with several nuclei; (2) an elongate cell which contains only one large nucleus; the following cell is shorter but also uninucleate. The two cells next in the coil possess two small nuclei each, the remaining cells having a number of smaller nuclei. A nucleolus is conspicuous only in the large solitary nuclei. The end of the coil disappears in the vegetative tissue; no trichogyne was at that time formed. In every archicarp there were thus found in order (1) a long cell with many nuclei; (2) a long cell with a large nucleus; and (3) a short cell, also with a large nucleus. These stages were observed in material collected in the end of July or the beginning of August. Later in the season there were developed many-celled branches from the archicarp, considered by Nienburg as trichogynes. One branch was directed towards the leaf-stroma, but disappeared below the epidermis: another branch grew towards the upper surface of the leaf. Nienburg came to the conclusion that these branches took no part in fertilization.

The two important cells were the long multinucleate cell, and the neighbouring equally long cell with the one large nucleus. The former he considers as the antheridium, the latter the ascogonium. He found a thin area in the wall between the two cells even before the ascogonium had reached full development. Later there is an opening between the two, through which only one nucleus passes from the antheridium, easily recognized by its smaller size; later, it increases till equal with the female nucleus. The structure of these sexual nuclei and the changes they undergo are fully described. All the antheridial nuclei are similar, and therefore equally able to fertilize the female cell. Changes also take place after fertilization in the plasma of the ascogonium and in the neighbouring vegetative cells, which at once become more active. Then follows the degeneration of the other cells of the archi-

* Zeitschr. Bot., v. (1914) pp. 369–400 (17 figs.).

carp, until only the ascogonial cell is left, still retaining its characteristic spindle shape, and the two nuclei, which do not fuse in this cell. The development of the paraphyses and of the perithecial wall was also followed. The ascogonial cell was still recognizable by its plasma contents. Further nuclear development was difficult to follow, but Nienburg is in no doubt that conjugate division takes place. Ascogenous cells were frequently found in the young perithecium containing a pair of nuclei. As new ascogenous cells are formed, the plasma contents pass over into them, and nuclei left behind gradually degenerate. The final stages were not followed. A general review is given by Nienburg, and a criticism of the views of other workers on the cytology of the Ascomycetes.

As regards the spermogonia of *Polystigma*, the "spermatia" of which are now functionless, he suggests that these may be equally regarded as conidia which for some reason or other have degenerated. He is inclined to trace the evolution of the Ascomycetes back to the Oomycetes, and compares *Monoblepharis* with *Polystigma*.

**Studies on Yeast.***—Horace T. Brown has carried out a series of cultures to determine the relation of cell-reproduction to the supply of free oxygen. The facts which have been established experimentally with regard to the reproduction of yeast-cells in a nutrient liquid containing dissolved oxygen are summarized as follows. 1. When the available oxygen is limited to that initially contained in the liquid, the number of yeast-cells per unit volume tends to attain a maximum which is independent, or nearly so, of the number of cells of seed-yeast per unit volume, but is conditioned in the first instance by the initial amount of this dissolved oxygen. 2. Within certain limits of oxygen supply, the maximal reproduction is strictly proportional to the initial amount of the oxygen. 3. The rate of reproduction under these conditions is not logarithmic, but is a linear function of the time. 4. The dissolved oxygen does not remain as such in the liquid during the reproductive period, but is rapidly absorbed by the seed-yeast before cell-budding commences. The author also discusses the metabolism of the yeast-cell, with special reference to the thermal phenomena of fermentation. The paper is illustrated by numerous tables and diagrams.

**Ascosporic Condition of Aschersonia.†**—Hitherto this genus has been placed among the Sphæropsideæ, as the pycnidial condition only was known. Now Roland Thaxter has discovered the ascosporic fruits which place it definitely among the Hypocreaceæ. There are some forty species of this mostly tropical genus, and though they live on leaves, and are given specific names to indicate the kind of leaf they affect, they are really saprophytes on the honey-dew, and are thus entomogenous fungi. *Aschersonia* is often brightly coloured, and of soft consistence, but it is frequently blackened by accompanying *Capnodinæ*, which also grow on insect excreta. *Aschersonia turbinata*, the species

* Ann. of Bot., xxviii. (1914) pp. 197–226.
† Bot. Gaz., lvii. (1914) pp. 308–13 (7 figs.).

found by Thaxter on fruit, form small stromata, on which are developed pycnidia or perithecia. The latter are bottle-shaped cavities containing long slender asci with eight filamentous spores, at first cylindrical and continuous, but later divided by septa, as in *Cordyceps*.

**Studies of Microscopic Fungi.***—J. Beauverie has completed his studies of the "Muscardine" group, and has added a chapter defining and delimiting the genus *Botrytis*, by describing under different genera the species wrongly associated with it, such as species of *Spicaria*, *Beauveria*, etc. The type of *Botrytis* is the well-known species *B. cinerea*, with its groups of spores borne at the apex of special branching hyphæ. The author reviews and recapitulates Vuillemin's suggested classification of Hyphomycetes, which is based on the manner in which the conidia are borne on the hyphæ, whether directly or at the apex of a special sterigma.

**New Rhizosphæra.**†—The genus *Rhizosphæra*, one of the Sphæroidaceæ, was established by Mangin and Hariot in 1907. At a later date Maublanc placed in the genus a fungus frequently found on withered fir leaves, known as *Leptothyrium Pini*. A somewhat similar fungus was submitted to Bubak, and was determined *Phoma Pini*, as it occurs on the needles of *Picea*. He now places the fungus as *Rhizosphæra kalkhoffii* nov. nom. The pycnidia arise on all four surfaces of the needle in superficial rows. They have a flat base, and from the centre of the base is formed a stalk of elongate brown hyphæ, which penetrates the leaf through the stoma and broadens out after gaining entrance, then forms a knot of woven brown hyphæ. A diagnosis of the species is given.

**Effect of External Stimuli on Sporidia.**‡—W. Robinson carried out a series of experiments with the germinating sporidia of *Puccinia malvacearum* to test the effect of various stimuli such as light, etc. They proved to be negatively heliotropic, though in some other fungi and in *Botrytis poarum* no irritability to light was apparent. As regards moisture, the tubes formed on germination tend to grow out of a drop of water, but on gelatin they pierce the substratum. On contact, the tip of the germ-tube swells and becomes closely applied to the epidermal surface of the host or of non-susceptible plants. On the host-plant a growth from the swollen tip pierces the cuticle and outer cell-wall of the epidermis, and true infection takes place. There was no evidence of chemotropic influences radiating from a fragment of leaf laid on a drop of gelatin, nor any indication of positive chemotropism of the germ-tubes towards the normal host or of negative chemotropism of the germ-tubes towards fragments of non-susceptible leaves.

**Position of Sorus of Uredineæ on the Leaf.**§—F. Grebelsky has examined and experimented with a number of species of Uredineæ with

* Rev. Gen. Bot., xxvi. (1914) pp. 157–68 (figs.).
† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 188–90.
‡ Ann. of Bot., xxviii. (1914) pp. 331–40.
§ Verh. Schweiz. Naturf. Ges., ii. (1913) pp. 212–13. See also Bot. Centralbl. cxxv. (1914) p. 506.

regard to the side of the leaf on which they are habitually to be found. As that depends largely on the position of the stomata, their occurrence either above or below cannot be utilized as a systematic character. The uredosorus in every case examined by the writer was located below the stomata, and by closing these the formation of the sorus could be more or less prevented. If leaves that had stomata only on the under surface were turned round, sori were still formed on the morphologically lower side. On *Geranium pyrenaicum*, which has stomata on both surfaces, *Uromyces kabatianus* forms uredosori only on the under surface, but if these leaves are turned round, sori are produced both above and below. The case is somewhat different with teleutosori. Though in many instances these are located beneath the stomata, in others they have no connexion with them: thus in *Puccinia Ribis* the teleutospores emerge on the upper side, though stomata are found only on the lower.

**Uredineæ.***—J. Ramsbottom criticizes the nomenclature of Uredineæ as dealt with in recently published lists and books. A number of species have there appeared under two names; these he has corrected and has given the original name and synonymy with the references to the literature where they were first recorded, with notes descriptive of many of the species dealt with. Special attention is given to the genus *Phragmidium*, as there is much confusion in the determination and early descriptions of the different species.

**Culture Experiments with Merulius Spores.**†—C. Wehmer has already told of his failure to induce the germination of the spores of the dry-rot fungus. He has made another attempt with spores taken from a specimen growing in artificial conditions. He gives in detail the methods he followed and the contents of the media employed. The spores were entirely normal in appearance, but they were found to be incapable of germination, and the results (as before) were negative. Cultures were made not only in tubes but in hanging drops. After three weeks there was not the slightest sign of development.

**Imperfectly-developed Spores in the Agaricaceæ.**‡—A. D. Cotton has given special attention to spore-production in the higher Fungi. In all groups the size and shape of the spore is an important item in the diagnosis of the species except in the Hymenomycetes. In many of the genera the field-characters are sufficient to delimit the species without relying on spore-characters; in many the spores show little variation: they are, however, a useful supplementary means of determining species. Cotton gives an account of an examination he made of the spores shed on successive days from the gills of *Stropheria semi-globata*. Spore casts were taken from the same pileus on three successive days, and the last shed spores were not only paler in colour, but of much smaller size.

* Trans. Brit. Mycol. Soc., iv. (1914) pp. 331–40.
† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 254–6 (1 pl.).
‡ Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 298–300.

This result, however, was probably due to the unnatural laboratory conditions. In the open, the mature spores are practically uniform during the life of the sporophore.

**Fruit-body Mechanism of Bolbitius.***—A. H. R. Buller has already described the deliquescence of this fungus as being due to auto-digestion, which in *Coprinus* proceeds from below upwards on each gill, and so removing those parts of the gills which have become spore-free. Buller found that auto-digestion in *Bolbitius*, on the contrary, does not proceed from below upwards: it does not have any relation to spore-discharge but it is a post-mortem change. In this genus adjacent basidia develop and discharge their spores in succession—another distinction between it and *Coprinus*. He considers that the various fruit-body mechanisms for the production and liberation of spores being essentially different, the two genera really stand far apart, though the more obvious characters, such as habitat and deliquescence seem to place them together.

**Polyporaceæ of Ohio.**†—In his list of these fungi, L. O. Overholts includes the species of pored fungi, all except *Poria*, which is wholly resupinate. He gives keys both of genera and species. He finds that the colour of the internal tissue is one of the most constant gross characters of the plants. The presence or absence of a stipe, the hymenial configuration, etc., are also characters that are made use of. Measurements are given of the various parts of the fruiting body and in many instances microscopic details of pores, spores, etc. are added. An index to the species is appended.

**New Podoxons.**‡—P. Baccarini describes a *Podoxon* collected by Guido Paoli in southern Somalia. Dimensions of the various parts of the plant, form and colour of spores, etc., are given. The fungus proved to be a variety of an African species collected by Welwitsch (*P. mossamedensis*). Another series of specimens from the same locality was distinguished by the spiral markings on the stalk. It proved to be near to *P. loandensis*, differing only slightly in the method of dehiscence, and to some extent in the coloration. A specimen, more markedly different in the structure of the gleba, and in the colour and form of the spores, was made a new species and named *P. Paoli*. Diagnoses of variety and species are given.

**Corticium porosum Berk. and Curt.**§—E. M. Wakefield gives a description of this rare plant, the only British specimens received by the writer in recent years having been collected by W. B. Grove at Earlswood and Studley Castle, Warwickshire. The "pores looked as if little dew-drops had settled on the hymenium, which had in consequence contracted." In perfect condition the hymenium is quite smooth as in

* Trans. Brit. Mycol. Soc., iv. 2, pp. 235–8.
† Ann. Miss. Bot. Gard., i. (1914) pp. 81–155.
‡ Nuovo Giorn. Bot. Ital., xxi. (1914) pp. 241–6 (1 pl.).
§ Trans. Brit. Mycol. Soc., iv. (1914) pp. 341–2.

other species of the genus, and corresponds with a species from Westphalia, determined by Bresadola as *C. stramineum*. Berkley's name, though inapt, has priority.

**Observations on Pure Cultures of some Ascomycetes and Basidiomycetes.***—F. T. Brooks gives an account of culture work done in connexion with the larger fungi, and describes results obtained by himself in cultures of spores on wood. He grew *Chlorosplenium æruginosum* on ash-wood, and obtained mycelium which on blocks of ash and oak turned the wood entirely green. The chief factor in the colouring of the wood is the accumulation of lumps of a green amorphous substance in the different elements, especially in the cells of the medullary rays.

*Daldinia concentrica* was also grown from spores, and the conidial form was produced. In these cultures the hyphæ of the fungus penetrated the wood, being especially abundant in the vessels.

Several Basidiomycetes were cultivated, and sporophores were obtained in *Hydnum coralloides* and *Pleurotus ostreatus*. A culture was also made of *Ozonium*, from which sporophores were formed, probably *Coprinus radians*. The spores of the *Coprinus* were then grown and the mycelium of *Ozonium* was reproduced.

**Nitrogenous Food of Filamentous Fungi.**†—Widar Brenner has made an exhaustive study of this subject, chiefly with *Aspergillus niger*. He gives an historical sketch of the literature of the subject, and draws attention to the work done on the assimilation of free nitrogen, which he considers to be absolutely proved and of very great economic importance. The author's own researches are then given at great length as to the use made of compound nitrogen as nitrates, nitrites, and various other salts and acids, inorganic and organic. The results are given in tabular form. Among nitrogen compounds, nitrites can be used by certain fungi, but they must have the power of converting the substance into a nitrate. For those forms that flourish in acid media, nitrite is a poison, while for those that grow best in alkaline solutions, nitrite may be a valuable source of nitrogen supply. To the acid series belong the Perisporiaceæ, under which is included *Aspergillus niger*: to the alkaline series, the Mucorineæ.

**British Mycology.**‡—An account is published of the work undertaken during the year 1913 by the British Mycological Society. A spring foray was held at Dolgelly in the end of May, and over 260 species were collected or observed by the members during their excursions in the district. Two very rare species were met with: *Cordyceps myrmecophila*, once before collected at Bristol, and again in North

* Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 239–48.
† Centralbl. Bakt., xl. (1914) pp. 555–647 (1 pl.).
‡ Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 199–235.

Wales; and *Phoma quercella*, not previously gathered in Britain. A list of the species found is added.

The autumn foray was held at Haslemere, when officers were elected, various scientific papers read and discussed, and excursions made during the week to collect specimens, which were subsequently named and exhibited at the Haslemere Natural History Museum; 562 species of fungi were listed during the foray. Several species new to science or new to Britain were announced. There were also forty-two species of Mycetozoa recorded by Gulielma Lister.

The President of the year, A. D. Cotton, gave an address to the members on "Some suggestions as to the Study and Critical Revision of certain genera of the Agaricaceæ," which he considered from three points of view—(1) the need of such revision: (2) possible lines of investigation; and (3) some practical suggestions with regard to the methods of securing results. Cotton urges not only the importance of a sound knowledge of field-characters, but also the microscopic structure and the characters that are peculiar to the different genera and species, such as spores, cystidia, and gill-margins. In the latter structures René Maire recognized three types of systematic importance: "Homomorphic, when the edge is of the same structure as the surface or lateral face of the gill; heteromorphic, when, owing to the presence of cystidia or other elements, it is different; and sub-heteromorphic, when there is a preponderance of hairs or cystidia, which are already present in small quantity on the surface." Methods of work were suggested, and advice given as to the best lines on which to undertake investigations.

J. W. Ellis * publishes a series of microscopic fungi new to Britain, two of them parasitic leaf-species, *Septoria taraxaci* and *Glœosporium loniceræ*, being new to science. Diagnoses are published of all the species, with critical explanatory notes.

A new species from Devonshire, *Pleospora hepaticola*, is described by W. Watson.† He found the perithecia on the leaves of liverworts. The species is akin to *P. muscicola*, which grows on the moss *Bryum pendulum*, but it differs in spore and other characters.

J. S. Bayliss Elliott ‡ gives an account of the growth and form of a new variety of microscopic fungus, *Sepedonium mucorinum* Harz. var. *botryoides*. It forms a dense pale-buff mycelium in culture. The conidiospores are of varying lengths and are usually branched; the conidia are large, at first smooth, then warted. The species is recorded as growing on various Mucors. The variety did not seem to be parasitic.

Carleton Rea § contributes a paper on "New and Rare British Fungi," chiefly the larger Basidiomycetes and Ascomycetes. Diagnoses are given of the species which are new to this country. One species, *Clitocybe albocinerea* Rea, is new to science. It has been found in three localities, in Hampshire, Shropshire, and Worcestershire. Copious critical notes accompany the diagnoses. The paper is well illustrated by

* Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 292–5.
† Trans. Brit. Mycol. Soc., iv. 2 (1914) p. 295.
‡ Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 296–7 (1 pl.).
§ Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 307–17 (3 pls.).

two coloured plates, drawn by Mrs. Carleton Rea, and by one photographic plate, the latter of *Trametes sinuosa*, which among other distinct characters possesses a very sweet smell.

A list of "New or Rare Microfungi" is contributed by A. Lorrain Smith and J. Ramsbottom.* Many of the species new to science or to Britain were collected and forwarded by D. A. Boyd. The list includes a number of species that are economically important as causing plant diseases, such as *Phytophthora erythroseptica*, discovered by Pethybridge as the cause of Pink-rot in potatoes. Several species are republished from the Scottish Naturalist for 1889, the types of which are preserved in the Phillips Herbarium in the British Museum. The genera added to the British flora are *Lamprospora*, *Pachydisca*, and *Hyaloscypha* (Discomycetes), and *Chætospermum* (Hyphomycetes). There are several new species described.

**Record of Cytological Work.**†—J. Ramsbottom has reviewed the work done on the cytology of Fungi during the year 1913. There has been great activity in this branch of research in all the different groups. The writer takes each group in turn, and gives a history of the discoveries made, and the theories and discussions of the different workers. No finality seems to be reached in any branch. A bibliography of the papers studied is given by the writer.

**Resistance of Oak-wood to the Attack of Dry-rot.**‡—C. Wehmer records the results of experiments made by him on the comparative resistance to attack from *Merulius* of oak-wood and pine. The planks of oak were mostly of hard heart-wood, and were exposed to the action of the fungus in conditions favourable to its development. The fungus grew vigorously and spread over the wood without destroying it. It remained hard and practically uninjured. Planks of pine-wood exposed to the same conditions were rendered quite soft before the end of the experiment. Wehmer discusses the question of the immunity of certain woods, and especially the tannin content. He concludes that, though many observations have been made, nothing definite is known as yet as to why pine-wood is so easily destroyed by fungi.

**Influence of Light on Fungus-development.**§ — Adalbert Blochwitz cites the discovery by Wehmer of a species of *Aspergillus* of giant dimensions which depended on abundant light for its development. He insists that such abnormal forms are laboratory growths and could not easily be produced in natural conditions. He also suggests that some of the larger forms of moulds recorded from tropical regions may be simply abnormal developments of familiar species. How far these size-characters are hereditary has not been determined.

* Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 318–30.
† Trans. Brit. Mycol. Soc., iv. 2 (1914) pp. 249–91.
‡ Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 206–17.
§ Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 100–5 (2 figs.).

**Fungi from Formosa and Japan.***—Papers on the fungi of these countries are published by H. and P. Sydow. From Formosa, which is almost a new territory as regards fungi, a large number of microscopic forms have been determined, most of them species of Uredineæ belonging to different genera, many of them on plants on which rusts have not hitherto been recorded, are listed as new species. A fungus agreeing morphologically with *Tubercularia* was found growing on living leaves of *Rhois semialata*.

The second paper † deals with fungi from north Japan, also microscopic species, many of them Uredineæ, of which two forms are new: *Gymnosporangium Yamadæ*, the telentospore stage having been detected for the first time on branches of *Juniperus chinensis*; and *Coleosporium Fauriæ*, a new species; uredospores and telentospores are described. A new genus of Pyrenomycetes is described, *Nematostoma*: the perithecia are beset round the ostiole with long hairs; the spores are clavate, hyaline to brown, and pluriseptate: the pycnidial form was also found. The fungus was parasitic on leaves of *Artemisia*. Several new species of Deuteromycetes are also described.

**New Microscopic Fungi.**‡—H. and P. Sydow describe a series of new forms from East Africa, the Philippine Islands, Brazil, etc. There is one new genus, *Theissenula*, a Pyrenomycete which forms a thin subiculum bearing pluricellular coloured conidia and perithecia, with hyaline septate spores and no paraphyses.

Bubak has given a list of fungi from the Tyrol and Istria, microscopic species, many of which are new. *Basilocula*, a new genus of Melanconiaceæ, forms a stroma under the epidermis, from which the conidiophores are developed, bearing filiform continuous hyaline spores. *Cystodendron*, a new Hyphomycetous genus with one species, parasitic on the leaves of *Quercus lanuginosa*; it forms chains of minute conidia. *Piricauda*, also parasitic, has acrogenous pyriform very dark muriform conidia. Still another new genus, *Verticilliodochium*, forms sporodochia with subparallel hyphæ and verticillate acrogenous sterigmata; the spores are oblong, simple and hyaline.

**Plant Diseases.**—A. Prunet § discusses the fungi that give rise to a straw-blight in France, generally known under the name "piétin." The base of the haulms is invaded and the plant is destroyed. Three different fungi have been found on the diseased stalks—*Ophiobolus graminis*, *O. herpotrichus*, and *Leptosphæria herpotrichoides*. In Central Europe, and more especially in Germany, *O. herpotrichus* is chiefly responsible for straw-blight in wheat and barley, while *Leptosphæria herpotrichoides* produces the disease in rye. It has been stated that oats are immune to *Ophiobolus graminis*, but may be attacked by *O. herpo-*

* Ann. Mycol., xii. (1914) pp. 105–12.
† Ann. Mycol., xii. (1914) pp. 158–65.
‡ Ann. Mycol., xii. (1914) pp. 203–20 (1 pl.).
§ Comptes Rendus, clvii. (1913) pp. 1079–81.

*trichus*. Each straw-blight should, however, be studied independently of the others.

L. Beille* has written an account of the diseases that affect the cocoa-tree in various countries. He notes that wounded trees are more liable to attack than sound trees, and that in this case the fungus penetrates more quickly and more deeply. He also states that saprophytic fungi on the trees already diseased may become true parasites. The diseases are divided into two series: those that are confined to leaves, stems, fruit, etc., and those that attack any part of the plant. Among the latter he signals "die-back" disease, due to the Pyrenomycetous fungus *Lasiodiplodia Theobromæ*, which attacks stems, roots, and fruits; it is propagated by the spores, which germinate easily and produce a dark-coloured felted mycelium. When the roots are attacked the trees die very soon. If branches are infected the disease works back towards the tree-trunk. The author recommends burning the diseased trees, the application of quicklime to the roots, and the tarring of wounds. Another severe malady, canker, is due, according to Beille, to the combined action of *Phytophthora* and *Nectria*. The fruits are very specially affected by canker, and when diseased ought to be collected and burned.

The author also describes a witches' broom, due to *Exoascus Bussei* in one country, in another to *Colletotrichum luxificum*. The latter fungus also causes hardening of the fruits. Diseases of the trunk are caused by species of *Corticium*, *Marasmius*, etc.; those of seedlings by *Ramularia necator*. The roots are damaged by *Hymenochæte*, and the fruit by *Colletotrichum*, etc.

L. E. Melchers † publishes a preliminary report of a serious disease of raspberries in America, called "raspberry curl," or "yellows." The disease does not, as a rule, make its appearance until the second year after planting, and is visible in the stunted or dwarfed condition of the plant. The canes and leaves are not withered or blighted by this disease. The leaflets affected become darker green and are noticeably revolutely curled. The severity of curl and the variations and intensity of colour depend very greatly on soil and climatic conditions. Hot and dry weather particularly favour the disease. The fruit produced is generally so small and poor that it is not worth picking. Melchers found various fungi in old crowns, but he was not able to connect them with the disease, and so far he has been unable to find any definite organisms causing the injury. He recommends the removal and destruction of plants affected with the curl, as they are in any case worthless for the production of marketable fruit.

A communication has been received by the Board of Agriculture ‡ from Jakob Eriksson, giving his experience in the sterilizing of soil infected with wart-disease of potatoes. Circumscribed plots were infected with small pieces of diseased potatoes, and after some weeks the soil in certain of the plots was watered with a solution of commercial

* Journ. Agric. Tropic, 1913, pp. 167–72, 193–7.
† Ohio Naturalist, xiv. (1914) pp. 281–8.
‡ Journ. Board Agric., xxi. (1914) pp. 135–6.

formalin and water (1 : 100), 10 litres of the solution being applied per square metre. The watering was done about two weeks before healthy tubers were planted. The plants on all the plots grew normally and vigorously, and the potatoes were lifted in September. It was then found that on the disinfected plots there were no diseased tubers; on all untreated plots there was more or less of disease. Ericksson desires that experiments should be tried in England, as it seems probable that this destructive disease might be eradicated in gardens where rotation of crops for a lengthened period is impossible.

E. J. Butler and A. Hafiz Khan * publish some new diseases that have been found attacking sugar-cane in India. They are due to various fungi belonging to the Fungi Imperfecti: *Cephalosporium sacchari* sp. n., which they call "wilt"; *Hendersonia sacchari*, which causes a "collar rot"; and *Helminthosporium sacchari* sp. n., which gives rise to what they term "Helminthosporiose." In the latter case it is the leaves that suffer, red spots being produced which run together and form streaks.

## Lichens.

(By A. Lorrain Smith, F.L.S.)

**Zoospores of Lichen Gonidia.**†—The formation of zoospores in gonidia which were isolated from the *Physcia* thallus was observed and described by Famincyn and Baranetzky in 1867. In more recent times their results were criticized by Beijerinck and by Chodat, the latter questioning the purity of the cultures. Famincyn replies to these critics in reaffirming the accuracy of their observations, and cites the drawings made by them of algal cells forming zoospores that still had lichen hyphæ attached to them. He insists on the great carefulness of the methods adopted in their experiments which were repeated by them to avoid all chance of error.

**Swedish Lichens.**‡—F. Erichsen has published a critical list of the lichens of the peninsula of Kullen, on the west coast of Sweden. He describes the topography of the district, the character of the rocks, soil, and trees on which the lichens grew. There is in such a locality a great variety of lichen vegetation, both maritime and inland, saxicolous and corticolous. On the higher plateau there are moors consisting of *Calluna*, etc. The woods consist mainly of oaks, beeches, elms, and alders, and on all of them a rich lichen vegetation found place. Lists are given of the species that were found on these trees as also on the various conifers. There was very little old wood, as stone walls took the place of palings, but a fair number of wood species were found on the stumps.

* Mem. Dept. Agric. India, vi. 6 (1913) pp. 181–208 (6 pls.). See also Bot. Centralbl., cxxv. (1914) p. 670.

† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 218–22.

‡ Verh. Naturw. Ver. Hamburg, xxi. (1913) pp. 25–93.

Erichsen criticizes Kajanus' theory that soredia and isidia are merely growth-conditions of lichens, and are therefore valueless as diagnostic characters. Though in abnormal conditions many lichens do occasionally form these bodies, yet in normal positions with customary illumination, etc., both isidia and soredia are, he found, specifically constant in occurrence and in form.

A long note is published on the distinction between *Ramalina scopulorum* and *R. cuspidata*, both inhabitants of maritime rocks distinguished only by a difference in the reaction of the thallus to potash. Erichsen has found, as others have done, that in most cases the reaction is not to be depended on. In none of the specimens could he induce the deep red colour stain that was found by Zopp in the medulla of *R. scopulorum*. He includes both species under *R. cuspidata*.

Additional tabulated lists are given of those lichens that were found on the various habitats, and a bibliography of the literature consulted in the progress of the work.

**Lichens from Brazil.***—Bernt Lynge publishes his study of the *Parmeliæ* that were brought home by the Regnell expedition from Brazil. He establishes one new genus, *Pseudoparmelia*, distinguished by the presence of cyphellæ on the lower cortex. There are 70 species of *Parmelia*, all of them fully described from the author's examination of specimens: a number of them are new to science. In the introduction there is an extended account of the thallus and peculiar structure of the genus. Lynge gives high systematic importance to the pycnidia which are very constant in this group. He discusses the occurrence of isidia and soredia, which he finds now present now absent on specimens of the same species growing side by side, so that they cannot be mainly due to climatic conditions. Outgrowths from the thallus he considers of minor importance, as they are generally due to some accident of habitat, etc. When combined with other characters, such as the perforations in *Parmelia vittata*, they are of diagnostic value. He found that a number of species were inhabited by aerial algæ: they are to be considered as accidental or occasional parasites. Parasitic fungi are not uncommon; on one species a fungus was always present within the base of the rhizinæ. A constant distinction among species is the appearance of the upper cortex as to whether it is cracked or continuous. A special account is therefore given of the mode of formation of that cortex. In several species he observed that gonidia strayed in small groups into the upper cortex, without however bursting out as soredia; they can be detected as small green points by wetting the surface. Notes and descriptions are given as to the anatomical structure of the apothecium: great value is given to the form and structure of the paraphyses, though caution is necessary to make sure that fully developed organs are under observation. Chemical reactions Lynge considers most helpful as subsidiary diagnostic characters, but they can only be supplementary to morphological features. A copious bibliography is given, and an index to the species. The plates illustrating the new species are from photographs.

* Ark. Bot., xiii. No. 13 (1914) 172 pp. (5 pls.).

**Verrucaria margacea.***—Ethel M. Poulton writes a descriptive and systematic account of a species of lichen determined by her as *Verrucaria margacea*. The authorities quoted and followed by her are of somewhat old date, and no authentic specimens seem to have been examined. The lichen dealt with occurs in great abundance in the streams of Cannock Chase, Staffordshire. When young it is pale-green, but becomes dark olive-green or almost black when older. The structure of the thallus is compact and pseudo-parenchymatous, and "uniform in structure throughout the whole thallus." The spores are at first unilocular, later they become bilocular, and finally quadrilocular. They may germinate in any of these conditions. The author concludes from his observations that spore-characters of lichens are not always reliable as a basis of classification unless the complete life-history of the organism is followed out. The spores of her *V. margacea* are rather minute structures, measuring when in the ascus 12–16 × 5–7 $\mu$; later they may increase to 21–24 × 9–10 $\mu$.

## Mycetozoa.

(By A. Lorrain Smith, F.L.S.)

**Snow Species of Mycetozoa.†**—Ch. Meylan finds that, though Mycetozoa are generally cosmopolitan, there are certain species influenced by altitude and by the presence of snow. He enumerates a number of such species that are constantly to be found in spring on grass and on sticks as the snow recedes. These species are abundant above 1100 m., but are never found in any other locality. It seems evident that the presence of snow—that is an extreme degree of cold—is necessary for their development; and it was only by carefully removing the snow that Meylan succeeded in discovering the plasmodium in several instances. The time of their appearance varies considerably according to the weather conditions of the spring. Generally, *Physarum vernum* appears first. Development is most abundant in a warm season. A dry east wind interferes with the growth of the sporangia and induces various abnormalities of form. It is generally the presence or absence of lime that is affected by these weather conditions. Meylan adds detailed descriptions and critical notes of the species which he considers exclusively confined to the snow-line.

**Formation of the Capillitium in certain Myxomycetes.‡**—R. A. Harper and B. O. Dodge have studied this subject in the genera *Trichia* and *Hemitrichia*, in both of which the capillitia are provided with spirals. According to their observations these threads arise from vacuoles which appear in regular rows. The cytoplasm immediately surrounding these vacuoles becomes very dense, with many fibrils, more or less radiately

* Ann. of Bot., xxviii. (1914) pp. 241–9 (2 pls.).
† Bull. Soc. Vaud. Sci. Nat., l. (1914) pp. 1–14.
‡ Ann. of Bot., xxviii. (1914) pp. 1–18 (2 pls.).

arranged. The nuclei at first are evenly distributed through the cytoplasm, but with the appearance of the vacuoles they move away to a distance equal to about three or four times their diameter and lie at the surface of the denser layer of cytoplasm. Gradually the vacuoles increase in length with a narrowing of their transverse diameters. The capillitial thread is at first nodular and uneven, but as it gains its permanent form—a contorted tubular opening through the cytoplasm—its membrane becomes more distinctly differentiated as the wall of the future capillitial thread. A striking feature of the whole process is the formation of fibrillar asters which appear about the capillitial vacuoles. They consist of delicate fibrillar strands extending from the developing capillitium in all directions through the surrounding cytoplasm. They are oriented on deeply staining granules which are abundant in the region of the vacuole, either on the surface of the thread or at some distance from it. Possibly their normal position is on the thread. A granule on the surface may be the centre for rays that run in several directions from it, only one of which is radial to the capillitial tube.

The authors discuss the significance of the various processes: 1. They are initiated by the liberation of water and the formation of vacuoles. 2. The vacuolar sap at first contains materials in solution, which are apparently precipitated in fixation, and which later disappear and probably furnish material for the capillitial wall and spirals. 3. The spirals are laid down as organized material, in a definite form on the outside of the thread next to the vascular membrane, although functionally, the position of the spiral on the inside of the thread would be also hygroscopically effective.

**Plasmodiophoraceæ and their Relationship to the Mycetozoa and Chytrideæ.***—E. J. Schwartz has studied the root-parasites of *Bellis perennis*, *Mentha pulegium*, and *Alisma plantago*, and concludes, from a cytological point of view, that the genus *Ligniera*, in which the organisms have been placed, belongs to Plasmodiophoraceæ. He compares the different families, and finds that the cruciform type of nuclear division and the presence of the akaryote stage are constant in the Plasmodiophoraceæ and in *Olpidium*, but are lacking in Mycetozoa. In the three families there are two types of nuclei, vegetative and reproductive, and an absence of Karyogamy prior to spore-formation.

In the Mycetozoa nuclear divisions are karyokinetic. The Plasmodiophoraceæ, though closely related to both the Mycetozoa and Chytrideæ, are best considered as a separate class. The spore mother-cells in the zoosporangium of *Olpidium* each give rise to four zoospores, and in the Chytrideæ the zoospores conjugate in pairs. The myxamœbæ in the Mycetozoa also conjugate, and there is nuclear fusion as well.

* Ann. of Bot., xxviii. (1914) pp. 227–40 (1 pl.).

## Schizophyta.

### Schizomycetes.

**Coccobacillus of Locusts.***—The causal organism of locust disease was first isolated by F. d'Herelle in Mexico, in 1911, from the bodies of the common New World locust (*Schistocerca americana*). The present papers embody the results of his investigations carried out in the Argentine on behalf of the Government of that Republic, both with regard to the etiology of the disease, and the possibility of producing massive infections, in locust districts, by means of infestations with virulent bacilli. After a variable period the contents of the chyle-stomach of an insect, either naturally or experimentally infected, are observed to liquefy and become blackish in colour; the liquefaction extends to the gut, and soon the characteristic diarrhœa becomes evident. The animal finally dies in a comatose condition, supervening on a convulsive stage. The specific micro-organism, *Coccobacillus acridiorium*, is present in almost pure culture in the intestines; it can also be observed in sections taken from any part of the body—thus revealing the presence of septicæmia.

The organism is a short, slightly ovoid bacillus, showing marked pleomorphism and bipolar staining. It is stained readily by ordinary anilin dyes, and is Gram-negative. It possesses flagella and is actively motile. Young cultures on agar are circular and waxy in appearance. The organism does not liquefy gelatin, coagulates milk and renders it alkaline, and ferments glucose, levulose, maltose, and galactose. It is a facultative anaerobe. The virulence of the bacillus can be exalted by experimental passage through locusts, so that death can be produced within 8 hours of inoculation. At its maximum exaltation (under natural conditions) 0·01 c.cm. can produce death in 3 hours. Although the organism possesses great vitality (living for two years at room temperature), it loses its virulence with extreme rapidity on ordinary media. Positive-agglutination experiments have been conducted with immune serum obtained from rabbits inoculated with the coccobacillus.

**Intestinal Flora of Bats.**†—Mdlle. Tsiklinsky has investigated the intestinal flora of the native bats of Russia (*Vespertillo*, *Vesperugo*, *Plecotus*, and *Myotis daubentonia*), and confirms the statements of Metchnikoff and Distaso regarding the paucity of bacteria found in the intestines of such animals. On account of the very rapid process of digestion met with among bats, bacteria have but little opportunity of development in the alimentary tract, and to this fact the extreme longevity of these animals is attributed. A considerable number of different organisms were isolated from the fæces of the bats examined, two in particular receiving special notice—(1) a brown pigment-

* Ann. Inst. Pasteur, xxviii. (1914) pp. 280–328, 387–407.
† Ann. Inst. Pasteur, xxviii. (1914) pp. 441–9.

producing bacillus (? described by Matchek in 1887), and (2) a short bacillus which produced an extremely fœtid odour in all ordinary culture media. Both organisms are described as Gram-negative and as rapid liquefiers of gelatin.

**Studies in Bacterial Variation.***—P. Eisenberg deals in these (the fourth and fifth) communications with the variations observed with *Bacillus prodigiosus* and *B. violaceus*, and with the mutations in the *fluorescens* and *Friedländer* groups, *Sarcina tetragena* and *Bacillus typhosus*. By growing *B. prodigiosus* on ordinary media and on media containing fuchsin, crystal-violet, safranin, and so forth, he was able to breed out twenty-two different mutants, which could be distinguished from one another by their chromogenesis (dark red to colourless), and by physical characters, such as size, opacity or translucency, sliminess, etc. The mutations originated more quickly in old cultures, and in greater variety in liquid than on solid media. With *B. violaceus* five mutants were bred out, which varied from violet to colourless, the shape of the colonies ranging from compact to spreading forms. In the *fluorescens* group seven distinct varieties were observed, which differed in their opacity, in their capacity to form pigments (pyocyanin, fluorescin, etc.), and in their ability to produce alkaline reaction. In the *rhinoscleroma* and *Friedländer* groups, the reaction of the medium upon which the bacilli are propagated appears to have marked effect upon their morphology; alkaline media favouring the formation of capsulated bacilli, which lose their capsules when grown in the presence of acids.

**Contribution to the Study of Bacillus salmonicida.**†—M. Bornand in this communication confirms the observations of Fehlmann regarding the morphology, etc., of the pigment-producing bacilli which are met with in "Furunculosis of the Salmonidæ." The organisms variously described as *Bacillus salmonicida* Emerl. & Weibel, *B. salmonicida B.* Plehn, *B. salmonicida C.* Fehl., and *B. truttæ* Marsh, may be regarded as members of the *fluorescens* group of bacteria, which they strongly resemble, both culturally and morphologically.

The organisms isolated by the author in Switzerland (Vaud and Berne Cantons) are described as short non-motile bacilli, which change into micrococci when grown in broth or on agar. By sub-culture, however, on trout-blood agar, they regain their original forms and, as has been already noted by Fehlmann, acquire motility when grown on this medium.

**Note on Bacillus perfringens Veillon.**‡—Mdlle. A. Raphael has studied the symptoms and lesions produced by the injection of active cultures of *Bacillus perfringens* into guinea-pigs and rabbits. Large doses injected intravenously into the former animals produce arterial depression, stoppage of respiration and hæmaturia; post mortem, the abdominal viscera are acutely congested and the blood does not coagulate.

* Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 449–88.
† Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 355–7.
‡ Ann. Inst. Pasteur, xxviii. (1914) pp. 564–8.

These results are said to be produced by a toxin analogous to snake-venom (Viperidæ), and death may supervene within five hours of inoculation. Similar results were obtained with inoculation experiments on rabbits. The strains used were isolated from healthy persons, from a case of puerperal septicæmia, and from guinea-pigs.

**Researches on the Etiology of Acute Polyarticular Rheumatism.***—D. Danielopolu describes the appearances of a micro-organism which he observed in direct examination of smears from joint-exudate in a typical case of the above. The smears were fixed with methyl-alcohol and stained by Giemsa. The organism (a bacillus with squared or rounded ends) varies considerably in size; it is generally extra-cellular, but is also met with in the polymorphonuclear leucocytes, and but rarely in the endothelial cells. Further researches upon the morphology, etc., of this organism are in progress.

**Atypical Paratyphoid Bacilli isolated by Blood-culture.†**—During his observations on para-typhoid fever in Algeria, Roussel has met with atypical bacilli belonging to the above group, which do not correspond with either of the classical types, *Paratyphoid A* or *Paratyphoid B*. They resemble *Paratyphoid B* in that they do not produce any change in litmus-milk, and do not blacken double tartrate of iron and potash-agar; but, on the other hand, they do not ferment arabinose (one strain fermented slightly), nor is fermentation produced to any extent in glucose media (Rothberger). They also differ from the "metatyphoid" bacilli described by Mendelbaum, as they produce yellow and not red colonies on rosalic-acid-glycerin agar.

**Vitality of Gonococcus Cultures.‡**—A. Lumière and J. Chevrotier, experimenting with gonococci, have found that the viability of these delicate organisms can be prolonged greatly by growing in Erlenmayer flasks, either in vacuo or under a layer of liquid paraffin. Cultures treated by these methods and kept at 37° C. were still active at the end of four months, while control cultures died out at the end of fifteen days or three weeks. The authors suggest that, as the action of oxygen per se has no deleterious influence on the vitality of the organism, the substance inimical to development may be an oxidation product of the endotoxin secreted by the gonococcus.

**Decomposition of Formates by Bacillus coli communis.§**—E. C. Grey has studied the circumstances under which *Bacillus coli communis* is able to decompose formates, which are conditioned by the presence or absence of an enzyme which decomposes formic acid. The splitting up of formates in the culture medium is inhibited by a small excess of either acid or alkali, and therefore a greatly increased decomposition is caused by the addition of glucose, due to the neutralization of the

* Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 353–4.
† C.R. Soc. Biol. Paris, lxxvi. (1914) pp. 721–3.
‡ Comptes Rendus, clviii. (1914) pp. 1820–1.
§ Proc. Roy. Soc., Series B, lxxxvii. (1914) pp. 461–71.

alkali from the formate by the acid derived from the sugar. It is suggested that, on account of this increased gas production, a medium containing sodium formate (0·5 p.c.) and glucose (1·5 p.c.) might be used as a delicate test for gas-producing strains.

**Oxidation of Thiosulphate by certain Bacteria in Pure Culture.*** W. T. Lockett in the course of investigations on the oxidation of thiosulphate on bacterial sewage filters, has succeeded in isolating an organism which is apparently responsible for the observed chemical change. This organism does not grow on ordinary laboratory media, but can be cultivated on a solid gelatin medium (made without bouillon and containing ammonium sulphate 0·1 p.c. and sodium thiosulphate 0·4 p.c.). On inoculation with active filtrates a large number of slow-growing circular non-liquefying bluish-white colonies develop. The oxidation of thiosulphate solution in vitro takes place very rapidly, while uninoculated control solutions show no change after several months incubation. Further experiments are in progress with regard to the morphology and classification of the organism in question.

* Proc. Roy. Soc., Series B, lxxxvii. (1914) pp. 441–4.

# MICROSCOPY.

## A. Instruments, Accessories, etc.*

### (2) Eye-pieces and Objectives.

**Measurement of the Initial Magnifying Powers of Objectives.**† E. M. Nelson points out that the problem involved is merely that of solving the equation $m = \frac{10}{f}$, but that the focal length ($f$) of an objective is a very difficult thing to measure directly. Indeed, it is usually found by an indirect method of measuring the magnifying power, for, as above, $f = \frac{10}{m}$. Probably the best way of measuring the focal length by the indirect method is to project the image of a measured object placed 100 in. from the stage, and to measure the diminished image at the focal point of the objective by means of a Microscope fitted with a screw micrometer; the magnification ($m$) thus obtained will give the focal length with great accuracy, for $f = 100 \div (m + 2)$. As the numerator is 100, the result can be found in a reciprocal table without the necessity of doing a division sum. Simple as this seems, it is, however, a troublesome thing to do; but the author describes a method by which the initial power and consequently the equivalent focus of a Microscope objective can be quickly and easily measured.

The apparatus required is a stage micrometer and a screw micrometer with a positive eye-piece. With a tube of a length as described below, the interval of two divisions of the micrometer scale on the stage is read on the drum of the eye-piece, and this reading will be the initial magnifying power of the objective. The only difficulty here is the determination of the proper tube-length. The tube-length is to be measured from the web in the eye-piece to the end of the nose-piece of the Microscope.

The formula for the determination of the tube-length is

$$15\sqrt{\frac{1}{p} + 0{\cdot}335}$$

where $p$ is the nominal initial power. Example: The initial power 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.

† Journ. Quekett Micr. Club, xii. (1914) pp. 295–300 (1 fig.).

a half-inch is required. The nominal power of a half-inch is 20, which is $p$, then

$$15\sqrt{\frac{1}{20}+0\cdot335} = 15\sqrt{0\cdot385} = 15 \times 0\cdot62 = 9\cdot3 \text{ in. tube-length.}$$

The tube must be drawn out until the web is 9·3 in. from the nose-piece, and with the half-inch on the nose-piece, two $\frac{1}{1000}$ in. divisions on the stage micrometer are spanned by the webs. The drum then is read, say, 22·4, and this is the initial power of that half-inch, without any further calculation; its focal length is $\frac{10}{22\cdot4}$ or 0·446 in. In case the nominal initial power is unknown, it is first determined with, say, a $9\frac{1}{2}$-in. tube; the value thus found is inserted in the equation and the measurement made again with the correct tube-length. All powers of $\frac{1}{4}$-in. and less focus, all Zeiss's apochromats of whatever focus, and other makers' apochromats, require a 9-in. tube.

For lower powers the accompanying table, computed by the above formula, gives the necessary tube-length.

TABLE.

O, objective; N, nominal power; T, tube-length in inches.

| O | N | T | O | N | T |
|---|---|---|---|---|---|
| | 3 | 12·3 | 1 | 10 | 9·9 |
| 3 | 3·5 | 11·8 | $\frac{3}{4}$ | 12 | 9·7 |
| | 4 | 11·5 | $\frac{2}{3}$ | 15 | 9·5 |
| | 4·5 | 11·2 | $\frac{1}{2}$ | 20 | 9·3 |
| 2 | 5 | 11·0 | $\frac{4}{10}$ | 25 | 9·2 |
| | 5·5 | 10·8 | $\frac{1}{3}$ | 30 | 9·1 |
| | 6 | 10·6 | | 35 | 9·05 |
| $1\frac{1}{2}$ | 7 | 10·4 | $\frac{1}{4}$ | 40 | 9·0 |
| | 8 | 10·2 | | | |
| | 9 | 10·0 | | | |

J. Grundy gives some experimental details of Nelson's method. The Microscope is placed horizontally; a low-power objective, 3, 2, or $1\frac{1}{2}$ in., according to circumstances, is placed in position; screw-micrometer eye-piece; the objective to be measured is placed in substage, with its front lens facing the stage. A card cut to the pattern as shown in figure (fig. 34) is fixed by means of a clip in front of the window; the card should be placed at the exact measured distance of 100 in. from the stage of the Microscope. The stage micrometer is placed on the stage, and the constant of the screw-micrometer determined. The focus of the Microscope is not to be disturbed, but, by means of substage focusing, the lens to be measured is racked up until the image of the card is sharply focused. Then one of the sides of the card is spanned by the webs of the eye-piece micrometer, and its

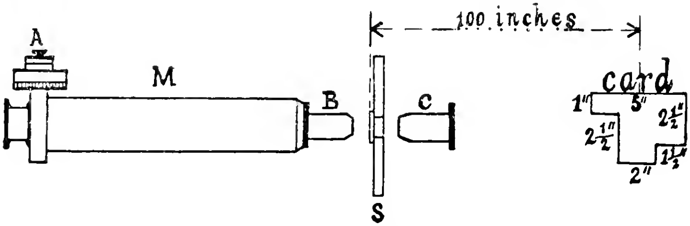



Fig. 34.—Diagram to show Relative Positions of the Apparatus.

M.—Microscope tube. B.—Objective.
A.—Screw micrometer. C.—Objective to be measured, in substage.
S.—Microscope stage and micrometer.

size measured and the magnifying (or, rather, diminishing) power found; then

$$f = \frac{100}{m + 2}$$

Of course, the idea of the 5 in. is that the reading is doubled, and then $10 \div x$ (say) gives the magnification, $m$, which can be found from reciprocal tables, as well as the value of

$$\frac{100}{m + 2}$$

It is not difficult, but a little more trouble, to make the calculations without tables.

This method will also measure the foci of large photographic lenses. In that case

$$f = \frac{100}{m + 2} - \frac{100}{(m + 1)^3}$$

This second term is only necessary when $f$ is large compared with 100 in.; for microscopic lenses it is not wanted.

The screw-micrometer eye-piece is perhaps a drawback, as an ordinary screw-micrometer with a negative eye-piece is no good for lens measurements. The eye-piece must be of the Ramsden type, and it is very doubtful if any ordinary ruled glass micrometer eye-piece would be sufficiently accurate. A screw-micrometer is necessary for both the methods described.

### (3) Illuminating and other Apparatus.

**Improved Form of Cheshire's Apertometer.***—J. Grundy describes E. M. Nelson's improved form of Cheshire's valuable instrument, the

* Journ. Quekett Micr. Club, xii. (1914) pp. 281–2 (1 fig.).

aim of the improvement being to read off the N.A. with greater ease and accuracy. Distinctness and clearness of reading have been effected by increasing the number of marked values of N.A. from 9 to 22, without the confusion that overcrowding of the lines would entail. To accomplish this, short arcs of circles are used instead of whole circles. A valuable property of these is the clear visibility of the ends or edges of the arcs; they are seen more distinctly than complete circles would be. The contrast between the white ground and the short black lines favours this. The exterior edges of the arcs denote the N.A., and thus give most convenient, accurate, and definite positions for reading. The first or lowest marked value is 0·05 N.A., and the values increase by increments of 0·05 up to 0·5 N.A. From 0·5 the values increase by 0·033 up to 0·9 N.A.

The apparatus consists of an apertometer diagram (fig. 35), printed

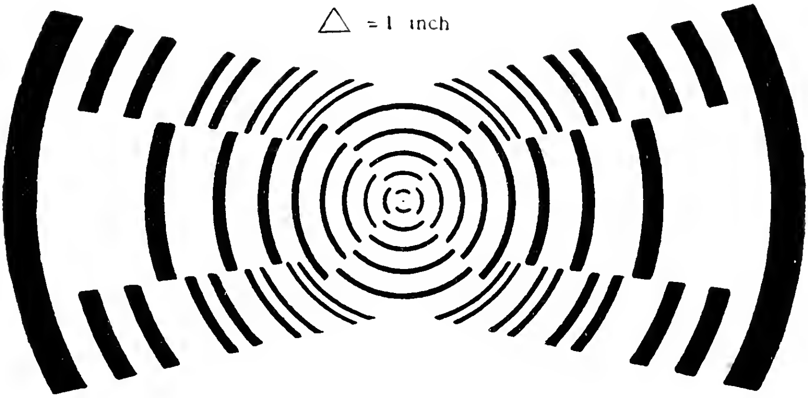



Fig. 35.

on a small card about the same size as Cheshire's form, another card of explanations and instructions, a cubic inch of wood, and a metal diaphragm with a hole not more than 1·25 mm. in diam. Nelson lays some stress on the hole in the diaphragm being not more than 1·25 mm. in diam. He says: "If the hole is larger than that, some objectives, especially low powers, will read a great deal too high. And accuracy is, relatively, more important with the small apertures, because, for example, an error of 0·01 or 0·02 will make a far greater percentage of difference than it would with, say, the N.A. of an oil-immersion objective. If 1·25 and 1·27 be compared with the N.A. 0·11 and 0·13 of a 3-in. objective, the actual difference between the two pairs of values is 0·02 in each case, but the percentage difference with the higher N.A. is only 1·6 as compared with 18 in the case of the low values." Nelson also makes another important remark, namely, "The working aperture is larger than the correctly measured true aperture, so that low powers resolve more than they are entitled to theoretically. This is probably due to the practically enlarged aperture caused by the rolling motion of the eye from side to side."

It will also be noticed that the diaphragm to be used with the apertometer is made convex on one side, and if the convex side is put into the larger aperture of an eye-piece—or other—diaphragm, it rests steadily in position.

**Two Simple Apertometers for Dry Lenses.***—These are due to F. J. Cheshire, who begins his description by quoting Abbe's authority † that it is useless to attempt an accuracy greater than 1 p.c. in an apertometer. Fig. 36 shows a plan of the author's form of an apertometer for dry lenses, which for simplicity in use and for the accuracy of its results probably leaves nothing to be desired. A strip of vulcanite A (the right-hand end is shown broken off) is so divided that the distance D of any line from the zero of the scale is given by the equation ‡

$$D = 2\,\Delta \tan\,(\sin^{-1} \text{N.A.})$$

The graduations are marked with the corresponding N.A. values for a value of $\Delta$ equal to 25 mm. In use the apertometer is placed upon the stage, and the object-plane of the lens to be tested adjusted at a height of 25 mm. above the plane of the scale. The upper focal plane of the objective is then observed in any known way, and the apertometer adjusted on the stage until the inner edge of the fixed white block B is seen on one edge of the objective opening. This adjustment effected, the sliding white block C is slid along the strip A until its inner edge is seen on the opposite edge of the objective-opening to that on which the block B is just seen. The N.A. value found opposite to the inner edge of the block C on the scale is that of the lens tested. The graduations from 0 to 0·9 N.A. proceed by steps of 0·02 and from 0·9 to 0·96 N.A. by steps of 0·01.

Fig. 37 shows a modification of the form of apertometer described in the author's original paper in 1904. He has substituted for the concentric circles there shown curved lines which project optically into the upper focal plane of the lens being tested as a number of equi-distant straight lines of equal thickness. The projected image of the apertometer scale is thus a simple linear scale upon which N.A. values can be read directly. The scale runs from 0·0 to 0·9 N.A. by steps of 0·05, i.e. the divisions starting from the centre have the values 0, 0·05, 0·10, 0·15, 0·20, etc., of N.A. The short curved lines of the scale should strictly be hyperbolas, but such curves are very difficult to draw accurately, and it was not until the author's son, R. W. Cheshire, suggested to him that they might be replaced by arcs of circles with curvatures equal to those of the corresponding hyperbolas at their vertices, that the apertometer described became a practical construction.

The author is of opinion that there are several objections to Nelson's form § of his apertometer which was introduced by him in 1904. These

* Journ. Quekett Micr. Club, xii. (1914) pp. 283–6 (2 figs.).
† See this Journal, 1880, p. 20.
‡ Journ. Quekett Micr. Club, ix. (1904) p. 1. § Vide supra.

may be briefly indicated. In the first place, no advantage can result from the use of the outer edges of the lines, instead of the middles, as

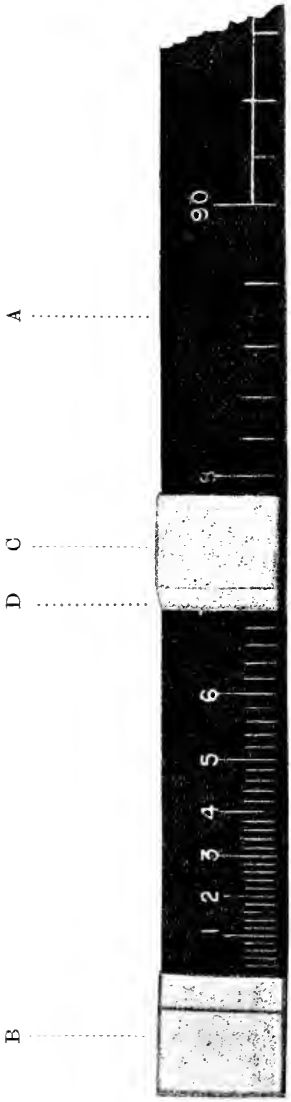



FIG. 36.


FIG. 37.

is usually done, as the part of the lines from which distances, and therefore N.A.'s, must be estimated by eye. Further, in Nelson's form the thickness of the lines varies in different parts of the diagram, and has no assigned or stated thickness in terms of N.A. This is a fatal defect, because when the thickness of a line has a N.A. value of, say, 0·02, such thickness, especially when dealing with low-power lenses, provides an invaluable standard of reference when estimating by eye N.A. values intermediate to those represented on the scale. In apertometers of the kind in question the further the subdivision of the scale is carried the greater must be the complexity of the image presented to the eye—the advantage of one is balanced by the disadvantage of the other. Possibly, however, most people would prefer the simplicity of a diagram with the larger divisions to the optical Hampton-Court-maze necessitated by the smaller ones.

**Variation of Cheshire's Apertometer.***—M. A. Ainslie states that experience in the use of both the original forms of Cheshire's Apertometer, and the modification thereof recently introduced by E. M. Nelson,

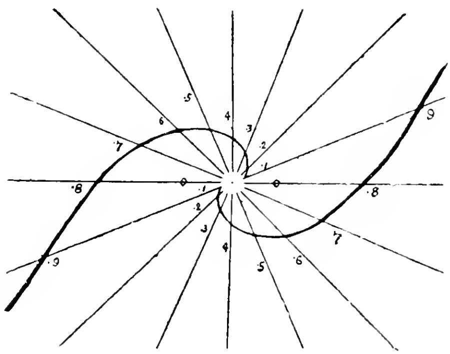



FIG. 38.

have revealed one or two difficulties in connexion with the reading of the instrument—that is, if any accuracy in the second place of decimals is required—and the present instrument is an attempt at removing these. The first difficulty is due to the fact that in Cheshire's instrument we have to interpolate or estimate between two divisions on a scale, one of which is not visible, being outside (apparently) the margin of the back lens of the objective. This renders the estimation of the second place of decimals in the N.A. uncertain, and although Nelson's modification of the original instrument is somewhat better in this respect, yet the very means adopted to improve the reading, namely, the introduction of a large number of additional circles, is likely to confuse the diagram and bewilder the observer.

The author's instrument, which consists, in the form for dry lenses, of a card diagram placed on the stage, is constructed as follows: A series

* Journ. Quekett Micr. Club, xii. (1914) pp. 287–9 (2 figs.).

of radial lines are drawn from a common centre, making equal angles with one another; the precise number is immaterial, but it has been found convenient to divide the circle into sixteen equal parts. One of these (preferably that lying horizontally) is selected as a zero, and points are marked off along the others at distances equal to a constant length (usually 25 mm. or 1 in.) multiplied by the tangent of the semi-angle of aperture, i.e. the tangent of the angle whose sine is the numerical aperture. This is done for every $0 \cdot 1$ of N.A., and a spiral curve drawn through the points thus obtained; this curve being repeated turned through 180°. The curves are shown with fair accuracy in fig. 38.

The diagram is used precisely as the Cheshire Apertometer: either the objective is focused on the upper surface of a cube of wood, as in the Cheshire instrument, or else a pinhole in the centre of the diagram is focused, and the body racked back 25 mm. or 1 in., this being measured easily enough with a scale. This latter method is preferable

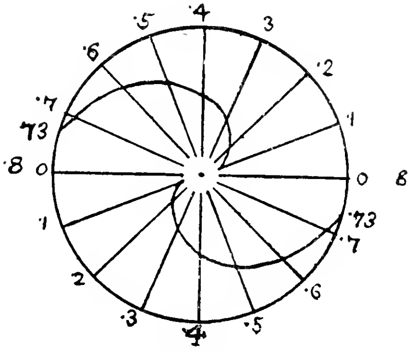



FIG. 39.

for objectives of high aperture. A low-power eye-piece is employed. On examining the Ramsden disk with a hand-lens (a watch-maker's eye-glass does well) the appearance in fig. 39 is seen, and the method of estimating the value of the N.A. is fairly obvious. We have only to start from the zero and count in the direction of the spiral $0 \cdot 1$ for each radial line passed over. The second figure is found by estimating the position between two adjacent radial lines of the point where the spiral cuts the margin of the back lens. In fig. 39, for example, the N.A. is about $0 \cdot 73$.

The procedure is the same with the form suited to immersion lenses; the upper surface of a plate of glass is focused, and the diagram is balsamed to the lower surface. It might be preferable to have twelve radial lines instead of sixteen, and read like a clock; this is a matter for experiment.

Of course the value of the radius vector of the curve for a diagram in optical contact with glass will not be quite the same as before. Instead of $r = C \tan \phi$, where $\sin \phi = N$, we shall have $r = C \tan \phi'$

where $\mu \sin \phi' = N$; but the principle is the same. The equation to the curve presents some interesting features; it is

$$r = C \frac{a\theta}{\sqrt{1 - a^2\theta^2}}$$

where C is the distance of the diagram from the lower focal plane of the objective and $a$ is a constant depending on $\mu$ and on the number of radial lines in the circle; for sixteen radial lines, and $\mu = 1$ (dry form), $a = \frac{4}{5\pi}$ The radius representing N.A. = 1·0 is obviously an asymptote to the curve; in the case of the glass form, N.A. = $\mu$ will be the asymptote.

It is of interest to note that the same curve will serve for any refractive index of the medium beneath which it is mounted. If we change the refractive index from 1 to $\mu$, we merely have to close up the radial lines in that ratio, leaving the curve unaltered. For instance, if we had 16 radii for the dry form we could use the same curve, but with 24 radii for a plate of glass of $\mu = 1·5$.

In practice the instrument proves of great utility, and very reliable and easily used. All that is necessary is to be accurate in centring; this is easily seen to be correct when the reading of each end of the spiral is the same.

**Dark-ground Illumination with the Greenough Binocular.*** — The Greenough pattern of binocular consists, says B. M. Draper, of two separate Microscopes, one for each eye, with paired objectives of very low power. Like other binoculars, it is particularly well-suited for use with dark-ground illumination, and a good way of getting the dark-ground with its higher powers is to put a stop behind the condenser. As, however, the front lenses of the twin objectives stand out some distance on either side of what would be the optic axis of an ordinary Microscope, the stop has to be correspondingly broad from side to side; otherwise direct rays would enter the objectives and would spoil the dark-ground at the sides of the field. But it is not necessary that the rectangular diameters of the stop should be equally great; on the contrary, if an ordinary circular stop be used, some rays are needlessly obstructed. On trial, a double or twin stop, corresponding with the twin objectives, gave much better results. This stop consists of two small circular patches placed side by side in the same plane, and touching each other, so as to form a figure of eight. It is used behind the condenser in the same way as an ordinary circular stop, and with almost equal ease. It is only necessary to be careful that the two circular patches shall be placed horizontally, i.e. so as to be opposite the two front lenses of the twin objectives. This position can easily be secured by arranging the stop in the carrier approximately, and then, whilst watching the object, shifting the whole condenser round in its sleeve until the best effect is obtained. A standard low-power condenser such as Swift's Paragon, with its top lens off, gives very satisfactory results. The twin and the ordinary

* Journ. Quekett Micr. Club, xii. (1914) pp. 313–14.

circular patterns of stop were compared experimentally by using a condenser fitted with two stop carriers, one behind the other, so that either stop could be used separately, or both together. The twin stop used by itself gave a good dark ground. The circular stop was purposely chosen too small to give a good dark ground; there was light at the sides of the field. Nevertheless when the circular stop was turned in above the twin stop whilst the object was under observation, there was a marked drop in the brightness of the image. This loss of light was due almost entirely to the circular stop, not to the clear white glass on which it was mounted, since it was found that the interposition of such a piece of glass, even when rather dirty, made very little difference to the light. Evidently, therefore, the circular stop, though too small in one direction, was too large in the other, and kept out some rays which might safely have been admitted. Of course, if the circular stop had been large enough to darken the background when used by itself, the loss of light would have been still more noticeable.

**Changer for Use with Substage Condensers.***—S. C. Akehurst has frequently felt the need of a method for quick change of substage con-

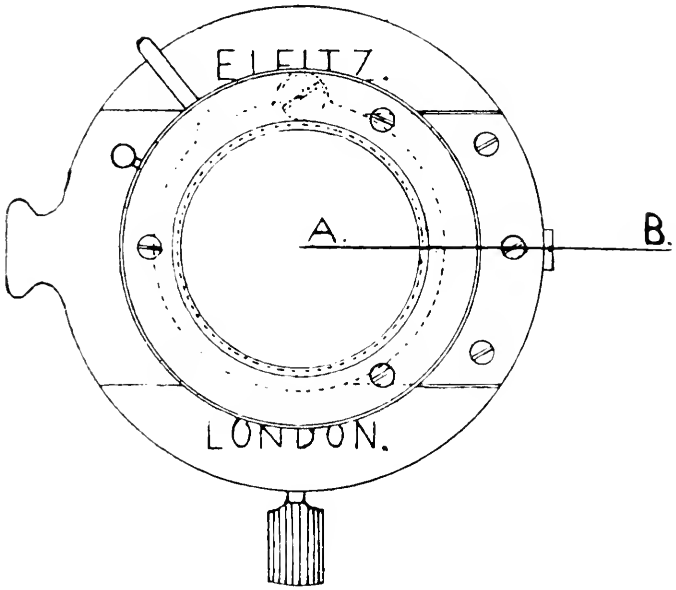



FIG. 40.

densers. He found the revolving nose-piece to carry three condensers did not work satisfactorily, and therefore adapted the principle employed

* Journ. Quekett Micr. Club, xii. (1914) pp. 277–8 (2 figs.).

in the sliding objective changer to the substage fitting, and found this enabled him to get an easy and rapid change of condensers. The scheme consists of a metal slide, $2\frac{1}{2} \times 1\frac{1}{2}$ in., with bevelled edges, on which the condenser is mounted, and, when necessary, a throw-out arm for stops, and an iris-diaphragm. Two D-shaped metal plates, the flat sides of which are set $1\frac{1}{2}$ in. apart, form a groove for the slide to work in. These plates are screwed to a metal collar, the diameter of which is such as to allow the slide-condenser changer to be fitted to any Microscope that has a substage made to the R.M.S. gauge.

Fig. 40 shows a plan of the slide-changer in position, while fig. 41

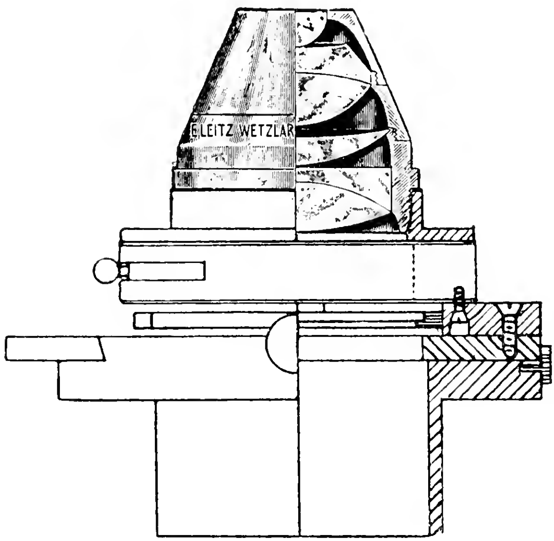



Fig. 41.

gives a sectional elevation along the line A B (fig. 40). When three or more condensers are used it is desirable to have each mounted on a separate slide; but when only two condensers are used, one slide may be sufficient, as the optical parts can be made interchangeable. When the slide with condenser has been pushed home, a screw, working through one of the plates, holds this firmly in position. This changer does away with the necessity of a throw-out substage, and any variation of centrality in the condenser can be adjusted by the centring screws in the regular way. To rack down the substage fitting, withdraw, and insert a new slide, are all the movements that are required to obtain a change of condenser, and this can be effected as readily as a change of objective on a revolving nose-piece.

**Substage Illumination.***—S. C. Akehurst urges the convenience of employing annular light with objectives of high aperature, the annular light being obtained by the use of a concentric reflecting condenser. By this means there is no chromatic dispersion, and the spherical aberration is reduced to a minimum. Moreover, with the reflecting condenser there is no loss of high-angle rays, because the excess of light is modified by stopping out a portion of the central or dioptric beam ; hence the fullest possible advantage can be taken of the N.A. aperture of the whole optical system. The absence of chromatic dispersion results in a pure image and in the possible application of photomicrography to critical work. The author gives photographs of *Pleurosigma angulatum* and other well known diatoms, taken with annular illumination under magnifications, in some cases, as high as 3000 diam.

**New Microscope Illuminators.**†—F. Levy describes two forms of illuminators which he has found satisfactory. The first is adapted for illuminating a Microscope hall, and consists of a centrally placed 2000-candle Osram half-watt lamp in a hemispherical milk-glass globe. The glass should have a slightly bluish tinge. Such a lamp should be placed about 2 m. above the work-tables, and would suffice for one hundred Microscopes.

His second lamp is for individual use with high-powers in a laboratory, and consists of a special Osram lamp with wavy metal filaments of 100 candle-power. The front side of the globe is matted ; the rear side mirrored. The lamp is enclosed in a frame in such a manner that the greater part of the light falls on the Microscope mirror. The frame is provided with grooves for the insertion of filter or matt disks. Near the grooves openings are left so that the working space may be illuminated without blinding the worker.

**Application of Direct Coolers to Projection.**‡—O. Zoth points out the inconveniences of those forms of coolers which are operated by water straight from the water-main. In such cases the water is under pressure, and there is considerable risk of cracking, bursting, or loosening the cover-glass. The author finds it better to use water at a pressure less than the atmospheric. He accomplishes this by means of a siphon arrangement, at the highest point of which is the cooling chamber. By means of a tube the chamber is connected with a large trough of water, iced if necessary, under the projection stage. Another tube leads from the cooling chamber to a vessel on the floor at a lower level than the trough. A gentle sucking at this second tube will start the siphon, and the flow of the liquid can be controlled by a pinchcock. A difference of level equal to 50 or 60 cm. is found to be sufficient. It is easy to see that there is now no risk of damage to the cover-glass. By exchanging the levels of trough and vessel and adjusting tube-lengths the flow can be reversed and the same liquid used again.

* Journ. Quekett Micr. Club, xii. (1914) pp. 301–8 (3 pls.).
† Zeitschr. wiss. Mikrosk., xxxi. (1914) pp. 99–100 (2 figs.).
‡ Zeitschr. wiss. Mikrosk., xxxi. (1914) pp. 97–8.

### (4) Photomicrography.

**Photographic Dark-box for Field Work.***—The difficulties encountered in doing photographic work in the field where dark-room conveniences are lacking led to the making of a dark-box which is an adaptation of the inoculating chamber in common use in plant pathology. Elda R. Walker has found it so satisfactory that he uses it entirely for plate work even in the laboratory where a dark-room is available. The dark-box (fig. 42) is a plain light-tight box 24 in. long, 18 in. wide, and 20 in. high. It is made of light-weight lumber $\frac{3}{4}$ in. thick. To avoid all chances of light entering, it is made of well-seasoned lumber; all corners are joined, as shown in the accompanying diagram, at *k*, and all seams in the sides are made by inserting a strip-"tongue," $\frac{1}{4} \times \frac{3}{4}$ in.

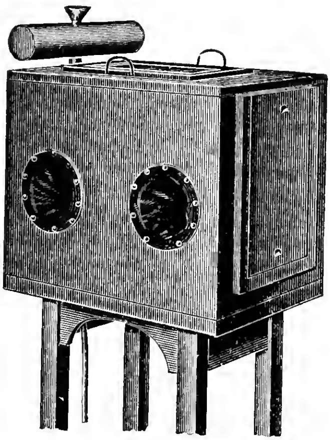


FIG. 42.

in cross-section, as is shown at *m* in the diagram. Besides these precautions, all joints are glued as well as nailed. In the right-hand end is a door, $14 \times 11$ in., for admitting to the box plates, plate-tank, and such things as are to be used in the work. In the top and back are red-glass windows, $10 \times 8\frac{1}{2}$ in., set firmly with putty. The back one serves to admit light, and the top one permits the operator to see what he is doing in cases where light is needed. (When using the windows it is well to cut out side lights by throwing a focusing cloth over the head. For most work, however, the windows are covered by wooden doors, and the work is done without sight.) All doors are of the sliding kind and work in a groove, as is shown in the diagram at *a*. This shuts out all light. In front of the box (fig. 42) are two round holes for the operator's arms; these are 6 in. diam. They are 7 in. apart, and 6 in. from the bottom of the box (outside measurement). These are convenient dimen-

* Trans. Amer. Micr. Soc., xxxiii. (1914) pp. 51–4 (5 figs.).

sions for an average-sized person. These holes are closed each by two sleeves, with rubber tape at the wrist to draw them tightly about the arms. The sleeves are 12 in. long, and are tapered slightly to eliminate surplus fullness at the wrist. The inner sleeves, which are tacked on the inner side of the box about the openings, are of black oilcloth, for protection from chemicals as well as to cut out any possible light that might have come through the outer sleeves. These are of fine black sateen, and are tacked to the outer side of the opening (fig. 42). Each sleeve is finished separately with a rubber draw-string, so that should any light pass the closing of the outer sleeve it would be cut out by the

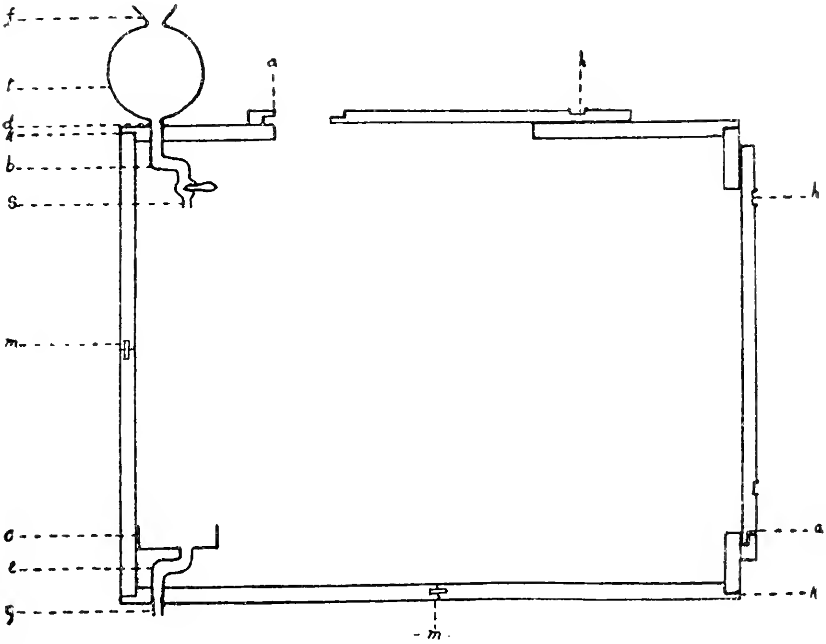



FIG. 43.

inner one. On the top, at the left-hand end of the box, is a cylindrical copper tank for holding water (fig. 43, *t*, and fig. 42). This is $3\frac{1}{2}$ in. diam. and 18 in. long, and is provided with a funnel (fig. 43, *f*, and fig. 42) above for convenience in filling. From the tank a short section of $\frac{1}{2}$-in. water-pipe passes into the box, where it is bent to form two elbows (fig. 43, *b*) to prevent the entrance of light. To this pipe is attached a small faucet (fig. 43, *s*) through which water can be drawn as needed. The tank screws on to the pipe (fig. 43, *d*) so that it can be removed for convenience in transportation. Directly below the faucet is a copper pan (fig. 43, *c*), 5 × 6 in. diam. and $1\frac{1}{2}$ in. deep, for receiving waste liquids. The drain from this has two elbows (fig. 43, *e*), as in the tube above. At the bottom of the drain-pipe is a short removable section (fig. 43, *g*) to which a piece of rubber tubing can be attached to carry the waste to a convenient receptacle. The doors are fitted with metal finger-pulls (fig. 43, *h*) for convenience in sliding, and two metal handles are attached at the top for lifting the box. The whole is painted inside and out with a dull black shellac. It stands on a small table, in which there is a hole to permit the passage of the drain-tube. I have found the most convenient height of the table for use with an ordinary chair to be 2 ft. In the field a box or two chairs serves very well for a support in place of the table.

When filling plate-holders, the box of plates and the holders are placed in the dark-box and all openings closed. The workman sits with his arms in the sleeves, which are pulled well on at the wrists, and fills the holders in perfect comfort.

In developing the plates, the plate-tank containing the developer, the plate-cage and the plate-holders are placed in the box as before. When the cage, containing the plates, is safely in the closed tank, the box can be opened until the developing is done, when the tank is returned to the box, where the developer is poured off through the drain (fig. 43, *c*). The plates are then washed in several changes of water, which is drawn from the faucet (fig. 43, *s*); then they can be taken to the light of the room and placed in the fixing-bath.

The box as described is a convenient size for use with $4 \times 5$ and $5 \times 7$ plates. With a $5 \times 7$ plate-tank it would be well to make the water-tank slightly larger.

### (6) Miscellaneous.

**Manual of Petrographic Methods.***—This book removes a long-standing reproach to English Petrography. It is, as is stated in the preface, "the first attempt to give in English a comprehensive review of petrographic methods." The author has abundantly realized his aim, and produced a book which, in our opinion, must long remain the standard book of reference on petrographic methods in the English language. It represents a colossal amount of literary research, which will be appreciated when it is stated that more than 130 periodical publications, in some half a dozen languages—mainly, however, in English, French, and German—are referred to. In addition, eight bibliographies are given at the ends of as many chapters, together with copious references in the form of foot-notes on nearly every page.

The first twelve chapters of the book are of a more or less introductory nature, dealing as they do with general and crystallographic optics; the action of the various optical elements used in petrographic research—more especially polarizing prisms—being very fully dealt with. The various forms of petrological Microscopes, too, come in for a good share of attention. Chapters XIII to XX deal principally with observations in

* By Albert Johannsen, Ph.D., Assistant Professor of Petrology, University of Chicago. New York and London: McGraw-Hill Book Co., Inc., 1914, xxviii. and 649 pp. (765 figs. in text).

ordinary as opposed to polarized light. The various methods that have been proposed from time to time for the determination of refractive indices, commencing with that of the Duc de Chaulnes (1767), and ending with the more modern methods of Schroeder van der Kolk, Pauly, De Souza-Brandão, Clerici, and Becke, are given in brief, as are also the various modifications of the method of Delesse for the determination of the volume percentage of the constituents of rocks by the measurements of areas and lines. No less than eight chapters, of more than one hundred pages—illustrated by remarkably good reproductions of plates from Dr. Hauswaldt's magnificent atlas entitled "Interferenzerscheinungen im polarisirten Lichte"—are devoted to the consideration of the examination of sections in plane, polarized, and convergent light. The work of Becke in determining the positions of the isogres in random sections, by making use of the curves of equal velocities (isotaques) and their orthographic projections (skiodromes), is dealt with. The measurement of the optic axial angle by the most approved modern methods receives satisfactory treatment in two well-illustrated chapters, as does also the determination of specific gravity in succeeding chapters. The final chapters deal with the mechanical separation of rock constituents; micro-chemical reactions; the cutting and preparation of thin rock sections, and petrographic collections.

Enough has been said, we doubt not, to convince English petrographers that Dr. Johannsen's book is one that cannot be dispensed with for their future work.

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Trap for Free-swimming Organisms.**†—Simply stated, this is an arrangement which cuts off the retreat of the creatures after they have been attracted into a small receptacle by light. The first trap used by the writer, S. C. Akehurst, was made of glass, in two pieces. The top is funnel-shaped, and holds about 5 oz. of water. This is attached to a horizontally-placed cylinder, 1 in. diam. and 1¾ in. long, the whole being mounted on a stem and foot. Into the cylinder is fitted a glass spigot, which has been ground in to avoid water passing. There is a hole at the bottom of the funnel flask which allows free access of the water to a small well in the glass spigot. When the trap is working, this well opens immediately under the hole at the bottom of the flask, and into this the organisms can enter freely. When desiring to fix the catch, give the spigot a slight turn—the mouth of the well then presses against the side of the cylinder and the contents become locked in.

To set the trap, fill the flask with pond-water, cover the entire

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

† Journ. Quekett Micr. Club, xii. (1914) pp. 279–80 (1 fig.).

funnel-shaped flask with some light-proof material, and direct all the light that can be gathered by a bullseye on to the cylinder which contains the glass spigot. Any swimming phototactic organism in the water will at once react and pass into the well, which is brightly illuminated—usually 10 to 15 minutes is sufficient to allow for this, but longer time can be given if necessary. Give the spigot half a turn and, as already explained, this locks the creatures in the well. The water can then be poured off from the flask, the spigot withdrawn, and the rotifers, or whatever may have been trapped in the well, can be taken up with a pipette and transferred to the slide for examination. After the

FIG. 44.

first catch has been taken the trap can be set again and a second lot secured. Work can therefore be carried on without interruption or loss of time until all the water has been dealt with. Should there be any sediment, this can be allowed to settle and then trapped off before any attempt is made to catch the organisms.

There is difficulty in obtaining this trap made in glass, so another has been worked out in metal (fig. 44). This consists of a round box, 1 in. deep, $3\frac{1}{4}$ in. diam., the top and bottom slightly convex, mounted on a tripod. A hole in the bottom allows the water to pass through a short tube, which is in three sections, the first part metal, the second rubber, and the third glass. A pinch-cock can be applied to the rubber connexion, which will prevent water passing when the glass tube has been removed for examination of contents. The metal box to hold the water is now made almost flat, which will allow any sediment to settle at the bottom. If the water is very muddy, a cork can be fitted into the outlet hole and left until the debris has settled, first filling the tube with clean pond-water. If the cork is carefully removed, very little, if any dirt will pass down the tube. Should some slip by, this can be trapped off, and the tube refilled with water, when a perfectly clear gathering can be secured. A strainer is provided, to be used, when necessary, for removing larvæ or any of the entomostraca.

It is important that as much light as possible should be concentrated on the glass tube. To arrange for this a bi-convex lens, $1\frac{1}{2}$ in. diam., silvered on one side and mounted in a metal holder with a movable support allowing it to be tilted at an angle, is placed under the tube, light from a bullseye condenser is received by the lens, and a bright beam passed up the tube. This method of transmitting the light is very effective, and the trap in consequence acts more rapidly and effectively than when the bullseye condenser only is employed. The lens, placed in position, is shown in the illustration.

**New Hæmoglobin-agar Medium for the Cultivation of Bacillus influenzæ.***—W. Thalhimer, having failed to obtain satisfactory growth of *Bacillus influenzæ* on crystalline hæmoglobin-agar, has devised a culture medium prepared with amorphous hæmoglobin, which has given encouraging results in his hands. The new medium is prepared as follows: Dissolve about 10 c.cm. of amorphous powdered hæmoglobin in 100 c.cm. distilled water and filter through a Reichel porcelain filter. Add a sufficiency of the filtrate to fluid agar to give it the colour intensity of ordinary blood-agar. The mixture is then poured into tubes and slanted. With regard to the failure of crystalline hæmoglobin, it is suggested that in the process of crystallization the hæmoglobin becomes so changed that it is no longer available for the growth of *B. influenzæ*.

**New Method of Investigating Anaerobic Stab Cultures.**†—Konrich recommends the following method of obviating the difficulties that usually attend the abstraction of culture material from "stab cultures," which not infrequently involve the breaking of the test-tube and the contamination of its contents. Seize the culture tube with a Cornet's forceps near the middle; remove the plug and flame the edge and upper part of the tube, which is then introduced between the two halves of a sterile Petri dish. Now hold the lower part of the test-tube for a moment in the Bunsen flame till some of the agar becomes liquid. The small portion of liquid agar becoming vaporized expels the agar column (just as the expansion of steam drives forward the piston of a steam-engine), which glides uninjured into the Petri dish, where it can be cut longitudinally or in cross-section and the culture material conveniently abstracted. During the expulsion of the agar hold the test-tube slightly

* Centralbl. Bakt., 1te Abt. Orig., lxxiv. (1914) pp. 189–90.
† Centralbl. Bakt., 1te Abt. Orig., lxxiv. (1914) pp. 191–2.

downwards. In old cultures, where the upper portion of the agar has adhered to the tube, the medium can be loosened with a suitable spatula.

The above method applies to agar and serum agar cultures (which do not stick to the tube). With gelatin cultures the test-tube should be held in warm water until the layer next the glass becomes melted. If the tube is then held steeply the culture column will often glide out into the Petri dish without further manipulation.

**Demonstration of Streptococci in the Flowing Blood.***—S. Reichstein draws attention to the fact that bacteriological investigation in cases of septicæmia is often unsatisfactory, and suggests modifications in technique in order to bring about better results. His investigations were carried out on rabbits infected with *Streptococcus pyogenes*. The bleedings were made by means of aspiration of the jugular vein, which vein presents advantages over (1) the marginal vein of the ear, as the blood can be procured sterile and without producing thrombosis; and (2) the carotid artery, as repeated samples can be taken for purposes of continued research. The use of a medium-sized syringe is insisted on, as in the filling of a large syringe coagulation of the blood may take place. Samples of blood taken at varying periods were defibrinated or treated with oxalate solution or leech extract to prevent coagulation. The first method gave poor results on account of the organisms becoming entangled in the fibrin clot; the other methods, however, gave satisfactory counts on plating out. The blood samples were inoculated on to the surface of glycerin-agar, glucose-agar, and ascitic-fluid agar respectively, but no significant variation in the number of the resulting colonies was observed. Blood samples should be placed for twenty-four hours in the incubator previous to plating; if left at room-temperature the contained organisms may decrease in numbers or perhaps die out completely.

### (3) Cutting, including Embedding and Microtomes.

**Paraffin Ribbon-carrier.**†—The carrier described by Robert T. Hance was designed to handle the paraffin ribbon as it comes from the microtome in such a way as to preserve a perfect series and to eliminate some of the difficulties encountered with the usual method. Not only is the old method of cutting long serial sections into short pieces and laying them upon a sheet of paper tedious, but the danger of losing a part of the sections in a sudden draught or having them hopelessly mixed is great. Without careful shielding, ribbons placed upon paper may not be allowed to lie for any length of time before mounting. With the use of the carrier long unbroken series may be wound on the drum and allowed to remain until used. The writer has allowed a ribbon to remain on the carrier for three days, exposed to all the draughts common in the average room, and at the end of the time was able to mount a perfect series with no difficulty. The inclined plane shown in the photograph

* Centralbl. Bakt., 1te Abt. Orig., lxxiii. (1914) pp. 209–23.
† Trans. Amer. Micr. Soc., xxxii. (1913) pp. 297–9 (2 pls.).

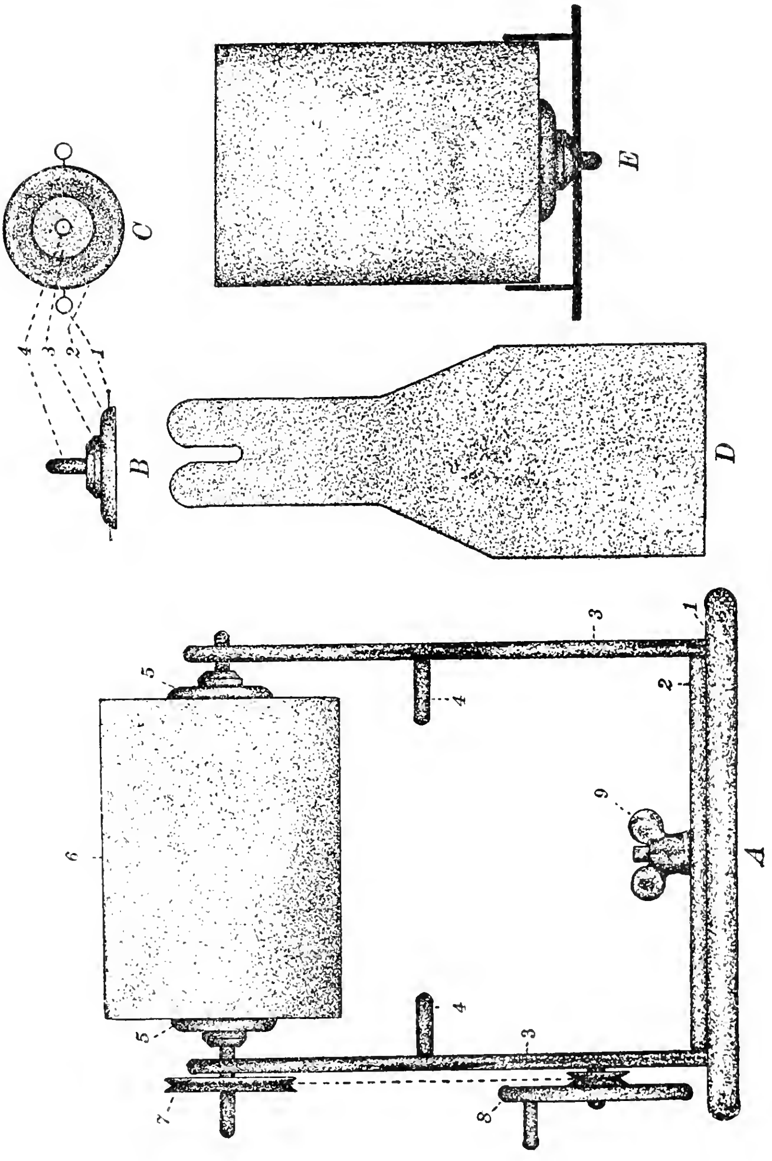


Fig. 46.

greatly facilitates mounting. The ribbon is unwound from the drum on to the plane, where it is cut to the desired lengths. The continuous ribbon does away with the bother of piecing bits together, as is frequently necessary when mounting from short strips laid on paper.

*Directions for making. Material* :—All the materials necessary for making the machine are easily obtained, and at slight expense. The wood used was poplar and yellow pine, taken from an old packing-box. A 1-lb. coffee-tin was made to serve as the cylinder or drum. *Dimensions* :—*1.* The base, $9 \times 6 \times \frac{1}{2}$ in. (fig. 46, A). A slot, $2\frac{1}{2} \times \frac{1}{4}$ in. (fig. 47, *10*), is cut in the centre to accommodate the winged nut (*9*), which fastens the uprights (*3*) to the base. *2.* The base to which the uprights are fastened, $7 \times 3 \times \frac{1}{4}$ in. A $\frac{1}{4}$-in. hole is bored in the centre of this base to pass the screw of the winged nut through. *3.* The uprights, $2 \times 3 \times \frac{1}{4}$ in. The width narrows 4 in. from the bottom to

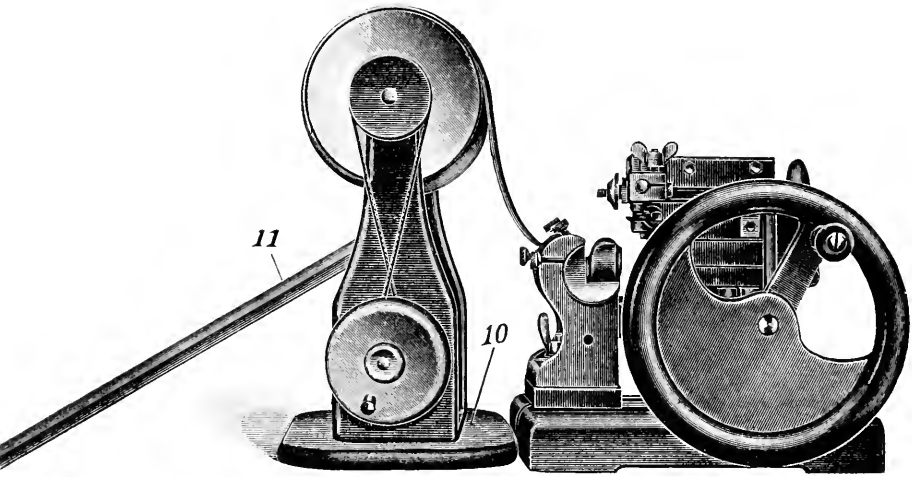



Fig. 47.

$1\frac{1}{2}$ in. Slots, $1 \times \frac{1}{4}$ in. are cut in the tops of the uprights (fig. 46, D) to accommodate the axles of the drum. The uprights were made for the Leitz Base Sledge Microtome, and though the height to which they raise the drum works very well with the rotaries, 2 in. might be cut from their length with advantage. *4.* These are pegs that are inserted $4\frac{3}{4}$ in. from the base to carry the inclined plane, shown in fig. 47, *11*. *5.* The axle support. This is a disk of wood $2 \times \frac{1}{4}$ in., through the centre of which a $\frac{1}{4}$-in. walnut axle is thrust. The end of a maple-spool is glued to the top of the disk to serve as a bearing (fig. 46, B *3*). *6.* The drum. The lid is soldered on to a 1-lb. coffee-tin, the measurements of which are $6 \times 4$ in. The can is covered with blotting-paper. This drum will carry about 14 ft. of $\frac{1}{2}$-in. ribbon. *7.* The drum pulley, $2 \times \frac{1}{4}$ in., and grooved as shown in the diagram. The belt runs from this pulley to one made by fastening the ends of a small spool together, and which is secured to the inner surface of the driving wheel. *8.* The driving wheel, $3 \times \frac{1}{4}$ in. A handle is inserted in one side, as shown in the diagram, though very little use is found for it. *9.* Winged nut, $\frac{1}{4}$ in. in diameter. *10.* Slot, $2\frac{1}{3} \times \frac{1}{4}$ in. (fig. 47), in which the bolt of the winged nut slides. This allows the adjustment of the drum to meet requirements. *11.* Inclined plane, $12 \times 6\frac{3}{4} \times \frac{1}{4}$ in. At one end two pegs are placed to engage those shown in fig. 46, A *4*.

*General Directions* :—The only difficulty that will be encountered in the making of the carrier will be to fasten the axle supports squarely in the centre of the drum. Centring the axles may be easily accomplished by drawing a circle the exact size of the drum on a board, and then, after determining the centre, drill a hole the size of the axle ($\frac{1}{4}$ in.) through it. Insert the axle into this hole (fig. 46, E). Drive long brads or nails at the periphery of the circle as shown in this fig. so as to hold the drum firmly in place when it is lowered. Coat the axle support with glue and press the drum tightly against it. The nails will hold the drum in place, and the axle will be in the exact centre of the cylinder. Glue may serve to fasten the axle permanently to the drum, but the author finds that it does not take a very firm hold of the tin and soon breaks away. This may be overcome by first placing small brads or screw-eyes (fig. 46, B *1*) in the sides of the axle supports and then gluing the disks on as directed above. After the glue has set firmly enough to hold the disks in place solder is run in under the screw-eyes and they are thus firmly fastened to the tin.

*Directions for using* :—Cut a ribbon from 8 to 10 in. in length and press one end lightly against the blotting-paper covering the drum. After this the ribbon is wound on the cylinder as it comes from the microtome (shown in fig. 47) by thumbing the edge of the driving wheel, which revolves the drum very slowly (the drum revolves once to every two and a half revolutions of the driving wheel). The winged nut allows the cylinder to be adjusted to the demands of the particular microtome in use. The ribbon is wound spirally upon the drum by sliding the carrier parallel to the knife. When ready to mount, the ribbon is unwound on to the inclined plane which is covered with blotting-paper and cut to the desired lengths.

### (4) Staining and Injecting.

**Viability of Dried Bacterial Preparations (Stained and Unstained).***—O. Thurn has investigated the effects of drying, and staining with different reagents, on slide preparations of various kinds of bacteria. The organisms principally used were micrococci, coli, typhoid, cholera, diphtheria, and yeast. Ordinary methods of drying film-preparations (including the usual rapid drawing three times through the Bunsen flame) had no effect on the viability of the bacteria. With regard to stained preparations, he found the Ziehl carbol-fuchsin stain killed most vegetative forms of bacteria, but spore-staining by Möller's method had no effect (*B. mesentericus* and *B. anthracis*). Acetic acid methylen-blue (Neisser's stain) prevented the growth of *B. diphtheriæ*,

* Centralbl. Bakt., 1te Abt. Orig., lxxiv. (1914) pp. 81–90.

and Gram's stain destroyed all vegetative forms of bacteria by virtue of the independent bactericidal action of anilin and iodin respectively.

**Demonstrating the Structure of Mixed Nerves.***—S. W. Ranson used the human vagus nerve, and made sections some distance below the nodose ganglion. The steps of the technique were as follows:—The animal is exsanguinated and the desired tissue promptly removed and placed in absolute alcohol containing 1 p.c. strong ammonia for forty-eight hours, rinsed in distilled water, put in pyridin for thirty-four hours, washed thoroughly in distilled water for twenty-four hours, placed in 2 p.c. silver nitrate at 35° C. in the dark for three days, rinsed in water and placed for one day in a 4 p.c. solution of pyrogallic acid in 5 p.c. formalin. Paraffin sections are made. Medullated axons are stained yellow and are surrounded by a colourless ring of myelin. Non-medullated fibres are stained black, and are sharply differentiated from the light yellow endoneurium.

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

**Method of Marking a given Object for Future Reference on a Mounted Slide.**†—First find the object, says J. Burton, then with a fine camel-hair or sable brush carefully place a dot of water-colour over it large enough to be seen with the naked eye, set it on one side to dry. When dry put the slide on the turntable with the dot accurately in the centre and turn a ring round it with any dark cement you may have in use; when this is hard the water-colour can be removed with a damp brush and the cover can be carefully cleaned with a piece of soft rag.

When the object is very small a more complicated variety of the foregoing plan is adopted. Again, first find the object with a suitable power such as $\frac{1}{4}$ in. or $\frac{1}{6}$ in., and let the specimen be as accurately placed in the centre of the field as possible; then substitute for this power, preferably a water-immersion objective, say $\frac{1}{10}$, put on the front lens a small drop of water, and carefully focus. It is necessary that the slide should not be moved after contact is made, as it is desirable to keep the drop of water as small as possible. When the object is recognized as in the centre of the field, raise the Microscope tube rather sharply and a small circular spot of water will be left on the cover-glass right over the desired place. Now stain this spot with water-colour as in the other case—I always use the carmine kept for feeding infusoria, etc., but any colour will do. When this is dry the slide may be roughly examined and the object will be seen through the coat of colour, which for this purpose should not be too thick. If it be rightly placed, proceed as before, puting a fine ring of suitable size round the spot with some dark cement, and when this is dry carefully clean off the colour, and the arrangement is complete. Water-immersion lenses are not very commonly used now, and if the microscopist does not happen to possess one

* Anat. Anzeig., xlvi. (1914) pp. 522–5 (1 fig.).
† Journ. Quekett. Micr. Club, xii. (1914) pp. 311–12.

an oil-immersion may be used instead, but obviously it must be used with water, not oil; but this will give a sufficiently good image for our purpose, which is merely to recognize the specimen for marking, not to examine it. If an oil-immersion be not available, any close-working objective, say $\frac{1}{8}$ in. or even $\frac{1}{6}$ in. may be used, but it is necessary that the front lens be a small one, so that the spot of water placed by it should be as local as possible.

There are, of course, some difficulties; the chief is, that objects mounted in glycerin are somewhat liable to move if at all roughly handled, and may work out of the circle; but with balsam or glycerin-jelly mounts, or even a shallow glycerin one, there is little danger of this. If a turn-table is not in the outfit of the experimenter, a sufficiently good circle may be drawn by hand, or a line drawn to indicate the position, or, as has been suggested, the barrel of a mapping pen or similar object may be used. But the first great difficulty is always to indicate the exact spot it is desired to mark, particularly if the object is a very minute one, and that is got over with facility by the method indicated.

**Picking Out and Mounting Diatoms.**—The art of selecting and picking out any considerable number of diatoms from a spread which contains a variety of species, and of arranging the selected diatoms successfully for mounting, appears to be attained by comparatively few persons. The methods by which successful results are secured are not generally known. Many workers are able to select a limited number of forms by the hand method of picking, but this method requires great concentration and nerve control. Among the difficulties to be surmounted, or at least allowed for, are the pulse beats that affect the hand, the high magnification making the pulsations quite apparent.

In 1895, J. M. Blake * devised an apparatus which overcomes many of the difficulties. This apparatus is a small pantograph made of light wire. It reduces the motion of the hand twenty-six times. It consists of a jointed parallelogram P made of No. 20 iron wire. This wire is flattened at the points where the rivets are placed. This parallelogram measures 5 in. on each side. Within this area, in one of its angles, is built a minute parallelogram twenty-six times smaller than *s*. This tiny parallelogram measures $\frac{3}{16}$ in. on each side. The apex of the larger outer form P is coincident with that of the small inner member *s*, and rotates on the same rivet. This rivet also passes through a short bit of wire, and on this wire P can be rotated in its own plane. This rotation gives P a horizontal motion, while the short bit of wire itself rotates in bearings which give an up-and-down motion at right angles to the plane of P; P itself slips over and around the body of the Microscope. The short bit of wire referred to has its bearings held about $\frac{1}{4}$ in. above the stage of the Microscope. This leaves room for a glass slip $1\frac{1}{2}$ in. wide and 6 in. long to move underneath. A piece of sheet-tin is bent so as to form a clip to spring over the farther edge of the Microscope stage, and to this piece of tin the bearings of the short piece of wire are attached by supporting strips. In use the diagonally opposite apex

* Amer. Journ. Sci., xxxvii. (1914) pp. 535–8.

of P is to be held in the hand, and a short and finely pointed hair is attached by wax to the corresponding apex of *s*. This hair is the implement for picking up the diatoms, and points in a downward direction. The diatom spread is made on a cover-glass, and from this spread the selections are to be made. This cover-glass is attached by moisture to the first-mentioned slip of glass. The cover-glass to which the diatoms are to be transferred is also attached to this slip by wetting. The Microscope is inclined, and the slip of glass rests on the stage and slides on the top edge of a thin strip of wood, which also rests on the stage. This strip may be $\frac{1}{2}$ in. wide and 1 ft. long. Attached to this strip of wood from below are two broader strips, which come level with the top of the stage and form a shelf or a rabbet along which the slip of glass can slide. This narrow shelf forms a lateral extension to the stage of the Microscope. Strips of wood attached by screws to the shelf from below bind it to the stage. These clamping pieces allow the shelf to be pushed up and down. The cover-glasses mentioned can also be pushed up or down on the glass slip, provided we preserve the moisture under them. The pantograph can be adjusted in position by slipping the tin clip on the Microscope stage. P is so arranged and adjusted that the point of the hair comes into the field of the Microscope. When it is desired to leave P for a time out of hand, a temporary support is provided so that the point of the hair is held just at the top of the field of view, but raised a little so as to be partly out of focus. When all the adjustments are completed, the working of the apparatus is as follows: The glass slip is moved along on its shelf to bring the spread into view, and the hair point is employed to loosen any desired diatom. This selected diatom is then picked up by the hair. In very dry weather electrical action often causes a good deal of trouble. Diatoms will sometimes suddenly jump out of the field. If we are successful in holding the diatom, it is then raised and the glass slip is moved to the position which brings the desired part of the reception cover into view, and the diatom is deposited at or near the desired place and worked about with the point until it is satisfactorily located. We now breathe upon the located diatoms through a flexible tube, which tube is attached in proper position for this purpose to the Microscope objective. Gentle breathing causes adhesion to the prepared cover-glass.

The preparation of the cover-glasses is as follows: The covers are cleaned so that liquid will flow freely over them without creeping. They are then dipped, while held singly in clean forceps, in filtered gelatin solution containing 10 gr. of gelatin and 5 gr. of sugar to the ounce. This is sometimes diluted to two volumes. The sugar may at times be omitted. We endeavour to adapt the gelatin solution to the atmospheric conditions at the time of coating. The gelatin itself may vary in quality. The aim is to make this coating sufficiently adhesive to hold the diatoms, and at the same time not to have it run in and obscure them. Contact with the fingers must be avoided. The covers are now stood on edge to drain and dry. Then a small central ring may be spun on them, and also a marginal ring to be mentioned later.

In this way any desired number of diatoms can be collected and located. It is well to have an intermediate stamping ground for temporarily depositing the selected diatoms where they can be cleared from adhering fragments before finally locating them. It is important to have all these cover-glasses of the same thickness, so that no time will be lost in focusing as we pass from one to the other.

One difficulty in picking up from a diatom spread will be found due to adhesion to the glass surface. This adhesion is caused by dissolved silica, or by some other soluble substance which may come from the glass surfaces, or from the water in which the diatoms are suspended. This adhesion may be prevented in part, by repeated settlings from freshly distilled water; but at the best, some of the more delicate shells will often break before they can be detached.

The author has recently tried a plan which promises to be a help in such cases. This plan is to grind down thin slips of baked pipeclay or similar material. This material is then finely surfaced and ignited to drive off moisture. These slips may be blackened by charring sugar solution, which can be soaked into them. They are then scrubbed in order to remove adhering particles, and again heated to drive off moisture. The diatom-spreading pipette is then drawn across the surface, and the liquid is at once absorbed before it has time to dry on the surface and cause adhesion of the diatoms. Porous arc-light carbon may be ground down thin and used for this purpose. Reflected light must be used over these opaque surfaces. A two-thirds objective will give sufficient working space, and the eye-piece should be an erecting one.

Monobromide of naphthalin has usually been regarded as a difficult mountant to make secure. Several of the monobromide mounts made by the author, however, in 1895 have kept in good order up to this date. For this reason it may be of interest to give some account of the method used in preparing them. They were sealed with gelatin. The refractive power of the unmixed monobromide used appears not to have suffered by lapse of time. Loss of refractive power has been reported to have occurred when a wax seal was employed. The glass covers that have been coated with thin gelatin in the way that has been described are next given a marginal ring, and the reception slide itself is also given a preparatory ring. This treatment secures reliable contact of gelatin and glass, as both gelatin rings are dried before the monobromide is applied. A binding ring of warm gelatin completes the adhesion of the two gelatin rings after the monobromide has been included. After this sealing ring has dried and has proved to be secure, and not till then, a final ring of shellac is applied. Any other cement that will resist the action of immersion fluids can be used in place of shellac. A recent sample of bleached lac has developed fine cracks on drying. The older slides did not show these cracks in the rings. The use of shellac is to protect the gelatin from damp.

The gelatin preparatory rings were composed of gelatin 20 gr., sugar 10 gr., and water $2\frac{1}{2}$ drams. These preliminary rings need not be thicker than the height the diatoms make necessary. Experience has shown that these rings should be broad, and that the surfaces of contact should be perfectly even. The final sealing gelatin ring may be made of more concentrated gelatin, rendered as thick by evaporation of a portion of the original preparation as will flow easily from the brush. The flow will depend to a great extent upon the temperature of the room. This gelatin seal can also be used for holding the solution of phosphorus in carbon disulphide when this solution is employed as a mounting medium.

### (6) Miscellaneous.

**Blocks.**—For the loan of the blocks to figs. 34, 35, 36, 37, 38, 39, 40, 41 and 44, we are indebted to the Quekett Microscopical Club.

## Metallography, etc.

**Microchemistry of Corrosion.***—S. Whyte and C. H. Desch have made corrosion experiments upon four copper-zinc alloys of $\alpha$ composition, by a method substantially the same as that applied previously to $\beta$ alloys.† All the alloys contained about 70 p.c. copper, the remainder being all zinc in one alloy, while the three others contained respectively 1 p.c. tin, 1 p.c. lead, and 2 p.c. lead. Corrosion appeared to proceed by dezincification in all cases; the loss of copper by corrosion, however, was greater than in the $\beta$ alloys. The film of copper left was intimately mixed with basic salts, which adhered very firmly. Momentary immersion in very dilute hydrochloric acid removed the oxychloride, exposing the coppery layer, which was invariably made up of small crystals, mainly exhibiting octahedral angles. In the long-period tests etch-figures were conspicuously developed, cubic forms being frequently observed. The boundary between the brass and the dezincified (copper) layer was always perfectly sharp. In the brass surface, after the copper skin had been detached, the crystal boundaries were visible. The cored structure of an unannealed specimen was strongly developed during corrosion, finally leaving ridges in high relief, whilst the annealed alloys corroded very uniformly. When the adherent layer was detached from the alloys containing lead, each isolated mass of lead was seen surrounded by a ring of copper. The micro-structure of some corroded condenser tubes, which also showed pronounced dezincification, is described.

**Vanadium in Brass.**‡—R. J. Dunn and O. F. Hudson have made a thermal and microscopic examination of copper-zinc alloys containing 50 to 60 p.c. copper and 0 to 1·5 p.c. vanadium. No tendency towards the structural resolution of $\beta$ into $\alpha$ and $\gamma$ was observed even after prolonged annealing. The authors conclude that the usual structure of brasses, containing between 50 and 60 p.c. copper, is not greatly modified by the presence of small quantities of vanadium, and that vanadium to the extent of at least 1 p.c. appears to have no influence on the structural stability of the $\beta$ constituent of the copper-zinc alloys.

**Muntz Metal.**§—In the course of a study of the properties of 60/40 brass after various heat-treatments, J. E. Stead and H. G. A. Stedman have examined numerous specimens microscopically. Long continued annealing at temperatures below 470° C. had the apparent effect of increasing considerably the volume of the $\alpha$ phase at the expense of the $\beta$.

* Journ. Inst. Metals, xi. (1914, 1) pp. 235–51 (6 figs.).
† See this Journal, 1914, pp. 220.
‡ Journ. Inst. Metals, xi. (1914, 1) pp. 151–68 (22 figs.).
§ Journ. Inst. Metals, xi. (1914, 1) pp. 119–50 (38 figs.).

It is suggested that the $\alpha$ constituent thus produced contained less than 62 p.c. copper. J. E. Stead describes a method for distinguishing the $\alpha$, $\beta$, and $\gamma$ phases in brass. Polishing is finished on a very wet block. The surface of the specimen is dried with a clean linen rag before the water has evaporated at all. The specimen is heated to 80–100° C., rubbed with chamois leather and floated on molten tin or lead. A gaseous mixture made by blowing air through dilute ammonium sulphide solution is directed on the polished surface until the desired tints appear. The $\alpha$ constituent passes through the range of colour, dark yellow, brown, carmine, blue, to slate-grey. The $\gamma$ constituent when associated with $\alpha$ remains unaltered, and appears white on the coloured ground. The method may be used for detecting variations in distribution of copper in the $\alpha$ phase, since it is capable of developing the primary dendritic structure. For distinguishing $\beta$ and $\gamma$ when they occur together, air containing traces of bromine instead of ammonium sulphide may be used.

**Structure of Electro-deposited Copper-tin Alloys.***—In the course of an investigation upon the electro-deposition of copper-tin bronzes, R. Kremann, C. T. Suchy, J. Lorber, and R. Maas have studied the micro-structure of the deposits. Alloys deposited from cyanide electrolytes were more uniform than those from a tartrate electrolyte.

**Annealing after Quenching of Copper-tin and Copper-zinc Alloys.**†
A. Portevin has quenched and annealed a copper-tin alloy containing 80 p.c. copper and a copper-zinc alloy containing 58 p.c. copper. The bronze was quenched at 700° C., the brass at 825° C.; in each case some of the $\alpha$ constituent was dissolved in the apparent $\beta$ upon heating, and retained structurally in the $\beta$ by quenching. On reheating to temperatures which were raised in successive experiments, the $\alpha$ separated from the $\beta$ in the form of needles, or at the grain boundaries. The needles produced the appearance of the Widmannstätten structure. The first effect of reheating the quenched alloys was to increase the hardness somewhat; the hardness then fell off again as the annealing temperature was raised. The copper-aluminium alloys have been shown to behave in a similar manner.

**System Silver-silver-sulphide.**‡—C. C. Bissett has made a thermal investigation of the equilibrium of this system, and has examined twenty alloys microscopically. Between 17 and 94 p.c. silver sulphide the molten alloys separate into two liquids. Silver sulphide appears to be slightly soluble in silver in the solid state. The eutectic contains 99 p.c. silver sulphide. No compounds in addition to the $Ag_2S$ were found. Two etching reagents were used; hot potassium cyanide solution etched the sulphide without attacking the silver, while freshly prepared hot ferric sulphate solution etched the silver without attacking the sulphide.

* Monatsh. Chem., xxxv. (1914) pp. 219–88.
† Comptes Rendus, clviii. (1914) pp. 1174–7 (4 figs.).
‡ Journ. Chem. Soc., cv. (1914) pp. 1223–8 (7 figs.).

**Alloys of Aluminium and Silicon.***—C. E. Roberts has found by thermal methods that the aluminium-silicon system is a simple eutectiferous one; this was confirmed microscopically. The silicon crystallized in plates arranged in five- or six-rayed stars.

**Tungsten and Carbon.**†—O. Ruff and R. Wunsch have studied the equilibrium of the tungsten-carbon system, and describe the microstructure of a number of alloys prepared by melting in the electric furnace. When more than 2 p.c. carbon was present, final polishing with any of the usual polishing powders was ineffective owing to the great hardness of the alloys; these were polished on emery-paper only. The specimens were etched with a mixture of nitric acid, hydrofluoric acid, and water, and washed with water and sodium-hydrate solution to remove the tungstic acid formed. Pure tungsten showed sharply-defined polyhedra. With 0·12 p.c. carbon a eutectic was observed at the crystal boundaries. As the carbon-content increased more eutectic appeared, and at 1·43 p.c. carbon the specimen consisted wholly of a eutectic of typical structure. With more carbon massive carbide appeared, and at about 2·1 p.c. the alloy appeared to be wholly the carbide $W_3C$. A second eutectic appeared in alloys containing more carbon. The carbides found were $W_3C$ (melting point over 2700° C.), WC, and probably $W_2C$. In all, three eutectics were observed, one of which appeared to be a metastable ternary eutectic.

**Copper-aluminium-nickel Alloys.**‡—A. A. Read and R. H. Greaves have determined numerous properties of two series of alloys containing 5 and 10 p.c. of aluminium respectively. The nickel in each series ranged from 0 to 15 p.c.; the remainder was copper. The authors find that of the typical $\alpha$ and $\beta$ constituents of the copper-aluminium alloys the $\alpha$ certainly, and possibly the $\beta$, will dissolve nickel without change in appearance. In addition to these, two other constituents were met with: A, in the 10 p.c. aluminium series, a greyish-blue constituent which appears in the slowly-cooled metal at 5 p.c. nickel, but is suppressed by quenching up to 7·5 p.c. nickel; with 10 p.c. and more it forms primary crystals which are not removed by quenching. B, in the 5 p.c. aluminium series: a constituent which in the slowly-cooled metal first appears at 5 p.c. nickel, but which is suppressed by quenching from 900° C. until the nickel exceeds 10 p.c. As a secondary constituent this etches brown or bluish, but with 15 p.c. nickel what is probably the same constituent forms primary dendritic crystals of a clear blue colour, persisting after quenching. The authors incline to the opinion that A is a nickel-aluminium compound, and B a copper-nickel solid solution (probably containing aluminium). The etching reagent generally used consisted of four parts of a solution of ferric chloride in water (1:12), and one part of concentrated hydrochloric acid.

**Neumann Lines.**§—In examining specimens of steel containing 0·05 to 0·10 p.c. carbon, broken from a partially-rolled ingot, Matweieff

* Journ. Chem. Soc., cv. (1914) pp. 1383–6 (5 figs.).
† Zeitschr. Anorg. Chem., lxxxv. (1914) pp. 292–328 (19 figs.).
‡ Journ. Inst. Metals, xi. (1914, 1) pp. 169–213 (28 figs.).
§ Rev. Métallurgie, xi. (1914) pp. 766–70 (7 figs.).

has observed straight lines, oriented in several directions, in the polished surface, after etching with 2 p.c. nitric acid in alcohol. The lines were considered to be Neumann lines. H. le Chatelier suggested that they originated during polishing. When a grain of emery scratched the surface in a direction identical with one of the cleavage planes of a particular crystal, twinning occurred in that crystal along the track of the scratch. Such lines would be interrupted where the scratch crossed a crystal of different orientation. A twinned layer formed in this fashion would be a Neumann lamella. The author has examined the specimens after deep etching and considers that the results confirm the truth of Le Chatelier's suggestion. It was found that the lamellæ were in relief and were cubical in transverse section.

A. Portevin and J. Durand * have found some exceptionally large crystals in the outer layers of a decarburized rail. A polished and etched section showed bundles of Neumann lines in the coarsely crystalline region. A very large crystal seen in the fracture, with one perfectly plane face (a cleavage face) was cut out for examination. The cleavage face was polished and deeply etched, and then showed very numerous Neumann lines. Out of the six possible different planes in which Neumann lamellæ can occur in one crystal, according to Osmond and Cartaud, five could be detected in the crystal examined. The authors point out that the so-called Neumann lines described by Matweieff (see above) appeared to be oriented in at least eight planes in one crystal. It is suggested that some of those lines were merely lines of cold-work caused by scratching during polishing. By re-polishing after deep etching it can be shown that Neumann lines are hollow grooves and are not in relief. The authors doubt whether Neumann lamellæ can be produced by the action of emery in polishing, and point out that the mode of preparation of Matweieff's specimens—by breaking under the hammer—is capable of developing a network of Neumann lamellæ, which are readily produced by mechanical shock.

**Volume Changes of Steel in Quenching.**† — M. Oknof has determined the specific gravity of seventeen steels, containing 0·08 to 1·67 p.c. carbon, after various heat-treatments, such as quenching from different temperatures. A number of the specimens were examined microscopically. Repeated quenchings of the hypereutectoid steels brought about decomposition of the cementite and a consequent progressive increase in volume, which masked the increase in volume due to hardening by quenching. The temper carbon formed was visible in polished sections, but not readily seen in the quenched specimens after etching, owing to the dark colour of the martensite and troostite. In the same specimens, after annealing, the temper carbon was readily visible within the pearlite; in some cases each mass of temper carbon was surrounded by a ferrite envelope.

**Structure of Hardened Steel.**‡—H. Hanemann and E. H. Schulz discuss the changes in volume and form which occur in the hardening of

* Rev. Métallurgie, xi. (1914) pp. 771–9 (15 figs.).
† Ferrum, xi. (1913–14) pp. 1–12 (13 figs.).
‡ Stahl und Eisen, xxxiv. (1914) pp. 399–405, 450–7 (24 figs.).

steel, and the effect upon structure of the stresses set up by the volume changes. The results of quenching and annealing experiments upon seventeen steels, containing 0·09 to 1·2 p.c. carbon, are given. To avoid the laborious sectioning by grinding of quenched pieces, some of the specimens were cut in two before hardening, the cut faces were polished and placed in contact, the pieces were fastened together with wire, and the joint luted with sodium silicate. The compound piece was readily divided after heating and quenching. The formation of an outer ring of martensite, surrounding osmondite in which martensite particles are embedded in the form of an inner ring, is explained.

**Iron-titanium Alloys.***—J. Lamort has studied the iron-titanium system in the range 0 to 24 p.c. titanium. Up to about 6 p.c. titanium the alloys consisted of crystals of a solid solution; beyond this concentration a eutectic, increasing in amount with increasing titanium content, was observed. At about 13·2 p.c. titanium the alloy consisted wholly of eutectic. A phase K, which is possibly the compound $Fe_3Ti$, then appeared, and increased, at the expense of the eutectic, with increasing titanium content. The alloy, containing 21·5 p.c. titanium, consisted chiefly of K, and contained very little eutectic. The etching reagents used were hydrochloric acid, concentrated and also in dilute alcoholic solution, and hydrofluoric acid. The duplex character of the eutectic, which consisted of the saturated solid solution and the phase K, is clearly shown by the photomicrographs. Inclusions of rod or cube form, yellow or reddish-yellow in colour, were numerous, and were evident in polished unetched sections owing to their comparative hardness. They were shown to be nitride or nitro-cyanide of titanium. The structure of some samples of commercial ferro-titanium is described.

**The 4·3 p.c. Carbon Eutectic.**†—J. E. Fletcher discusses the manufacture, properties, and structure of cast-iron. Commercial cast-irons are regarded as modifications of the 4·3 p.c. carbon eutectic (white iron), which may be considered as the natural form of pure cast-iron. The modifications occur through the addition of silicon, manganese, or other elements, or because of peculiarities in the processes of manufacture.

**Influence of Carbon and Silicon in Cast-iron.**‡—F. Wüst and K. Kettenbach have determined the mechanical properties and studied the microstructure of a large number of pure cast-irons containing varying amounts of carbon and silicon. Grey cast-iron may be regarded as a carbon steel, the structure of which is mechanically interrupted by graphite crystals. The mechanical properties of grey cast-iron are essentially dependent upon the amount and form of the graphite. Changes in carbon and silicon content influence the mechanical properties chiefly through their effect on the amount and form of the graphite. Increase in carbon and silicon causes an increase in the size of the graphite flakes. The best mechanical properties are obtained when the graphite exists largely in the form of temper-carbon.

* Ferrum, xi. (1914) pp. 225–34 (37 figs.).
† Foundry Trade Journal, xvi. (1914) pp. 278–84 (13 figs.).
‡ Ferrum, xi. (1913–14) pp. 51–4, 65–80 (20 figs.).

**Influence of Manganese in Cast-iron.***—F. Wüst and H. Meissner have investigated the mechanical properties and the microstructure of forty samples of grey cast-iron, falling into four series containing respectively 2·8, 3·1, 3·3, and 3·9 p.c. carbon, the manganese in each series ranging from about 0·2 to 1·5–2·5 p.c. The silicon content was about 1·6 p.c. Examination of large unetched sections at low magnifications indicated that the proportion of primarily-separated mixed crystals increased with increase of manganese. Thus the solid solubility of carbon in iron containing silicon at the temperature of solidification is raised by manganese, and the amount of the ledeburite eutectic is diminished; the size of the graphite flakes is also reduced. Graphite was found in two forms, lamellæ and small rounded inclusions which had apparently been formed in the temperature interval between final solidification and $Ar_1$. The pearlite was finer in structure as the manganese increased. The amount of graphite formed increased with increase of manganese up to 0·3 p.c., but further increase of manganese up to 2·5 p.c. had no further influence on the graphite content. The amount of ferrite diminished with increase of manganese.

**Meteoric Iron.**†—An account of the examination of a meteorite which fell at Winburg in 1881, by W. A. D. Rudge, includes a description of the microstructure. The specimen consisted essentially of iron containing about 7 p.c. nickel. It was formed of a mass of large ferrite crystals with veins of nickel-iron alloy running through, and with flakes and crystals of nickel-iron alloy disseminated throughout the mass. The details of the microstructure were most clearly developed by heat-tinting. The structure was considerably altered by annealing at 800° C.

**Solidification of Metals.**‡—C. H. Desch summarizes present knowledge on the subject of the earlier steps in the crystallization of metals from the liquid state. The summary is divided into the following sections; (1) the cellular structure of metals; (2) crystallization from centres and the formation of crystallites or crystal skeletons; (3) foam structures, and Quincke's hypothesis; (4) cellular structures in cooling liquids; (5) liquid crystals; (6) the influence of surface tension; (7) undercooling and the existence of a metastable limit; (8) changes of volume on solidification; (9) the thrust exerted by growing crystals. According to Quincke's hypothesis the first step in the process of crystallization is the separation of the liquid into two immiscible liquid phases. One of these, present in relatively very small quantity, forms the walls of "foam-cells" filled with the liquid present in greater quantity. Crystallization then proceeds within the foam-cells and is largely influenced by them. The crystal grain boundaries are the foam-cell walls. The author points out serious objections to Quincke's foam-cell hypothesis. Attempts have been made to connect the cellular structure of metals with a remarkable partitioning sometimes observed in cooling liquids. This effect, visible as geometrical patterns on the liquid surface, appears to be due to con-

* Ferrum, xi. (1914) pp. 97–112 (24 figs.).
† Proc. Roy. Soc., Series A, xc. (1914) pp. 19–25 (7 figs.).
‡ Journ. Inst. Metals., xi. (1914, 1) pp. 57–118 (9 figs.).

vection currents. It is probable that surface tension plays a part in determining the external form of metallic crystallites. The programme of experimental work proposed includes the microscopic examination during crystallization, of small masses of metals of low melting point, melted on an electrically heated Microscope stage, and covered by a thin cover-glass of transparent silica. The numerous references given form a useful bibliography.

**Processes of Solidification and Grain Growth in Metals.*** — F. Robin discusses the crystallization of metals from the liquid state and the phenomena observed during solidification and during the growth of metal crystals in the solid state. The results of a considerable volume of experimental work are reported. The observations of hot metals were made through the long-focus binocular stereoscopic Microscope previously described by the author. In a pure metal the solid surface, immediately after solidification, is smooth like the liquid surface, while crystallites may form in less pure metals. Then two systems of lines forming networks appear: (1) the crystal boundaries; (2) Cartaud's cellular network. All these lines are below the general level of the surface. On remelting, the network of crystal boundaries is the first to melt, and the level of the lines rises to that of the surrounding surface. The possibility of amorphous solidification followed by crystallization is suggested. Experiments on tin and lead have indicated that when a metal solidifies undisturbed by external mechanical influences the resulting structure is very stable and persists unchanged during reheating until the metal melts. Cartaud's cellular network is regarded as a contraction effect caused by a general shrinkage of the metal at the instant at which solidification is complete. Surface tension is an important factor in the growth of crystals on annealing.

**Metallographic Laboratory.†** — H. Hanemann states briefly the necessary requirements in the outfit of a metallographic laboratory.

* Rev. Métallurgie, xi. (1914) pp. 489–512 (21 figs.).
† Stahl und Eisen, xxxiv. (1914) p. 153.

# PROCEEDINGS OF THE SOCIETY.

## MEETING

Held on the 17th June, 1914, at 20 Hanover Square, W., Professor G. Sims Woodhead, M.A., M.D., etc., President, in the Chair.

**The Minutes** of the Meeting of May 20, 1914, were read and confirmed, and were signed by the President.

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**The List of Donations** (exclusive of exchanges and reprints) received since the last Meeting was read as follows, and the thanks of the Society were accorded to the donors :—

| | From |
|---|---|
| Report of the British Association for 1913 .. .. .. | *Sir Frank Crisp.* |
| Nees ab Esenbeck, Horæ Physicæ Berolinensis, 1820 .. | *Mr. Frank Robotham.* |

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**Mr. C. F. Rousselet** described John Cuff's "New Constructed Double Microscope," presented by Mr. John Sterry. This instrument is an early example of the model invented and introduced by Cuff in 1744, as is evidenced by its Latin inscription on the stage, "J. Cuff, Londini, Invt. & Fecit"; later, Cuff signed his Microscopes on the stage-plate in English, "J. Cuff. London. Maker." It is accompanied by a descriptive pamphlet, with plate, dated September 20, 1744, in which Cuff claims for his new Microscope the following advantages and reasons for its invention :—

1. A better method of illuminating objects than is possessed by either Hook's, Marshall's, or Culpeper's Microscopes.
2. A more exact method of focusing.
3. A silver reflector for viewing opaque objects.
4. A better form of stage, so that any object could be viewed without the legs being in the way.

In the year 1743, it appears, Henry Baker had complained of the various inconveniences of the older instruments, whereupon "Mr. Cuff, the optician, applyed his thoughts to fashion a Microscope in another manner . . . leaving the stage entirely free and open by taking away the legs, applying a fine-threaded screw to regulate and adjust its motion, and adding a concave speculum for objects that are opake." * The instrument thus invented by Cuff proved a very good and popular one, and contrasted favourably in its simplicity and compactness with the cumbersome Microscopes of the period. The model was afterwards copied by Adams, Jones, Dollond, and other makers as late as 1797.

About 1775 Dollond introduced a third bi-convex lens in the eye-piece for the purpose of increasing the field of view, and as the present model possesses this extra lens it is suggested by Mr. Thos. Court that at some time between 1775 and 1800 the instrument was placed in Dollond's hands for repairs, and the addition then made. Colour is lent to this suggestion by the fact that the box foot contained a descriptive circular by P. and I. Dollond, opticians in St. Paul's Churchyard, and not the original by Cuff. All other Microscopes made by Cuff seem to have only two lenses in the eye-piece.

John Cuff appears to have been a noted optician in the eighteenth century, highly esteemed by Henry Baker amongst others. Baker states that in the year 1740 a gentleman from Prussia, the ingenious Dr. Lieberkuhn, arrived in London and showed his Microscopes, a solar Microscope, and one for opaque objects, to several gentlemen of the Royal Society, and also to some opticians, amongst whom Mr. Cuff, "against Serjeant's Inn Gate in Fleet Street, has taken great pains to improve and bring them to perfection."

To the solar Microscope, Cuff added a rotating mirror; and Lieberkuhn's silver speculum, perforated in the centre, he applied to the compound Microscope by sliding it over the object-glass in the way it has been done up to very recent times, in particular in Powell and Lealand's Microscopes.

The box contains six object-glasses, finely ground, and polished single lenses, of various foci, and the usual accessories; condensing lens, frog plate, black and white discs, light modifying cone and ivory object sliders, etc.

The following particulars about Cuff have been supplied by Mr. Court. In the London Gazette for November 27, 1750, Cuff's name appears amongst the list of bankrupts; he is described as a spectacle maker of St. Dunstan in the West; his sign was a Microscope, Culpeper-Scarlett type, and three spectacles. The date of Cuff's death is not at present known, but he was supplying meteorological information to the Universal Magazine for the years 1758, when he describes himself as opposite Salisbury Court, and 1759, 1760, and 1761, when his address is opposite Shoe Lane; after this such information ceases to be given, and it is probable that he died about that date.

The Society now possesses three of Cuff's new constructed double Microscopes, one signed by him in Latin, another signed in English, and the third made and signed by Dollond.

On the motion of the President, a hearty vote of thanks was accorded to Messrs. Rousselet and Court for their interesting communications.

* Employment for the Microscope, 1753, p. 422.

**Dr. Shillington Scales** read a paper by Mr. Percy Aubin, F.R.M.S. on "The Buzzing of Diptera," omitting the descriptive part, which could hardly be followed in the absence of the detailed drawings and letterings (then in the hands of the lithographers).

Mr. Hopkinson thought the paper offered opportunities for discussion among entomologists. Although not an entomologist himself, he was familiar with Swinton's Insect Variety (1880), some 130 pages of which were devoted to discussing how sounds are produced in insects, including the following (page 211) :—"Chabrier informs us that in the bluebottle the hinder thoracic spiracles (metathoracic) are closed by (two) little scaly lips, and if these be carefully removed with a fine needle the buzz of the insect is scarcely audible during flight. Burmeister advanced further. Having removed all movable external parts from the common drone fly of our flower beds which still continued its peculiar notes, he also became convinced that the sound arose at these same metathoracic spiracles, which he proceeded to dissect. He then discovered their edges to be furnished internally with a fringe of parallel membranous plates, horizontally overlapping and decreasing in size towards either extremity. In this insect there are fifteen such on either edge."

Mr. Hopkinson then read from the English translation of Burmeister's Manual of Entomology the passage alluded to by Swinton, which gave a full account of these experiments on *Eristalis tenax*. As this translation appeared in the year 1836, the original would in all probability have been published in about 1834, so that similar experiments on the same fly were made some eighty years ago, with the same results as those carried out by Mr. Aubin and described in his paper, and it was somewhat strange that no reference had been made by the author to Burmeister's work.

The President said it might seem an extraordinary thing that two workers, living at such different periods, should independently have come to almost identical results, but in regard to plagiarism he always recalled what an old teacher of his, Professor P. G. Tail, once said to his class : "Gentlemen, our plagiarists are our predecessors." It must be remembered that subconscious cerebration was constantly occurring, and many examples were current in which a man had at some time or another gained an impression from something he had read, or may be from the very work upon which he was engaged, which led him along the same lines of thought as that pursued by his predecessors, and this without doubt perfectly honestly and sincerely, with the result that he brought forward what he thought was new work, only to find that it had all been done before. Whilst we could not fail to be very much struck by the great similarity which often occurred in the results of experiments carried out by two different workers, it must be remembered that men of like minds given the same material would naturally perform the same experiments. They would select the same organisms and work on the same lines ; and thus be led to obtain the same results. He was very loth indeed to believe that any man would willingly bring forward work he was not convinced was absolutely original. In the case of the paper they had just heard, it would be very interesting to find out from the author himself whether there were any possibility of his ever having come in contact with Burmeister's work; whether he had seen it, or discussed the book with anybody who had read it, a fact which might possibly account for the similarity of his conclusions with those of Burmeister.

Mr. Hopkinson said that he would like to absolve himself from all suspicion of accusing Mr. Aubin of plagiarism. He thought that both he and Burmeister had come to the same conclusions by the same method of experiment. But he also thought that when such a well-known book as Burmeister's Manual was available to all students of entomology, it was remarkable that the author had overlooked it when writing his paper.

The President said he had not thought even of hinting that Mr. Hopkinson had accused Mr. Aubin of plagiarism; his remarks on plagiarism had been of an entirely general nature. Mr. Aubin's paper would prove a valuable addition to the literature and study of the subject, especially because of the excellent illustrations, which were exceedingly accurate. He then proposed a hearty vote of thanks both to the author of the paper and to Mr. Hopkinson for his comments thereon, which was unanimously carried.

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**The President** then gave an address on "Luminous Bacteria," with demonstrations.

Dr. Shillington Scales regretted the absence of Mr. Barnard, as well as others interested in this subject, who would no doubt have taken the opportunity of discussing Professor Woodhead's valuable and interesting communication. He then proposed a very hearty vote of thanks to the President for his communication and demonstration on "Luminous Bacteria," a subject on which he was a recognized authority, at this their last Meeting before the summer vacation, which had certainly proved to be one of the most interesting evenings of a busy and strenuous session. The vote of thanks was carried with acclamation by all present.

The President thanked the Society, and said how much he appreciated the consideration and kindness which had been extended to him during his term of office, on which he would look back as one of the most pleasant episodes of his life—the honour of being President of this venerable and esteemed Society.

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Attention was called to the Roll, which was there for signing by those Fellows who had not already done so.

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It was announced that the next Meeting would take place on October 21, when a Conversazione would be held, similar to that which had proved such a success for the past two years. The same Committee had undertaken the organization of this Conversazione which it was hoped would prove a good opening for their next Session.

It was also announced that the Society's Rooms would be closed for the Summer vacation from Friday, August 14, to Monday, September 14.

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

John Cuff's Double Microscope. Shown by Mr. Rousselet.
Cultures of Luminous Bacteria. By the President.

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**New Fellows**:—The following were elected *Ordinary* Fellows of the Society:—Eugene Garretson, Arthur Douglas Merriman, B.A., Ralph Thorne, James Strachan.

# JOURNAL

OF THE

# ROYAL MICROSCOPICAL SOCIETY.

OCTOBER, 1914.


## NOTE.

### *Note on Sphærotilus.*

By E. Moore Mumford.

Since I understand from correspondence received by me that certain misconceptions have arisen with regard to my communication to the Society on *Sphærotilus*, I should like to communicate the following amplification.

Although I gave the diameter of the cells of the *Sphærotilus* described as 0 4–0·6 $\mu$, I do not regard this as rigid or typical, since many observers have reported the cells as from 1–2 $\mu$, and I am of the opinion with regard to these organisms that the size is extremely variable, but that a general morphological resemblance persists throughout the group. In the plate the *Sphærotilus* observed by Mr. Haigh Johnson, I am informed by him, has a cell diameter of about 2 $\mu$; *Cladothrix dichotoma*, observed by Ellis, is described as 1–1·5 $\mu$; and Mr. Johnson desires me to state this dimension, which I have pleasure in doing.

# SUMMARY OF CURRENT RESEARCHES

RELATING TO

# ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

# MICROSCOPY, ETC.*

## ZOOLOGY.

### VERTEBRATA.

#### a. Embryology.†

**Development of Gonads of Frog.‡**—E. Witschi begins with the "indifferent" stage. A single layer of germinal epithelium bounds a central cavity, the primitive genital cavity. Into this from the suspensory band there project solid partitions at regular intervals. These are the sex-strands of the pronephros.

Characteristic of the development of the ovary is the peripheral germinal epithelium and the early passage of the germ-cells into the growing phase. Characteristic of the direct development of the testes is the central position of the germ-forming areas (the urogenital connexion), and the late onset of the growing phase in the germ-cells. But in most cases (perhaps in all cases in natural conditions) the testes arise indirectly from an indifferent stage, which first puts on the characteristics of an ovary. The germinal epithelium thickens; nests of ova are formed; the elements pass through a phase of pseudo-reduction; sooner or later multiplying cells or strands of these separate from the germinal epithelium and migrate into the sex-strands; and, as in direct development, a typical testis is formed in the centre with seminal canaliculi and a rete.

The germ-cells of the indifferent stage arise from cells which lie at first outside the region of the subsequent gonads, and preserve the character of undifferentiated embryonic cells until they undergo metamorphosis into typical germ-cells. According to the author, all the facts point to the conclusion that from their earliest appearance the germ-cells are to be regarded as specific elements. In conditions not markedly divergent from the normal they do not change into somatic cells, nor do they arise from them.

* 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. Mikr. Anat., lxxxv. (1914) 2te Abt., pp. 9–113 (6 pls. and 7 figs.).

**True Hermaphroditism in Man and Mammals.***—Ludwig Pick takes a critical survey of the available facts in regard to hermaphroditismus verus in man and mammals. What is meant is the occurrence of definite male and female gonads in the same individual. Whether they produce gametes or not is another question. Organs which are characteristically testicular should be ranked as testes even if they produce no sex-cells. All gradations occur. Eleven cases of true germinal or gonadial hermaphroditism are known in the pig and three in man. It may be bilateral, with an ovotestis on each side; or unilateral, with testis on one side and ovary on the other. In Salén's case in man, the ovotestis on the right side had a functional ovary, and the tubules of the testicular part contained some indubitable spermatogonia. But we cannot do much more than refer to the author's very careful discussion of an intricate subject.

**Hermaphroditism in a Dogfish.**†—A. Vayssière and G. Quintaret describe what is a very rare occurrence—hermaphroditism in *Scyllium stellare*. The fish was on the whole a female, but the right pelvic fin showed a "clasper," and the ovary had attached to it a well-formed testis. There were two normal oviducts, and there was a single vas deferens (to the right) which had no connexion with the ureter.

**Blood-formation in Embryonic Liver.**‡—R. Haff finds that the liver of the embryo chick shows two periods of blood-making. The first begins about the middle of the seventh day of incubation and lasts till the beginning of the ninth day. There are numerous erythropoietic groups and a sparse granulopoiesis. The capillary endothelium and the peritoneal enveloping cells produce a reticular tissue, which is the starting point of the hæmatopoiesis.

From the indifferent connective tissue cells there develop the mother-elements of the blood, and from these through diverse stages of differentiation the red and white blood-corpuscles. The elements of the erythrocyte series appear in an extravascular reticulum, the open mesh-work of which bounds the vascular spaces, and they pass thence into the blood-stream.

The newly formed connective tissue does not extend through the whole organ at the time of the most intense blood-formation; especially in the central portions of the vascular area it retains its original closed character. About the middle of the ninth day the organ returns to its original indifferent state. About the eleventh day an intense granulopoiesis sets in, which reaches a climax about the fourteenth or fifteenth day. It wanes towards the end of the embryonic development.

**Origin of Supra-cleithral Bones from Epidermis.**§—B. Haller supports the view of Klaatsch that skeletal parts may arise from the epidermis. In the case of the supra-cleithral bones of the trout, he is

* Arch. Mikr. Anat., lxxxiv. (1914) 2te Abt., pp. 119–242 (5 pls. and 5 figs.).
† Comptes Rendus, clviii. (1914) pp. 2013–4.
‡ Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 321–50 (2 pls.).
§ Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 446–52 (1 pl.).

convinced that skeletoblasts migrating from the epidermis are the formative elements.

**Development of Pectineal Process.***—N. G. Lebedinsky has studied this in young Ratitæ. The anterior margin of the acetabulum of birds is formed from the processus ilii acetabularis pubicus. A blunt process, the eminentia iliopubica, is formed where the processus ilii acetabularis pubicus and the pubis unite. On the processus ilii acetabularis ilii there is often a pectineal process, or spina iliaca, on which the ambiens muscle is inserted. Mehnert showed that the eminentia iliopubica can be seen in the half-grown bird whether there is a pectineal process or not. Parker and Baur have shown that the pectineal process of the kiwi is formed by both ilium and pubis; Burge, Mehnert, and Lebedinsky have shown that the pectineal process of Carinatæ is formed from the ilium only; Lebedinsky now shows that the pectineal process of the ostrich (*Struthio*) is formed from the pubis only. Therefore the pectineal process cannot have any phylogenetic importance. It is probably a new acquisition within the class of Birds.

**Development of Lacertilian Sternum and Pectoral Girdle.**†— S. Bogoljubsky has studied *Lacerta*, *Anguis*, and *Ascalabotes* embryos. As regards *Lacerta*, the primordium of the sternum appears without assistance from ribs, from two paired triangular mesenchymatous streaks which lie on the sides of the embryo opposite the distal ends of the first two ribs. The primordium appears after that of the shoulder-girdle. The girdle-primordium appears after that of the basis of the limb. It includes at first a scapular region, a coracoid region, and a part of the clavicular region. The cranial part of the girdle, becoming joined to the epidermis, separates off from the rest of the connective-tissue primordium, except a connexion at its proximal (dorsal) end. Separating away from the skin, it ossifies directly into the clavicle. The coracoid region differentiates into præscapula, procoracoid, and epicoracoid. The interclavicles are outgrowths in a caudal direction from the median primordia of the clavicle. In *Anguis* the sternal streaks are not helped by ribs. In *Ascalabotes* the ribs coalesce early with the sternal streaks; in fact, an interval between them was not demonstrated.

**Embryonic Circulation in Axolotl.**‡ — F. Houssay returns to a difficult question which he discussed in 1893. A cardino-aortic primordium gives origin to the aorta and a common cardinal vein. The latter gives rise to a procardinal vein and a cardinal vein. The cardinal vein gives origin to the inferior vena cava by another splitting. The pronephros is connected with the procardinal vein and the cardinal vein; the mesonephros with the cardinal vein and the inferior vena cava; the metanephros with the inferior vena cava.

* Anat. Anzeig., xlvi. (1914) pp. 84–9 (2 figs.).
† Zeitschr. wiss. Zool., cx. (1914) pp. 620–66 (7 pls.).
‡ Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 5, pp. 101–8 (2 figs.).

### *b*. Histology.

**What are Plastosomes?**—Fr. Meves * answers some criticisms by Retzius, who doubts the distinctiveness of plastosomes or chondriosomes. The answer to the question, What are plastosomes? is somewhat as follows. The plastosomes are granules or threads of a specific nature, which are often visible in the living cell; they are present in all embryonic cells and in many cells of the adult body; they lie between the radiations or mitom of the cytoplasm, or between the threads of the framework which takes the place of the radiations; they are dissolved by strong acids or by strongly acid fixatives; they can be isolated microscopically, more or less perfectly, by using certain methods (Altmann, Benda, Meves, Regaud, and others); they pass in mitosis from the mother-cell to the daughter-cells; they represent according to many the primordial material for the most diverse differentiations that occur in development; male plastosomes pass with the sperm into the ovum at fertilization.

**Dimensions of Chromosomes.**†—C. F. U. Meek found some evidence in 1912 that both the diameter of the chromosome rods and the total volume of chromatin on the spindles increase as we pass from less to more complex organisms. He has lately studied the spermatogenetic mitoses of *Smerinthus populi* and *Gallus domesticus*. In the former, both the diameters of the chromosomes and the total volume of chromatin on the spindles are noticeably smaller than those observed in corresponding cell-generations of organisms of similar or even inferior somatic complexity. In the latter, the chromosomes are closely crowded on the spindles, and accurate measurement of the rod diameters is therefore difficult; but no doubt can exist that the total volume of the chromatin present is considerably less than that found in *Stenobothrus* and *Helix*, and many other lower organisms.

It seems, then, that neither the diameter of the chromosome rods nor the total volume of chromatin on the spindle can be correlated with the degree of somatic complexity of the organism. Thus cytometrical investigations have yielded only negative generalizations. The author proposes to continue his investigation. If his final results are also negative, it will show that this line of enquiry is unprofitable.

**Movement of Chromosomes in Nuclear Division.**‡ — Richard Geigel has given special attention to the movement of the daughter-chromosomes from the equator toward the centrosomes, and considers the mechanical interpretation proposed by Hartog. Geigel finds himself compelled to assume a special "vital attraction" or "vital force from a distance"—something peculiar to protoplasm.

**Transformations and Excitability of Protoplasm.**§—R. Demoll has made a number of experiments with the liver-cells of newts which

* Arch. Mikr. Anat., lxxxv. (1914) 1te Abt., pp. 279–302 (17 figs.).
† Note from C. F. U. Meek, Culls, Stroud, Gloucestershire, pp. 1–3.
‡ Arch. Mikr. Anat., lxxxiv. (1914) pp. 453–64 (2 figs.).
§ Zool. Jahrb. Abt. Allg. Zool., xxxiv. (1914) pp. 543–58 (12 figs.).

go to show that neither the removal of oxygen nor the hindering of the giving off of carbon dioxide is able to throw cells into the state of excitation. This state seen in moribund cells is not due to scarcity of oxygen or to accumulation of carbon dioxide. Histological investigation shows that non-fatal doses of chloroform leave the cells in a resting state. When the limit is passed the protoplasm of the cells passes into the state of excitation, and death ensues. The protoplasmic changes induced appear to be irreversible. The processes of excitation do not depend on what takes place at the periphery or membrane of the cells.

**Nuclear Substance in Relation to Fibrous Elements.***—Gaylord Swindle finds that the most important neuroglia-fibres arise by a metamorphosis of certain neuroglia nuclei. There are three kinds of metamorphosis involved. 1. A finger-like bud on the surface of the nucleus may grow out into a long fibre, the chromatin taking the form of a funnel-shaped bundle of fibrils. The protoplasm does not play an important role. 2. There may be a unipolar, or, more rarely, a bipolar or multipolar elongation of small compact glia-nuclei. 3. A third type of nuclear metamorphosis, in its earlier stages at least, is indirect amitosis. A neuroglia-cell may assume a multipolarity, as complex as a highly specialized ganglion-cell. Pseudopodia grow out in all directions, but the energy is in most cases expended only in one bud, which takes the form of a migratory vesicle. The whole elongated nerve-cell is really multinuclear—there is a stationary nucleus, a migratory nucleus, and the connecting nuclear cylinder with its protoplasmic sheath.

**Trophospongium and Reticular Apparatus in Spinal Ganglion Cells.**†—Emil Holmgren returns with fresh evidence to his thesis that the intracellular "Saftkanälchen" are due to the liquefaction of portions of a protoplasmic network or trophospongium, and that the latter is the same as Golgi's "apparato reticolare." In the vegetative life of the ganglion-cells the trophospongium extends as a network; under certain conditions portions become more or less fluid, forming the canaliculi. The acidophilous contour of the canaliculi represents the remains of the threads of the reticulum. Some remarkable figures are given of spinal ganglion cells from the rabbit.

**Vitreous Humour in Amphibians and Reptiles.**‡ — A. Syent-Györgyi has made a study of the vitreous humour, and of the histological and histo-topographical relations of its fibrillar portion, in the eye of Amphibians and Reptiles. In all the Amphibians and Reptiles investigated (and probably in all Vertebrates) the fibrillar portion of the vitreous humour exhibits a special structure, characteristic for each species, and constant down to the smallest details in the same form. The zonula and the vitreous humour are not so sharply distinguished from one another in Amphibians and Reptiles as in higher Vertebrates, but in most forms they are separated by a thickening of the vitreous

* Anat. Anzeig., xlvi. (1914) pp. 149–51.
† Anat. Anzeig., xlvi. (1914) pp. 127–38 (9 figs.).
‡ Arch. Mikr. Anat., lxxxv. (1914) pp. 303–60 (5 pls. and 6 figs.).

humour, due to stronger fibrils and a denser inter-fibrillary substance. In all the Amphibians and Chelonians investigated, the zonula consists of two parts, the actual zonula-fibres and a delicate interstitial fibrillar network. This fine network is in direct connexion with the zonula fibres, and it shows differences in degree of development in different forms. Its great interest is that it here forms a permanent character, while in higher Vertebrates it is only a transient embryonic stage. The vitreous humour everywhere shows the well-known fibrillar structure, with anastomosis of the fibrils. A definite and constant structure is always demonstrable. The fibrils show a tendency to invade, secondarily, any structures that may be in the vitreous humour or surrounding it. With the exception of *Rana*, all the forms investigated showed a marked difference in the grouping of the fibres in the nasal and temporal halves of the eye. In *Salamandra* two specially differentiated groups of fibres are visible, and the fine fibrillar network shows a concentric arrangement on the nasal side, which is less marked on the temporal side. In *Rana* the tractus centralis is noteworthy, and the fibrillar network is looser and less regular than in *Salamandra*.

Details of the structure of the vitreous humour in *Tropidonotus*, *Coluber*, *Lacerta*, and *Testudo* are also given.

**Nerve-endings in Pericardium of Man and other Mammals.***—W. Martynoff describes the numerous encapsuled nerve-endings (the corpuscles of Golgi and Mazzoni), which lie in the fibrous and serous layer of the pericardium of man. They were not found in other mammals. In the pericardium of man and of other mammals there are unencapsuled nerve-endings, which take three forms—unencapsuled coils, dendriform terminal ramifications, and modifications of the dendriform apparatus. As to nerve-endings in the single layer of flat epithelium, Martynoff saw fine fibres given off from the sub-epithelial plexus, which extended directly under the epithelial cells and gave off on their course short filaments. These filaments ended in knob-like thickenings apposed to the bases of the epithelial cells.

**Structure and Innervation of Dentin.**†—C. Fritsch describes the "funnel-fibres" (Trichterfasern) extending from the connective tissue of the pulp to the lamina terminalis interna, arising from the plexus of fibres; the peripheral sheath of the dentin-tubules; Römer's substance outside each tubule; in each tubule a massive process of the odontoblast cell; surrounding the process a lymph-space which can be injected; and in the lymph-space some of the nerves of the tooth. He has been able to trace nerve-fibres into the substance of the dentin and into the lymph-spaces.

**Grafting Pieces of Cornea.**‡—Bonnefon and Lacoste have experimented with the rabbit. When a fragment of living cornea is implanted in a healthy cornea it is assimilated, whether autoplastic or

* Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp 430–37 (2 pls.).
† Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 307–20 (2 pls.).
‡ Comptes Rendus, clviii. (1914) pp. 2017–19.

heteroplastic. But it is only the epithelial portion that can retain its cellular vitality and individuality. The necrosed connective elements are replaced by regenerating tissue.

**Hair of the Cat.***—Hermann Hofer has made a detailed study of the hair of the cat. There are three kinds: (1) the main hairs (Leithaare), marked by strength, length, and prominence; (2) the shorter wavy hairs (Grannenhaare), with alternate broader and narrower regions; and (3) the shortest, woolly hairs (Wollhaare), delicate and undulating, with alternate broader and narrower portions, and with little pigment. In a group there may be distinguished, according to de Meijere, the primary hairs (Stammhaare), of which one may be distinguished as the middle hair, and the subsequently developed accessory or side-hairs.

The medulla of the cat's hair is in a single row, like a necklace of pearls or a rouleau of sovereigns; the gas is intercellular. The shape of the medullary cells in the thicker parts (main hairs and short hairs) is somewhat different from that of the thin parts (woolly hairs and proximal shaft of the short hairs). The cortex is relatively narrow and without peculiarities. The cuticular cells can be well seen after treatment with nitric acid; they show great variability in shape and arrangement in the different kinds of hairs in the cat; but seem to be very similar in the same kind of hairs in different animals.

The hair-groups in the cat consist of an isolated median hair and several lateral primary hairs, each of which has a number of accessory hairs in a group or bundle. The median hair comes first, then a lateral main hair on each side, so that at a certain stage, before and at birth, the three-hair-group is prominent. The number of lateral primary hairs increases gradually, and they are accompanied by their accessory hairs. In the adult cat the groups become disguised. The sebaceous glands are all at the same level. Each follicle-complex has its glandular complex. Each median hair has a sudorific gland, and probably each of the lateral primary hairs likewise.

The hair-groups are disposed in longitudinal rows, and there is great diversity in the size of the groups. The median hairs are long hairs, the lateral primary hairs correspond to the short hairs, and the accessory hairs to the woolly hairs. In development, which is described at length, there is no difference in the earliest stage between the median hair and the primary lateral hairs. In the papilla-stage and later there are marked differences. The papilla-stage and later stages of the accessory hairs show a close resemblance to the similar stages in the development of the lateral primary hairs.

**Phylogeny of Mammalian Hairs.†**—E. Botezat discusses the various theories of the morphological nature of mammalian hairs. They have been denied structural unity and regarded as parts of the epidermis, or they have been interpreted as derivable from placoid scales, teeth, pearl-organs of Cyprinoids, scales, parts of scales, integumentary sense-organs

* Arch. Mikr. Anat., lxxxv. (1914) pp. 220–78 (2 pls.).
† Anat. Anzeig., xlvii. (1914) pp. 1–44 (2 figs.).

of Amphibians, or touch-spots of reptiles. The author does not find that any of these theories can be accepted. Mammalian hairs are structures *sui generis* and peculiar to mammals. They have differentiated in two directions—tactile and protective, but the tactile function is probably the more primitive.

A classification is proposed :—

- Hypothetical primordial hair
  - I Hairs without sinus
    - A. Ordinary hairs
      - *a.* Protective non-sensory hairs
      - *b.* Sensitive hairs, with one nervous apparatus or with more than one
    - B. Transition hairs
  - II Sinus-hairs
    - A. Passive tactile hairs
      - *a.* Without an annular sinus
      - *b.* With an annular sinus
    - B. Active tactile hairs
      - Mobile vibrissæ

### *c.* General.

**Sense-organs of Invertebrates.***—Gustav Kafka has given a valuable account of the sense-organs of Invertebrates, which implies much microscopical detail. He deals with structures specialized as sensitive to touch, movements of the body, sound, temperature, chemical influences, light, colour, and so on. There are also two very interesting chapters discussing "space-sense" (as in homing) and "time-sense" (as in rhythmic responses to external periodicities).

**Influence of Salts.**†—Erwin Hirsch, in conjunction with the late W. Cronheim, has made numerous experiments, testing the influence of various salts (in solution in the medium) on Daphnids, *Chironomus* larvæ, eels, tadpoles, and other animals. He shows what the limits of endurable concentration are, and compares the results with those reached by others. He calls attention to some influences on development, on the growth of appendages, and on pigmentation. The experimental results are correlated with faunistic observations.

**Lateral Glands of Shrews.**‡—Sigurd Johnsen has made a study of the gland which stretches along each side of the shrew's body. It consists of strongly-developed sudorific glands, and of sebaceous glands which are sometimes strongly developed, as in the male of *Sorex araneus*, and sometimes not enlarged, as in the female of this species. In *Crocidura murina* the sebaceous glands are equally developed in the two sexes. The odoriferous secretion comes from the sudorific glands, but it is possible that the sebaceous glands may contribute. The sebaceous

* Einführung in die Tierpsychologie. Erster Band. Die Sinne der Wirbellosen, Leipzig: 1913; xii and 593 pp. (362 figs.).

† Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 559–682.

‡ Anat. Anzeig., xlvi. (1914) pp. 139–49 (9 figs.).

glands are enlarged later, if they are enlarged at all. They appear to increase in size with age (the length of life does not exceed two years), while the sudorific glands attain their maximum at the breeding season.

Johnsen has shown that there is a correlation between the ripening of the testes and the growth of the sudorific glands of the lateral organ. In quite mature males almost all the tubules are in secretory activity. Thereafter a resting-period begins. In adult non-gravid females the glands are in full secretion; in gravid or lactating females (twice in the summer) there is a diminution of the secretion or a regeneration stage. The secretion appears to be repulsive to enemies; but it seems to be more directly connected with sex, facilitating recognition.

**Effect of Postponed Moult.***—C. W. Beebe gives a fresh description of his important experiments originally recorded in *The American Naturalist* six years ago. The subjects of the experiments were males of the Scarlet Tanager, *Piranga erythromelas* Vielliot, and the Bobolink, *Dolichonyx oryzivorus* (Linnæus), in both of which a brilliant summer plumage alternates with a totally different winter garb. The problem of the research was "the discovery of the factors which determine this seasonal change," but only one of the possible factors was investigated, namely, "the condition of fatness or thinness of the bird's body, and its influence on moult."

Normally, the autumnal moult is associated with the thin and poor condition that follows the stress and cares of the breeding season. In these experiments tame tanagers and bobolinks which had not bred were placed under careful observation at midsummer while "still in the height of vocal and physical condition." The birds were kept in small cages in a quiet room, and the light was gradually cut down, while the food supply was slightly augmented. Under these conditions they became very quiet and inactive, and rapidly put on fat and increased in weight. These conditions were maintained without ill effects on the subjects, but with the important result that the autumn moulting time passed without a single feather being shed. Mid-winter thus found the birds in their summer dress, and it was noted that if one was temporarily brought into a stronger light, and had meal worms added to its diet, the song was fully resumed for a limited period. A sudden alteration in temperature, whether upwards or downwards, brought about a diminution in weight; one tanager that lost weight rapidly under such circumstances underwent a belated moult into the green winter plumage.

"Early in the following spring individual tanagers and bobolinks were gradually brought under normal conditions and into their seasonal activities, with quick result." The spring moult took place, and the birds went directly from one nuptial plumage to another. "The old scarlet and black feathers fell from the tanagers, and were replaced by others of the same colour; and from buff, cream, and black, the bobolinks moulted into buff, cream, and black!" In every case the intervening winter plumage had been entirely suppressed.

* Zoologica, i. (1914) pp. 253–8.

The conclusion drawn is that the condition of the birds as regards fatness or thinness determines whether they shall moult or not. The seasonal "pigmental changes in the blood," however, go on as usual, but are not apparent when there are no new feathers to be coloured. In the single tanager which was induced to moult in winter by a temperature change, the green potentiality was proved to exist. In the others, which did not moult till spring, the scarlet tendency had succeeded the green without the latter ever having found expression. "We have thus proof that the outward manifestation of the sequence of plumage in these birds is not in any way predestined through inheritance bringing about an unchangeable succession, in the case of the tanager, of scarlet-green, scarlet-green, year after year."

Two additional points may be noted. The green winter plumage of the male Scarlet Tanager is the permanent dress of the young of both sexes and of the adult female, and is therefore presumably the ancestral and more primitive hue. But in the allied Summer Tanager, *Piranga rubra* (Linnæus), the male remains scarlet throughout the year under ordinary conditions.

## INVERTEBRATA.

### Mollusca.

**Phagocytic Organs of Molluscs.***—L. Cuénot has studied the little-known phagocytic organs and cells of Molluscs. By injecting Chinese ink or solid carmine he was able to demonstrate in many Molluscs the existence of fixed phagocytes, grouped or scattered, either forming autonomous organs, or situated within other highly vascularized organs. These phagocytes have frequently a topographical relation to the arterial vessels of the liver; in Aplysians and terrestrial Pulmonates they invest the extremities of the fine arterioles externally, thus recalling in a striking manner the phagocytic apparatus of decapod Crustaceans. In *Chiton* it is the endothelium of the arterioles which has the phagocytic power; in other forms the hepatic arteries terminate in an absorbent region, a kind of sponge (*Mactra*, *Scaphander*), while in others they bear numerous spongy nodules (*Cardium*, *Donax*, *Scrobicularia*). In many cases the phagocytes are within the blood-spaces of a renal organ, such as the left kidney or papillary sac of the Diotocardia, the single kidney of Monotocardia, the nephridial gland (Tenioglossidæ), or the appendix to the branchial heart of many Cephalopods. The phagocytes are scattered throughout all the folds of the simple kidney of Tenioglossidæ, while in the Stenoglossidæ they are concentrated in the accessory folds. This relation between the phagocytes and the renal spaces recalls the analogous arrangement in certain fishes (*Squatina*, Teleosteans). In two groups the fixed phagocytes are arranged in the lacunæ of the gills (most Monotocardia, Cephalopods). In *Solen marginatus* the small and very numerous phagocytic organs are situated within the labial palps on the arterioles which supply these appendices.

* Arch. Zool. Exper., liv. (1914) pp. 267–305 (4 pls ).

In *Vivipara* they are situated in the wall of the auricle, thus recalling the intercardiac nephrophagocytes of bony fishes. Finally, in the three families of Bulleidæ (except *Scaphander*), Pleurobranchs, and Doridiidæ, there is a large and well-defined phagocytic organ which is abundantly vascularized by the aorta. It recalls the organs of various Insects and of Scorpionidæ. In those Molluscs in which it has not been possible to demonstrate fixed phagocytes (primitive Lamellibranchs and aquatic Pulmonates) it is probable that they occur, but are so sparse and so inconstant in situation that they cannot be distinguished from wandering amœbocytes.

In all cases the fixed phagocytes, whether imprisoned in a network of connective tissue or applied to the walls of lacunæ, are small amœboid cells exactly resembling free amœbocytes. Mitosis, effecting replacement, rarely occurs (gill of Cephalopods, auricle of *Vivipara*) ; it may therefore be concluded that worn-out elements are replaced by free amœbocytes which settle down and become fixed phagocytes.

From the point of view of function, the phagocytic apparatus of Molluscs is of considerable interest: the papillæ of the left kidney of Trochidæ, the folds of the single kidney of Monotocardia, the gills and the appendix to the branchial heart of Cephalopods, the nodules of the hepatic arterioles of various Lamellibranchs, possess the unexpected property of prephagocytic agglutination: that is to say, the floating particles in the blood-fluid are retained, fixed, agglutinated at the very spot where later they will be ingested by the phagocytes. In this way the organism gets rid of what encumbers the plasma almost instantaneously, and long before the phagocytes have time to intervene. An analogous process is known in Synaptids and Sipunculids; the floating particles in the cœlomic liquid are rapidly agglutinated by a vibratile mechanism (ciliated urns), and the phagocytes play their part later.

### α. Cephalopoda.

**Nervous System of Myopsidæ.***—Boris Schkaff has made a careful study of *Loligo marmoræ* and *Sepiola rondeletii* in regard to the details of the nervous system. He describes the central nervous system or "brain" with its four component ganglia (cerebral, brachial, pedal or infundibular, and visceral—of which the brachials are most distinctly paired); the connexions between cerebral and pedal, pedal and visceral, brachial and pedal, visceral and brachial, cerebral and brachial; the nerves given off from the cerebral, visceral, pedal, and brachial ganglia; and the sympathetic system, which consists of three ganglia connected to one another by commissures and also with the central nervous system, namely—the superior buccal, the inferior buccal, and the gastric.

### γ. Gastropoda.

**Abyssal Fresh-water Snails of the Lake of Geneva.†**—W. Roszkowski has made a minute study of the shells, teeth, and reproductive organs of *Limnæa profunda* and *L. abyssicola* from the depths

* Zeitschr. wiss Zool., cix. (1914) pp. 591–630 (3 pls.).
† Rev. Suisse Zool., xxii. (1914) pp. 457–539 (4 pls.).

(down to 100 metres) of the Lake of Geneva; and, after taking due account of the varieties, comes to the conclusion that *L. profunda* is an abyssal variety of the littoral *L. ovata*, and *L. abyssicola* of *L. palustris*. It may be noted that the deep-water forms, contrasted with the shore forms, are mainly carnivorous, that they breathe cutaneously, that they have smaller but not degenerate eyes, and that they are less prolific.

**Salivary Glands of Nudibranchs.***—W. Brygider has investigated the microscopical structure of the salivary glands of Nudibranchs, with a view to their classification and nomenclature. In Nudibranchs the external mouth-orifice opens into a tube, the terminal portion of which widens into a mouth from which an aperture through a muscular sheath opens into the pharyngeal cavity, the thick muscular walls of which project outwards like a ball. This cavity encloses the tongue and radula, and it is bounded anteriorly by the jaw, which rests on its lateral walls. An analogous series of parts occurs in *Doriopsis*, though tongue, radula, and jaw are absent. In addition to skin-glands, the investigator found two pairs of well-developed glands, one pair opening into the pharyngeal cavity, the other into the anterior mouth-tube. The pharyngeal glands are the true salivary glands, the others are secondary salivary glands. All Nudibranchs possess the pharyngeal pair; they may or may not possess the other. The Porostomata have an unpaired mouth-gland in addition to the pharyngeal pair. In general appearance the salivary glands are of three types, tubular (*Spurilla*), sac-shaped (*Doto*), or lobed. The characters common to each pair in different forms, and their distinctive differences, are described, and the question of their homology is discussed.

### δ. Lamellibranchiata.

**Musculature and Muscles of Anodonta cellensis.**†—Artur Brück first describes the musculature of the foot and the visceral sac, distinguishing four layers and showing how they are correlated. He then describes the structure of the adductor muscles and those of the mantle-margin. The minute structure of the muscle in the larva and adult is then described. The origin of the longitudinally striped and the spirally striped muscle is dealt with, and the development of fibrils from plastosomes. The spirally striped muscle with heterogeneous fibrils must be regarded as a stage in the evolution of cross-striped muscle. Three chief types of muscle may be distinguished:—1. Longitudinally striped or smooth muscle-fibres with homogeneous fibrils. 2. Muscles with simple heterogeneous fibrils; in some bivalves (e.g. *Pholas*) with longitudinally striped fibres; in *Anodonta* and *Unio* with spirally striped fibres. 3. Muscles with typical cross-striping, characterized by the appearance of the Z-line.

**Kidneys of Anodonta.**‡—Wilhelm Fernau publishes the second (the histological) part of his paper on the structure of the kidney in *Anodonta*

* Zeitschr. wiss. Zool., cx. (1914) pp. 359–418 (3 pls.).
† Zeitschr. wiss. Zool., cx. (1914) pp. 481–619 (81 figs.).
‡ Zeitschr. wiss Zool., cx. (1914) pp. 304–358 (20 figs.).

*cellensis* Schröt. He finds that the walls and folds of the kidney consist of fibrillar lacunar connective tissue in which are embedded elastic and muscle-fibres, and of a single epithelial layer of nephridial cells, similar in the sac and coils, and only slightly different in the duct. The ureter and funnels have a specially differentiated epithelium. The connective tissue lies as a very fine layer beneath the homogeneous epithelium. The cylindrical nephridial cells have no specially developed basal membrane. The plasma shows a fine reticular structure; the nucleus with well-defined nucleolus is median. The cells have flagella and fine hair-like processes. They contain concretions of urine which are the final product of the secretion of the cells. These concretions are circular, or irregularly crystalline in form, and may number from two to thirty. The smaller crystals are sometimes aggregated in masses. The nephridial cells also contain granules, circular formations about the size of a nucleolus, disposed in definite longitudinal series along the lateral walls of the basal portion of the cell. They are probably to be regarded as the "plasmosomes" of Duesberg. The distal portion of the cell often contained vacuoles, but these could not be identified with the "secretory vesicles" of Leydig. Mitotic cell-multiplication occurs in the epithelial cells, but mitosis does not appear to affect the secretion process materially.

## Arthropoda.

### α. Insecta.

**Optic Ganglia of Dragon-fly Larvæ.***—Alexius Zawarzin has made a detailed study of the minute structure of the three optic ganglia in *Æschna* larvæ. The very striking differentiation in layers, which Radl described, is discussed at length. Among the cells surrounding the medullary substance of each ganglion there are three types. Some send a process through the medullary substance, giving off lateral branches, and passing to another ganglion. Some send a process into the medullary substance, which passes out again and enters another ganglion. Some have a process which does not pass out of the ganglion to which they belong. Other cells which usually lie to the side of a ganglion may be called the cells of the horizontal plexus, and they, again, exhibit various types.

The first ganglion is simplest. Its medullary substance has only three layers. In the second there are eighteen, in the third twenty-one layers. The structure is extraordinarily complicated. In Insects the fundamental chain of elements has four links—(1) retina cells; (2) cells with processes passing through the first ganglion; (3) similar cells passing through the second ganglion; and (4) the internal cells of the third ganglion. These may be compared with the chain in Vertebrates—(1) optic cells; (2) bipolar cells; (3) ganglion-cells; and (4) cells of the optic lobes with long processes. The first two elements in the chain may be compared to the optic cells of Cephalopods, with their long processes ending in the plexiform layers; the other two elements are represented by the cells of the inner granular layer, and the cells of the medullary layer with descending processes.

* Zeitschr. wiss. Zool., cviii. (1914) pp. 175–257 (6 pls. and 19 figs.).

**Female Reproductive Organs in Ichneumonidæ.***—W. Pampel has made an extensive comparative study of these, and distinguishes four chief types: the *Ichneumon*-type, the borer-type, the *Ophion*-type, and the *Tryphon*-type. These differ in the shape of the ovaries; in the number of ovarioles; in the presence or absence of uterine glands; in the state of differentiation of the receptaculum; in the very varied length of the oviducts; and in the structure of the ovipositor. The presence or absence of egg-stalks is also distinctive.

**Malpighian Tubes of Beetles.†** — A. von Gorka has made an anatomical and experimental study of the Malpighian tubes of *Gnaptor* and *Necrophorus*, with a view to a more precise knowledge of their physiological functions. In *Gnaptor spinimanus* there are six tubes; in *Necrophorus humator* four. In *Gnaptor* the Malpighian tubes form a network on the wall of the rectum, but they do not open there. From this network of tubes there arises a single thick stem, in which, however, the tubes are not fused together but closely apposed. The common trunk immediately divides into two branches, consisting of three tubes each. These three again separate, and after taking a zigzag course through the body-cavity, open at the junction of the mid-gut and hind-gut. The Malpighian tubes of *Necrophorus* end blindly. In all the forms examined the tubes opened into the mid-gut, and not into the hind-gut. In *Gnaptor* there are, just posterior to their openings, some epithelial cells which correspond in every respect to the epithelial cells of the mid-gut. Behind the openings of the Malpighian tubes the large sphincter dividing mid-gut from hind-gut is visible. The development and disposition of the muscle-fibres of the mid-gut and hind-gut, the histological structure of the Malpighian tubes themselves, and the activity of the sphincter already mentioned, lead the investigator to conclude that the contents of the tubes escape into the mid-gut, and that this accounts for the peculiarity of the mid-gut in *Gnaptor*, where the anterior portion of the mid-gut has an acid, and the posterior portion an alkaline reaction. The histological and physiological differences between the two portions of the Malpighian vessels—the network on the walls of the rectum, and the free-lying tubes in the body-cavity—are fully described. Experimental and chemical investigation showed that physiologically the Malpighian tubes of beetles are equivalent in many respects to the mid-gut glands of other Invertebrates, and that their influence differs from these only in so far that, being adapted to the rapid metabolism of insects, their excretory function has predominated over their other functions of absorption, secretion, storing, etc.

**Gall-wasps and Saw-flies of Central Europe.‡**—Attention may be directed to the continuation of Chr. Schröder's Insects of Central Europe, an admirable work of reference. J. J. Kieffer deals with the Cynipidæ, and E. Enslin with the Tenthredinidæ. The bulk of the work is purely systematic, but the effective introductions discuss the structure,

* Zeitschr. wiss. Zool., cviii. (1914) pp. 290–357 (3 pls. and 28 figs.).
† Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 234–338 (2 pls.).
‡ Die Insekten Mitteleuropas, Band iii. Teil 3 (1914) pp. 1–213 (8 pls.) 58 and 75 figs.).

the life-histories, and the œcology. Thus there is a discussion of the formation of galls and an account of their minute structure. Among the other subjects treated of we may mention the parthenogenesis of Tenthredinidæ.

**Acridiidæ of British India.***—The late W. F. Kirby left a not quite completed account of the Locusts or Short-horned Grasshoppers of British India, which has been prepared for publication by C. O. Waterhouse. Members of the family of Acridiidæ may be generally recognized at a glance by the short antennæ and the three-jointed tarsi, and thus distinguished from the other Leaping Orthoptera—the Gryllidæ or Crickets, and the Phasgonuridæ or Long-horned Grasshoppers called (often improperly) Locustidæ. The memoir deals with no fewer than 329 species.

**Pupation of Holometabolic Insects.**†—E. Poyarkoff publishes a study of the evolution of insect-metamorphosis with a view to establishing a theory of the pupation of holometabolic insects. He deals with the biological significance of the moult in general, and of the nymphal and imaginal moults in particular; the different periods in insect-metamorphosis; the mode of appearance and characters of the primitive nymph; the establishment of the period of nymphal inactivity in the development-cycle of holometabolic insects; the cessation of external alimentation, the retreat of the nymph into a shelter; the exuvial glands; the general course of the development of the tissues during metamorphosis; the organs of the nymph; the biogenetic law and the metamorphosis of insects; the phyletic significance of the pupa stage; and the primitive number of imaginal stages. Very generally stated, the author's theory is that primitive hemimetabolic insects had only a single imaginal stage —the word stage being carefully distinguished from "period"—and that this single stage in hemimetabolic insects is in holometabolic insects subdivided, by the addition of a new imaginal moult, into two, a nymphal stage and an imaginal stage.

**Reduction of Wings in Orthoptera.**—R. Puschnig ‡ discusses this subject, with especial reference to the conclusions of H. Karny who supports Dollo's thesis of "irreversibility." According to this thesis there is no reversibility in a phylogenetic sequence; organs which have reached a certain stage in a given direction cannot return to a previous stage. The discussion deals very largely with secondarily macropterous forms which occur in series with reduced or absent wings. Karny emphasizes the change in the structure and venation of the wings; Puschnig emphasizes the apparent return to a large-winged ancestral type. Karny § replies to Puschnig's points.

* Fauna of British India. Orthoptera (Acridiidæ) (1914) ix and 276 pp. (140 figs.).
† Arch. Zool. Expér., li. (1914) pp. 221–65.
‡ Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 515–32.
§ Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 532–42.

**Development of Polyembryonal Chalcidians.***—Friedrich Martin publishes a paper on the development of the polyembryonal Chalcidian *Ageniaspis fuscicollis* Dalm, which is parasitic on *Hyponomeuta cognatella*. *Ageniaspis fuscicollis* lays its eggs within the eggs of its host, which adhere in packets of 20–40 to the bark of the Euonymus on which *Hyponomeuta* feeds. The caterpillars emerge in autumn but remain hidden till spring when they begin to feed. The *Ageniaspis* eggs have by May developed to "Keimschlänche" within them, and go through the pupal stage at the same time as the host. They leave their pupal covering some time after the butterflies emerge, and they are then ready to infect the new generation of eggs. The investigator finds that the ovarian tubes of *Ageniaspis* are typically polytrophic in the anterior part, but in the extended posterior part they contain free follicles. The germinal vesicle of the developing egg shows first a polar aggregation and then a regular distribution of chromatin substance; this then breaks up, and forms numerous chromatin corpuscles which unite to form apparently four chromosomes lying parallel to the longitudinal axis of the ovum; finally these again unite into a compact body. In regard to maturation, division, and the fate of the polar bodies, the investigation confirmed the results reached by Silvestri, and amplified them in some particulars: the early differentiation of trophamnion and blastomeres; the complex transformation of the polar bodies; the differentiation of the plasma of the trophamnion into an inner mass and an outer zone. The nucleolus of *Ageniaspis* presents certain characteristics that mark it off from other known structures, such as yolk-nuclei, within the ooplasm. It arises in the posterior part of the young ovarian egg, grows within it, is labile and vacuolar during the process of maturation, is taken up into one of the two first blastomeres, the division of which it inhibits, then undergoes progressive degeneration until, at the 4-celled stage, it is no longer demonstrable. The ova of *Ageniaspis* can only develop in the embryonic cells of *Hyponomeuta*: those that lie within the yolk undergo a characteristic process of degeneration. Occasionally the trophamnion plasma of the polyembryo was found filled with bacteria-like structures which may have come from the caterpillar-host. The second chitinous envelope of the *Hyponomeuta*-egg encloses it completely.

### δ. Arachnida.

**Second Pair of Lung-books in Mygalomorph Spiders.**†—B. Haller maintains that these are derivable from the tufted tracheæ of Protracheate spiders (Dysderidæ, *Argyroneta*). He found, for instance, that in *Mygale* a long tubular trachea arises from each of the posterior lung-books and extends far forward in the cephalothorax. From a study of the development of the lung-books or plaited tracheæ in *Cœlotes atropos*, Haller confirms his view that the so-called lung-books are comparable to tufted tracheæ and not to Crustacean gills. Arachnoids are to be traced back to Tracheata, not to Xiphosura.

* Zeitschr. wiss Zool., cx. (1914) 419–79 (2 pls. and 8 figs.).
† Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 438–45 (3 figs.).

**Mating of Spiders.***—Lucien Berland has made minute observations on the mating habits and sexual union in *Scytodes velutina delicatula*, *Storena reticulata*, *Drassodes severus*, *D. lapidosus*, *Theridion denticulatum*, *Lycosa laciniosa*, and *Philæus chrysops*, and his observations throw an interesting light on the mental faculties and sensory acuteness of these animals. We shall refer to three of his results. 1. The seminal ejaculation is due to the blood-pressure, and the rhythmic movements of the spines of the appendages (in *Dysdera erythrina* var. *provincialis*) correspond to the beating of the dorsal vessel. 2. The structural complexity of the copulatory organ is sometimes at least (as in *Storena reticulata* and *Theridion denticulatum*) correlated with the mode of sexual union. 3. Similar methods of sexual union occur in the same family, but the same method may be observed in different families. Perhaps there may be some phylogenetic suggestiveness in this.

### ε. Crustacea.

**Muscular Reticulum of Mid-gut Gland of Crustaceans.†**—W. Pump has studied this in *Gammarus*, *Asellus*, *Astacus*, *Cancer*, and other types, with special reference to the structure of the muscle. The reticulum of the glandular diverticula consists of cross-striped annular fibres and their longitudinal connexions. It appears to be embedded on a structureless hyaline layer, the so-called tunica propria. The two are in very close association. The annular fibres run more or less parallel, usually at right angles to the longitudinal axis of the tubules. In some cases (terrestrial Isopods) they lie obliquely. They are always closer together near the apex of the tubule.

Where the annular fibres fork, there are "fork-branches" given off which form along with the annular fibres the transverse meshes. The longitudinal connexions are lateral processes of the annular fibres, but run parallel to the long axis of the tubules. They sometimes branch and become connected with one another. Along with the annular fibres the longitudinal fibres form the longitudinal meshes. Broad transverse and narrow longitudinal meshes are to be seen on each tubule.

Three kinds of longitudinal connexions are described—by connecting filaments, connecting fibres, and "cleft fibres" (Spaltfasern). The connecting filaments are extensions of the matrix-membranes (Grundmembranen) beyond the breadth of the annular fibres. While the membranes lie within the annular fibres, associated with their sheath, the connecting threads extend over areas which are not filled with fibrillar substance.

The connecting fibres are cross-striped longitudinal connexions of annular fibres, joined on to the latter by means of the matrix-membranes. The "cleft-fibres" differ from the connecting fibres in the way in which they are joined on to the annular fibres. The sheath of the annular fibres is continuous with the sheaths of connective fibres and "cleft fibres."

The whole of the muscular network is a syncytium. Its main fibres

* Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 5, pp. 109–19 (4 figs.).
† Arch. Mikr. Anat., lxxxv. (1914) 1te Abt., pp. 167–219 (1 pl. and 2 figs.).

are the annular fibres; they are connected by connective threads, connective fibres, cleft fibres, and fork branches. The annular fibres work in contraction in antagonism to their longitudinal connexions. The connective threads and the various membranes show some elasticity, but are not active in the contraction of the tubules.

**Influence of External Conditions on Nuclear Division in Cyclops.***—Alfred Tobias has experimented chiefly with the eggs of *Cyclops viridis*, and has been able to study the effect of altered temperature as such. Increased temperature produces disruptive changes in oviducal eggs and premature dicentric movement of the spindle, but has especially this effect that the chromosome pairs in their biserial arrangement tend to separate from one another, each pair by itself representing an idiomere-like structure.

In the maturation-divisions these bodies retain their independence, they migrate to the periphery, and may even show separate maturation-divisions. The chromosomes of the female pronucleus do not form a unified single nucleus, but the idiomeres remain independent. There may be multipolar maturation-divisions. Even in fertilization the idiomeres tend to remain independent; each may show a typical growth-stage and prophase-stage. When the eggs are restored to normal temperature, they may show several typical pseudo-amitoses. It should be noted that clumps of ova separated from the mother *Cyclops* can develop quite normally.

**Orientation in Crustaceans.†**—W. von Buddenbrock has made numerous experiments with swimming Crustaceans. There are a few, like *Lysmata seticaudata*, which do not steer at all. There are some, like *Penæus*, that depend on their statocysts. There are others, like *Phronima* and larval Decapods, which depend solely on their light-reflex. There are others, like *Squilla mantis*, which depend on their light-reflex (associated with the eyes) and on a general position-reflex which does not seem to be associated with any special sense-organ. In many cases, such as Mysidæ and shrimps, there is a combination of light-reflex (the dorsal surface turned to the light), the gravitational reflex (the ventral surface turned to the centre of the earth), and the general position-reflex.

### Annulata.

**Remarkable Epizoic Oligochæte.‡**—H. A. Baylis describes *Aspidodrilus kelsalli* g. et sp. n., specimens of which were found by Major Kelsall living as "external parasites" on a large earthworm in Sierra Leone. As the food-canal contained earth and vegetable debris, they are probably commensals, not parasites. They were 5 mm. in length. The posterior half of the body was flattened and expanded into an oval disk bearing numerous transverse rows of ventral setæ. Each of the anterior segments bears two pairs of short straight setæ. The clitellum

* Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 369–429 (1 pl. and 53 figs.).
† Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 479–514 (5 figs.).
‡ Ann. Nat. Hist., xiv. (1914) pp. 145–51 (2 figs.).

occupies segment XI, on the ventral side of which there is a muscular sucker, with the openings of a pair of sperm-ducts at its edges. Four pairs of ovaries, situated in segments IX and X, lie freely in the cœlom, and show large ova with much yolk. The spermothecæ open in segment III; the sperm-sacs occur in segments VIII and X; there are large sperm-funnels in X; the sperm-ducts are long and coiled.

**Earthworm with Caudal Bifurcation.***—L. Bordas gives a careful description of the internal structure as well as of the external appearance of a specimen of *Lumbricus herculeus* which resembled a Y reversed. The anterior portion was 9·5 cm. in length with 120 segments; the right posterior portion in a line with the anterior portion was 38 mm. in length with 70 segments; the left posterior portion or lateral bud was 27 mm. in length with 15 segments. Each posterior portion had an anus and a gut. On the dorsal surface, at the bifurcation, there was a median smooth area, corresponding to eight segments. On the ventral surface, in the same position, the segmentation was not interrupted. The branch showed a normal nerve-cord, attached by a narrow isthmus to the main cord, and there were the three main blood-vessels—dorsal, ventral, and sub-neural.

**Clare Island Annelids.**†—R. Southern reports on the Archiannelids and Polychætes found in the Clare Island area. There were three Archiannelids, *Nerilla antennata*, *Polygordius lacteus*, and *P. appendiculatus*, the species of *Polygordius* being new to the British fauna. The list of Polychætes comprises 249 species and two varieties, which is by far the largest list as yet recorded from any limited area. Thirty-six species have not been recorded previously from the British Marine Area, and seventy-seven are recorded from Irish waters for the first time. There are sixteen new species and two new genera—*Prægeria* (very closely related to *Pisione*), and *Thelepides* (near *Thelepus*).

### Nematohelminthes.

**Intra-uterine Development of Spermatozoa in Ascaris.**‡—D. Tretjakoff has followed up his earlier work on spermatogenesis in *Ascaris megalocephala* by a study of the intra-uterine formation of sperms in *Ascaris lumbricoides*. In contrast to A. Mayer and other observers he believes that the change from the spermatid stage to the mature spermatozoon is gone through after copulation, and not within the male organs, or suddenly at the moment of copulation. His observations lead him to believe that pairing in Ascarids only takes place when the previous provision of spermatozoa is quite exhausted. No more ova are then produced in the ovaries, and the uterus also becomes free from ova. Under ordinary circumstances, the expulsion of ova from the vagina is due to contraction of the muscular layer of the uterus and vagina, but the author believes that, at this complete clearing out of

* Bull. Soc. Zool. France, xxxix. (1914) pp. 252–60 (5 figs.).

† Proc. R. Irish Acad., xxxi. (1914) Clare Island Survey, part 47, pp. 1–160 (14 pls.).

‡ Arch. Mikr. Anat., lxxxv. (1914) pp. 135–203 (3 pls. and 1 fig.).

ova, the villous processes or flagella take part; and they multiply greatly at this stage, and the villous epithelium is transformed into a flagellate epithelium. The dense plasma-zone around the nuclei of the villi becomes much richer than usual in supporting-fibres. The outer muscular layer of the vagina and uterus becomes unnecessary, as the uterine contents are moved onwards by the flagella, and the muscle and cuticular cells disappear, except in the seminal sacs and the vulvar section of the vagina. There remains only the epithelial layer, the basal membrane of which thickens. After the formation of the spermatid sac on the utero-vaginal border, the female is ready for pairing. The vaginal epithelium in the muscle-free region becomes reticular substance, thus considerably enlarging the vaginal space. At the time of pairing, the spermatids find the whole apparatus for forwarding them to the seminal sac in readiness. For the expulsion of the spermatids from the spermatid vesicle there is no mechanism except the flagella of the villous epithelium, for the walls of the vesicle are non-muscular. Their further progress is secured in the same way. The refractive corpuscles are liberated in the vagina and the spermatid sac. The observer was able to detect the movement of the flagella of the villous cells, and considers himself justified in assuming that in the transport of spermatids to the seminal pockets they act as cilia. Morphological arguments in support of this conclusion are adduced from the observations of Hamann. Spermatozoa do undoubtedly occur in the furrows of the uterine villous epithelium, but these, the author considers, have simply been carried out from the seminal pockets with the ova, and they degenerate. They have not been seen in the villous epithelium of the vagina, and no positive proof of their movement from the lower section of the uterus to the seminal pockets has so far been given. Nor has the amœboid movement of the mature spermatozoa, the observer maintains, been sufficiently proved. In regard to the much discussed question of the drops of secretion so often observed on the villous epithelium of the uterus in *Ascaris*, Tretjakoff inclines to the opinion that these are connected with the motor activity of the protoplasm. He notes that the cells of the uterus regulate and control the formation of the vacuoles and vesicles. The alveolar layer of the villous processes is also of the nature of a secretion, but in that case the vesicles remain as an integral part of the structure of the processes or flagella.

### Platyhelminthes.

**Studies on Fistulicola plicatus.***—E. Rudin has made a histological study of this tapeworm from the rectum of a sword-fish. It seems that the sword-fish is infected by pleroceroids, and that the young tapeworms fasten themselves first to the mucous membrane of the intestine. They force their way into the wall, and the scolex is surrounded by a cyst due to the host. The part immediately after the scolex retains its original thickness; it is the "neck" which traverses the intestinal wall. Gradually, the scolex within the cyst suffers degeneration. In some cases the cyst may project into the body-cavity. The

* Rev. Suisse Zool., xxii. (1914) No. 11, pp. 321–63 (2 pls. and 10 figs.).

connecting region between scolex and strobila shows no trace of joints. The very short and narrow proglottides are dovetailed in a remarkable fashion. The longitudinal musculature is greatly developed. The gonads are described at length. The yolk-nuclei seem to be due to the plasma, not to the nucleus.

**New Swiss Terrestrial Planarians.***—O. Fuhrmann describes two new species found by J. Carl on Monte Bre, *Rhynchodemus carli* and *R. diorchis*, the latter being especially noteworthy in having only one pair of testes. This number has not been previously observed in any terrestrial Planarian. Seven European species of terrestrial Planarians were recorded by von Graff in his monograph. The occurrence of two new forms on one hill suggests that there are many more to be found.

### Incertæ Sedis.

**New Invertebrate Type.**†—Maurice Caullery gives a preliminary account of a worm-like type of unknown affinities, for which he proposes the name *Siboglinum.* The animal lives in a yellowish filiform tube, 100–120 mm. in length, 0·12–0·3 mm. in diam., with regular annulations. The animal itself was several centimetres in length, but no well-preserved specimen was obtained. There is a long unpaired tentacle, twisted in a spiral, bearing some lateral pinnules, and containing two vessels. Not far from the anterior end of the animal there is a strongly muscular region ; the ectoderm is very glandular ; there is a fibrillar strand, possibly nervous, and an internal cavity. Posteriorly there are very large ectodermic glands. The cavity is surrounded by muscle, and in two cases there were traces of ova. There was no evidence of mouth or alimentary canal.

### Cœlentera.

**Minute Structure of Veretillum.**‡—Albert Niedermayer has made a histological study of *Veretillum cynomorium*, a common Pennatulid and apparently rather a primitive type. The ectoderm consists mainly of very narrow and rather high cylindrical cells, some with muscular roots. There are also glandular, sensory, and nervous elements. A cuticular "crusta" is perhaps an indication of ciliated cells. The endoderm consists mostly of small roundish cells with spherical nuclei, with hints of cilia, with some transverse muscular roots at right angles to those of the ectoderm. No zoochlorellæ were to be seen. The ectoderm is extraordinarily rich in glandular cells of various kinds, some of which are doubtless concerned in luminescence.

The tentacles show large stinging cells, grouped in batteries, an ectodermic nerve-plexus on the oral surface, a well developed longitudinal and transverse musculature, and very minute spherical or oval spicules. The oral disk shows several layers of epithelial cells. The

* Rev. Suisse Zool., xxii. (1914) pp. 435–56 (1 pl.).
† Comptes Rendus, clviii. (1914) pp. 2014–17 (8 figs.).
‡ Zeitschr. wiss. Zool., cix. (1914) pp. 531–90 (2 pls.).

gullet shows traces of ciliation, and hints of a siphonoglyph both ventrally and dorsally. In the wall of the polyps there is an indication of nervous elements. The septa show a strong musculature. The dorsal mesenteric filaments resemble the ectoderm; the ventral (endodermic) mesenteric filaments show ciliated, stinging, and glandular cells. The gonads are either ovaries or testes.

There are two different kinds of siphonozooids—namely (*a*) pinnular zooids and rhachidozooids, which are better termed protozooids (arising directly from buds), and (*b*) metazooids (arising from retrogressive polyps at the apex of the colony).

The musculature is strongly developed, and may occur in places not usually muscular in Alcyonarians, e.g. the spongy tissue of the rhachis, the epithelium of the main canals, the endoderm of the tentacles, the gullet, and the fine nutritive canals. There is a colonial as well as individual musculature.

A nervous layer was found especially in the ectoderm of the tentacles, the oral disk, the ectoderm of the gullet, the dorsal mesenteric filaments, the ectoderm of the polyp-wall, and the ectoderm of the rhachis. Endodermic nervous elements were found in the endodermic epithelium of the gullet, the endoderm of the septa, the ventral mesenteric filaments, the endoderm of the cavity of the polyps, of the cavities of the rhachis, and of the main cana s. There is a colonial as well as an individual nervous system.

The mesoglœal matrix consists mostly of fibrillar elements. It represents a sort of basal membrane or connective tissue "propria," secreted by ectodermic and endodermic epithelium. It includes isolated or grouped mesenchymatous cells mostly derived from the endoderm.

Niedermeyer gives a full account of the spicules, which are mostly elliptical biconcave rodlets. A few forked forms occur, and twins or triplets. It appears that the compound forms may arise by splitting or by coalescence. The spicules show a centre with radiations, a medullary mass, a cortical region, and concentric lines. A spicule arises as an intracellular differentiation within an ectodermic scleroblast.

The axis shows three zones—an indistinct central strand of longitudinal horny fibres closely compacted; a median zone mostly of longitudinal fibres with some spicules, and an external zone with connective tissue in process of transformation, showing concentric lines and remains of cells and spicules. There is a mesoglœal axis-sheath and an apparently endodermic axis-epithelium. The facts point to the conclusion that the Pennatulid axis is mesoglœal, not endodermic. The intraseptal spaces are mesoglœal and not connected with the gastral cavity of the primary polyp The histological facts support the view of Kükenthal and Broch that *Veretillum* is one of the most primitive Pennatulids.

**Minute Structure of Ovarian Ovum of Aurelia aurita.***—R. Tsukaguchi describes (1) the small densely-packed oogonia, with usually sparse spherical plastosomes in the vicinity of the nucleus; (2) the young oocytes, with larger nucleus, some yolk-spherules, fine irregularly

* Arch. Mikr. Anat., lxxxv. (1914) 2te Abt., pp. 114–23 (1 pl.).

shaped granules surrounded by vesicles, and plastosomes in the form of granules, rodlets, and chains of granules; (3) the medium sized oocytes, with still larger nucleus, with more numerous granules or vesicles accumulating at the attachment pole of the ovum, and a large number of plastosomes, mostly rod-like; and (4) the large oocytes, which lie freely between the genital lamellæ, with much yolk, minute granules at the pole, and diffuse plastosomes. The author found no evidence of chromatin-emission, such as Schaxel described in the ovum of *Pelagia*; and the demonstration of plastosomes in the oogonia is a strong argument against homologizing plastosomes with emitted chromatin.

**Development of Siphonophora.*** — L. Lochmann has especially studied *Galeolaria aurantiaca*, *Diphyes sieboldii*, and *Abyla pentagona*, and finds that there is a very striking similarity in the development of Galeorinæ and Diphyopsinæ. The same is probably true of the third sub-family, Abylinæ.

The fertilized ovum shows total segmentation, and develops into a bipolar planula. The poles are not opposite one another, the aboral pole being bent at right angles. At the oral pole the primary-stem-group develops; at the aboral pole the primary bell. Between the two is formed the stem, the proliferating zone of the colony. On the stem there bud out the other primordia, the stem-groups which arise from the primary bud, and the secondary heteromorphic bell, which displaces the primary bell.

In Monophyidæ this ends the development. In Diphyidæ and Polyphyidæ, however, the primary bud forms a further budding zone. This gives rise to the "Unterglocke" and the "Ersatzglocken." In short, there are two budding zones instead of the single budding zone of Monophyidæ. The primary larval bell is a hydrostatic apparatus, securing a favourable position for the developing larva.

## Porifera.

**Japanese Tetraxonid Sponges.**†—Fr. Lebwohl gives a finely illustrated account of Japanese Sigmatophora, Astrophora metastrosa, Enastrosa, and Sterrastrosa, and describes a considerable number of new species, e.g. of *Tethya*, *Characella*, *Papyrula*, *Sphinctrella*, *Pachastrella*, *Yodomia*, *Dercitus*, *Steletta*, *Caminella*, and *Geodia*.

**Remarkable Infusorian.**‡ — E. Penard describes *Legendrea bellerophon* sp. n., which he found along with *L. loyesæ* Fauré-Frémiet in a marsh near Geneva. The new form is 120–180 $\mu$ in length, and about a third as broad; slightly compressed, especially in front; rounded behind or like a fish-tail; covered with a delicate cuticle with a definite sub-cuticular layer outside of the ectoplasm; with faint longitudinal striæ; with long very delicate cilia over the whole surface; with a slit-

* Zeitschr. wiss. Zool., cviii. (1914) pp. 258–89 (1 pl. and 5 figs.).

† Journ. Coll. Sci. Univ. Tokyo, xxxv. (1914) Art. 2, pp. 1–116 (9 pls.); Art. 5, pp. 1–70 (2 pls.).

‡ Rev. Suisse Zool., xxii. (1914) No. 13 pp. 407–32 (1 pl.).

like mouth, extending almost right across, and showing short, rigid, buccal threads and pharyngeal trichites.

On each side of the animal there are stinging papillæ, projecting like guns from a frigate, about a score altogether. There are also reserve trichocysts scattered on the ectoplasm. There is a large posterior contractile vesicle. The nucleus is horseshoe-shaped, filled with microsomes and a number of nucleoli. There is also a pale micronucleus.

The Infusorian is carnivorous, and shows a preference for a Rotifer (*Diplax trigona*); the Rotifer's eggs and fat-globules may be seen inside. It swims slowly, and the long anterior cilia appear to be of most importance. It is a very delicate animal, difficult to keep in captivity. A transverse division was once seen.

Sometimes this strange Infusorian passes into a resting phase. It is seen to be surrounded by a radiation of long tentacle-like processes. These are transformed stinging papillæ. The trichocysts are grouped in a crown at the apex, and some migratory trichocysts may be seen making their way up the stalk.

The author gives a detailed description of the trichocysts. They are minute curved rods 8–9 $\mu$ in length, 1 $\mu$ in transverse diameter. They can move or are moved about, and they pass up into the papillæ. They may accumulate at the base and "wait their turn" to pass up to the tip. They arrive at their place with their distal end in front, which is the proper disposition for the future explosion. It is possible that they are transported by movements of the plasma.

The stinging papillæ are the only offensive organs. The trichocysts do not act except from them. They may be compared to mitrailleuses. In explosion a fine clear thread emerges from the trichocyst, and at the end of it a minute nervous spherule with an acid reaction. It is possible that there is an evagination of a tube from within the trichocyst, and that a poisonous drop emerges by a rupture of the extreme tip.

**Diplodinium ecaudatum.***—R. G. Sharp has made a study of a Protozoon which is found in the stomach of Ruminants. In the course of his study he discovered three new forms, with respectively two, three, and four posterior spines, but otherwise similar in structure to *Diplodinium ecaudatum*, *D. caudatum* (one spine), and *D. catteria* (five spines), the six forms making a complete series. With the exception of the primary spine, spines of all sizes are to be found, ranging from mere nodules up to spines which are equal to one-third of the entire length of the body. In every case of division observed, animals with a certain number of spines gave rise to two daughter-animals, each of which was provided with the original number of spines. But none of these divisions, as far as was observed, followed at once after conjugation, and it is possible that division immediately following conjugation might have resulted differently. The presence of one of these forms in the stomach of the ox in no wise necessitates the presence of other forms, but the two-, three-, and five-spined forms were never found except when the four-spined form was also present. Revised in the light of the discovery of these new forms, the valid species in the genus are

* Univ. California Publications (Zool.) xiii. (1913) pp. 43–122 (5 pls. and 4 figs.).

reduced from ten to five. The body of *Diplodinium* is covered by a very resistant cuticle, divided into definite areas characterized by surface markings. Three of these areas, because of their relation to underlying skeletal structures, are designated as left, right, and ventral skeletal areas. These three areas, with their underlying skeletal structures, are separate at the anterior end of the animal, but merge together as they approach the posterior extremity. They afford attachment for the internal retractor structures. The arrangement of the oral cilia and the adoral membranellæ differs from that previously described for this genus. Starting from a point on the left of the animal, near the anterior extremity, the adoral row of membranellæ circles from left to right around the adoral region until it reaches a point inside of and opposite to that from which it started, then, turning upon itself, it reverses its direction and, as oral cilia, circles from right to left round the oral opening. *D. ecaudatum* has a complicated neuromotor apparatus, seemingly nervous in function. It consists of a central motor mass (motorium) from which definite strands radiate, one to the roots of the dorsal membranellæ, one to the roots of the adoral membranellæ, one to the circum-œsophageal ring, and several into the ectoplasm of the operculum. Each of these strands may give off one or more branches. In the walls of the œsophagus both nervous and contractile fibres may be distinguished. The structural and functional relations of these parts indicate that they constitute a neuromotor apparatus.

**Life-history of Ichthyosporidium gasterophilum.***—A. Alexeieff has studied this parasite of the rectum of *Motella mustela*; it was previously found by Caullery and Mesnil in the stomach-glands and pyloric cæca of *M. mustela* and *Liparis vulgaris*. He describes the amœboid stage which may be binuclear or mononuclear, and shows chromidia and fat globules: the schizogonic multiplication and the formation of moruloid and blastuloid plasmodia; the physiological degeneration of the plasmodia; and the simple, almost amitotic, nuclear division. Alexeieff comes to the conclusion that *Ichthyosporidium* and other Haplosporidia should be removed from the Sporozoa and referred to the Mycetozoa. A sub-order Haplomycetozoæ may be established to include Haplosporididæ, Endomycetozoidæ, and Blastulididæ.

**Life-history and Relationships of Stenophora.**†—G. Trégouboff has studied *Stenophora juli* A. Schneider, a parasite of *Julus terrestris*, and describes the formation of gametocytes, the differentiation of gametes, the process of chromatin reduction, the fertilization of the macrogramete by the microgramete, and the subsequent divisions. The gametes are very markedly anisogamous, the microgametes being spermatozoa of the *Nina* type, the macrogametes being spherical ova. The spores have eight sporozoites which are set at liberty by a simple rupture of the cyst. The vegetative forms are polymorphic. The family Stenophoridæ contains only the one genus *Stenophora*, and the affinities are not with Gregarinidæ but with Dactylophoridæ.

* Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 2, pp. 30–44 (4 figs.).
† Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 2, pp. 19–30 (1 fig.).

**New Sarcosporidia.***—Howard Crawley describes *Sarcocystis leporum* sp. n. from the muscles of the arm and shoulder of a very old rabbit. The spores show two very clear-cut oval areas, the nucleus in the posterior half and the clear faintly-stained area or rostrum in front. It is probable that the function of the rostrum is to enable the spore to drill its way into the intestinal epithelium of its host. Another new species, *S. setophagæ*, was discovered by Hassall in the muscles of a redstart (*Setophaga ruticilla*) and is now for the first time described.

**Development of Sarcocystis muris.**†—Howard Crawley has studied the earlier stages of this parasite in the intestinal cells of the mouse. The spore in the intestine is naked and displays very energetic twisting and boring movements. It forces its way into a cylindrical epithelial cell and becomes banana-like ; male and female forms are differentiated, and those that are clearly females show phenomena which suggest maturation. In the spaces beneath the epithelial cells a condition was found which looks like a macrogamete fertilized by a microgamete.

* Proc. Acad. Nat. Sci. Philadelphia (1914) pp. 214–18 (1 fig.).
† Proc. Acad. Nat. Sci. Philadelphia (1914) pp. 432-6 (1 pl.)

# BOTANY.

## GENERAL,

### Including the Anatomy and Physiology of Seed Plants.

### Structure and Development.

#### Vegetative and Reproductive.

**Embryogeny of the Cruciferæ.***—R. Souèges contributes a note dealing with his study of the development of the embryo in the Cruciferæ. The author has studied the embryos of several species of *Lepidium* and also of *Cochlearia officinalis*, and is led to the conclusion that modern investigators are wrong in their descriptions of the earlier stages of the embryo-formation in the Cruciferæ; it would rather seem that earlier authors were correct when they stated that the cells of the quadrant were disposed in a horizontal plane and were separated by two longitudinal walls. Subsequent to the formation of the first transverse wall the embryo is differentiated into a hypocotyl and cotyledons; the dermatogen is the result of a series of divisions parallel to the surface. The periblem and plerome of the hypocotyl develop as the result of two vertical divisions. The cotyledons grow at the expense of two cortical layers situated between the epidermis and the central axis, the cell-walls being formed always in a radial direction, thus differing from the adjacent tissues, in which cell-walls are formed in all directions. The origin of the hypophysis cannot be traced with certainty, but it appears to arise from certain cells which are adjacent to the lateral walls of the dermatogen; the four upper cells constitute the initial-cells of the cork, and the four lower cells divide once tangentially to form the initial-cells of the epidermis of the root-tip.

**Fertilization and Embryology in Œnothera.**†—O. Renner has studied the seeds and embryos obtained as the result of crossing several species of *Œnothera*, viz. *O. biennis* × *muricata*, *O. muricata* × *biennis*, *O. biennis* × *Lamarckiana*, *O. Lamarckiana* × *biennis*, etc. In all cases double fertilization was normal and there were fourteen chromosomes. The seeds obtained from *O. biennis* × *muricata* and from *O. biennis* × *Lamarckiana* were pure and fertile, those from *O. Lamarckiana* × *biennis* were 50 p.c. sterile; thus the reciprocal cross gives rise to twin-hybrids, but only one, i.e. that equivalent to the *velutina* type develops, while the other speedily dies. The seeds from *O. muricata* (Venedig) × *biennis* produced feeble embryos and endosperm, which soon ceased to develop; the sterile seeds had a normal testa. *O. Lamarckiana* when self-fertilized gave at least 50 p.c. sterile seeds. The persistent

* Comptes Rendus, clviii. (1914) pp. 1356–59.
† Flora, vii. (1914) pp. 115–50 (2 pls. and 15 figs.)

heterozygotic condition of this species enables it when crossed with *O. biennis* or a similar species, to produce two hybrids, viz. one of the *velutina* type and the other of the *læta* type; the hydrid-formation is thus a simple Mendelian splitting. The mutants *O. nanella* and *O. rubrinervus* behave in a similar manner. *O. gigas* produces rather more than 50 p.c. fertile seeds. The races of hybrids which are continually appearing as the result of *O. biennis* × *muricata*, *O. muricata* × *biennis*, and *O. Lamarckiana* × *biennis*, and which continue to produce sterile seeds until the third and fourth generation at least, are splitting heterozygotes comparable to *O. Lamarckiana*. In conclusion, the author points out that investigations of hybrids similar to those described above, seem to indicate that the proportion of sterile and fertile seeds is constant.

**Distribution of Stomata in Gramineæ.***—E. Zaepffel contributes a short note dealing with the distribution of stomata in the seedlings of *Avena sativa*, *Triticum vulgare*, *Panicum altissimum*, and *Paspalum stoloniferum*. The plants examined included specimens grown in full sunlight and others grown in the shade, but the same results were obtained in both cases, and are as follows:—The distribution of stomata is in direct relation to the power of response to heliotropic attraction. The axis of the hypocotyl, which is incapable of heliotropic perception, is destitute of stomata. In *Avena* and *Triticum* the stomata are most numerous at the tips of the cotyledons, the region of greatest heliotropic sensitiveness, while the decreasing sensitiveness towards the base of the cotyledons is accompanied by decrease in the number of stomata. In *Panicum* and *Paspalum* stomata are found throughout the entire length of the cotyledons, but in this case every part of the cotyledon is sensitive to heliotropic attraction.

**Amitosis in Root-development of Stratiotes.**†—A. Arber describes the structure and development of the adventitious roots of *Stratiotes aloides*, with special reference to amitosis. The writer's observations induce her to agree with the results obtained by D. G. Scott, since she finds that the apex of each young root is enclosed in a uniform cap of tissue, showing no distinction between pericyclic root-cap and endodermal digestive sac. The lacunæ of the middle cortex result from the varying rates of growth in the different parts of the root-tissues. The most important part of the present work deals with the probability of amitotic division of the nucleus of many of the cells. The root-cap, cortex, and stele of the young roots exhibit a large number of cells containing either an unusually large bi-lobed nucleus, or more than one nucleus; appearances seem to indicate that cell-walls are formed in such cells subsequent to direct nuclear division. After a series of observations extending over more than four years, the writer finds it impossible to support those investigators who maintain that amitosis is a senile phenomenon, but suggests that it "supplements karyokinesis in the early development of the adventitious roots."

* Comptes Rendus, clix. (1914) pp. 205–7.
† Proc. Camb. Phil. Soc. xvii. (1914) pp. 369–79 (2 pls.)

**Amitosis in Parenchyma of Water-plants.**[*]—R. C. McLean gives a brief description of amitosis in water-plants. The phenomenon has been observed in the cortical parenchyma of eight genera, but is most distinct and characteristic in *Hippuris*. In this genus amitosis occurs in the reticulate trabeculæ of the cortex, and its occurrence follows the general distribution of growth, being commoner in young stems than in old ones ; it is also more frequent in the neighbourhood of a node than in an internode, and is less common in the inner cortex than in the outer. The irregular outline of the nucleus usually assumes a twisted spindle-shaped form resembling the diatom *Pleurosigma*, and the length of such nuclei may be as much as ten or twelve times their diameter. The separation of the daughter-nuclei is very slow, as is also the subsequent cell-division. Amitosis was the only form of nuclear division observed in the tissues examined, and from its frequency it is probable that no other form occurs there. The author has also discovered amitotic division in the marsh-plant *Dionæa muscipula* and in the epiphyte *Polypodium ireoides*, facts which indicate that the phenomenon is of more frequent occurrence than has hitherto been supposed. It is suggested that it may be the constant form of nuclear division between sister-cells in all fully differentiated but still growing tissues, although it may also occur in meristematic tissues.

**Evolution and Physiology of Mitochondria.**[†]—A. Guilliermond publishes the concluding paper of his work dealing with recent cytological investigations as to the evolution and physiological function of mitochondria. The author points out that there is abundant evidence for regarding mitochondria as distinct organisms which elaborate the products of secretion ; also, that the plastids of plants resemble and are the products of slightly modified pre-existing mitochondria. The functions of the latter are of a very general character, and there is no doubt that the greater number of the secretory products of the cell are due to their activity. It is now known that every animal and plant-cell possesses a chondriome, which behaves exactly like a nucleus, in that it divides during mitosis and its products are shared between the daughter-cells ; the chondriomes are products of the mitochondria and possess similar functions. Researches dealing with the mitochondria of animal cells prove that their chemical composition is that of a lipoid (probably a phosphatide) united to an albuminoid base ; this appears to be true also in the case of plant-cells.

The question of the physiological function of the mitochondria has not been determined, but certain hypotheses based upon experiments with animal cells point to important conclusions. Regaud, basing his theory upon their chemical composition, maintains that they have a selective power of intussusception, fixation, and concentration. This theory finds support in the varied chemical reactions of plant-cells. Mayer and Schaeffer propose a theory applicable both to animal and plant cells and based upon three facts, viz. the universal presence of

* Proc. Camb. Phil. Soc., xvii. (1914) pp. 380–3 (1 fig.).
† Rev. Gen. Bot., xxvi. (1914) pp. 182–208 (9 figs.).

mitochondria, their general function and their lipoid character. According to this theory, the mitochondria are a support to and the region of the process of oxidation. This theory appears to assume that all mitochondria are of the same chemical nature, an assumption which has no support; but if it can be shown that they all contain lipoids, the objection might be overcome. The present writer considers that both these hypotheses may be correct, and concludes by pointing out the importance of the solution of the problem in dealing with the question of nutrition.

## CRYPTOGAMS.

### Pteridophyta.

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

**Phylogeny of the Filicales.***—F. O. Bower publishes some studies in the phylogeny of *Blechnum* and allied genera—*Plagiogyria*, *Matteuccia*, *Sadleria*, *Lomaria*, *Stenochlæna*, *Brainea*, *Woodwardia*, *Doodia*, *Scolopendrium*, *Asplenium* — and gives the following summary of his work. 1. These Blechnoid ferns and Blechnoid derivatives are believed to represent a true phyletic sequence. 2. Its origin has been traced in relation to the Cyatheoid ferns. 3. An actual point of probable contact has been found in *Matteuccia intermedia* C. Chr. 4. From such a source appear to have sprung several divergent lines. The main line leads through section *Lomaria* to *Eu-Blechnum*. 5. This involves the origin of the "flange," and diversion of the "phyletic margin" to indusial functions, as the structure styled by the older writers the "false indusium." 6. Minor lines led to Acrostichoid derivatives, respectively in *Stenochlæna* and *Brainea*. 7. Interruption of the fusion-sorus, foreshadowed as an anomaly in *Blechnum*, led to the status shown in *Woodwardia* and *Doodia*. 8. An outward arching of the fusion-sorus of *Blechnum*, ultimately combined with interruption, foreshadowed in the varieties of *B. punctulatum*, gives the key to the origin of *Scolopendrium*. 9. An outward swinging of the interrupted fusion-sori, variously combined with archings and new formations of partial sori, and various branchings of the leaf, give the several types of *Asplenium*. 10. The relation of *Plagiogyria* to the whole series is problematical. It seems probable that it is an isolated, as it is certainly a relatively primitive genus. 11. All the ferns here considered belong to the Superficiales. But in the methods of their advance they show interesting parallels with representatives of the Marginales.

**Jurassic Osmundaceæ from New Zealand.**†—E. W. Sinnott gives an account of some Osmundaceæ obtained from the Jurassic formations of the north and south islands of New Zealand. 1. They are referred to *Osmundites Dunlopi*. 2. They show a parenchymatous pith, with no phloem or endodermis. Leaf-gaps are very narrow and often "delayed," but always present. 3. One specimen shows in the pith typical diarch

* Ann. of Bot., xxviii. (1914) pp. 363-431 (11 pls.).
† Ann. of Bot., xxviii. (1914) pp. 471-9 (1 pl.).

roots, with definite cortex. This is comparable with the case of *O. cinnamomea*, where roots often enter the pith through the branch gap at a dichotomy. 4. The leaf-trace is monarch, and occasionally mesarch at the base. It expands into a single endarch arch, which in the base of the petiole is surrounded by a ring of sclerenchyma. On either side of this, in the cortex of the stipular wing, is a large island of sclerenchyma, and there is a patch of the same tissue inside each lateral bay of the leaf-trace. 5. Osmundaceæ and Zygopterideæ are not closely related, differing so widely, as they do, in anatomy of leaf-trace and foliar bundle. The leaf-trace of the Osmundaceæ and Ophioglossaceæ is typically monarch, and that of Zygopterideæ diarch. The simple condition of *Clepsydropsis* probably led rather to the diarch and triarch modern ferns than to Osmundaceæ. 6. There seem to have been both protostelic and siphonostelic Osmundaceæ in ancient times, and there is no convincing evidence that protostelic members, such as *Thamnopteris*, have given rise to species with a pith, for transitional forms are unknown. But there are transitions between primitive siphonostelic types, such as *Osmundites skidegatensis*, and the most reduced modern species. The xylem elements described in the "mixed pith" in *O. Kolbei* are probably root-bundles like those of *O. Dunlopi*. 7. The theory of the origin of the Osmundaceæ, which assumes that they have been reduced from typical siphonostelic forms, has the advantage of explaining very many structural facts in living and fossil members of the family which remain unaccounted for on any other hypothesis.

**Ulodendroid Scar.***—D. M. S. Watson discusses the structure and origin of the Ulodendroid scar. His summary is as follows. 1. In Lepidodendroids small branches issuing laterally were sometimes shed by an abscission layer, developed from a cambium which forms across the base of the branch in all its living tissues, except that part of the primary outer cortex which lies outside the secondary cortex. This abscission layer becomes connected with the secondary cortex of the main stem, and in old age entirely takes on the structure of the latter. 2. The Ulodendroid scar is such an abscission layer cutting off a branch which was formerly attached to its whole area. 3. *Halonia* is essentially similar in that it represents a stem from which lateral branches have been cut off by an abscission layer. 4. The most practical distinction between *Halonia* and *Ulodendron* lies in the arrangement of the branches, but the scars themselves are quite different when well preserved. 5. The well-preserved Halonial scar is divisible into two areas, of which the inner represents the abscission layer, whilst the outer results from the pressure of the long leaf-bases of the branch on those of the stem; consequently the Halonial condition can only occur in *Lepidophloios*. 6. In some cases the lateral branch of *Halonia* was not the peduncle of a cone. 7. No specimen of *Ulodendron* showing a well-preserved leaf-scar has ever been described, except in that type with oval scars and an excentric umbilicus, which belongs to *Bothrodendron*. 8. Consequently it is best to retain the generic name *Ulodendron*, as is done by most

* Ann. of Bot., xxviii. (1914) pp. 481–98 (1 pl. and 2 figs.).

continental authorities. 9. The reason why the leaf-scars are not found is that when whole branches were shed it was unnecessary to shed the individual leaves. 10. The increase in diameter of Lepidodendroid stems, owing to secondary growth, is very slight. 11. The growing points of *Lepidodendron* must have been of very great size.

**Anatomy of Epiphytic Lycopodiums.***—J. Ben Hill describes and figures the anatomy of six epiphytic species of *Lycopodium*, namely, *L. Billardieri* and *L. varium* from New Zealand, *L. verticillatum* and *L. Holstii* from South Africa, *L. Phlegmaria* and *L. carinatum* from Samoa. He gives the following summary of his results. 1. These species showed great variability in the development and structure of the stele. 2. The radial stele may be considered as the prevailing type, and as the basis in most cases for modification to the other types found. 3. There are radial, parallel-banded, crescentic, and amphivasal steles found in the same strobilus axis in *L. carinatum*, and all types but the amphivasal in *L. Phlegmaria* and *L. varium*. 4. *L. Billardieri* is the most constant in its stelar structure, with a type of stele so characteristic as to make the species almost recognizable by the transverse section of the stem. 5. *L. verticillatum* has generally a parallel-banded arrangement of stele, although the radial stele has been considered the prevailing type in epiphytic species. 6. All attempts to place the species of *Lycopodium* in definite catagories based on the character of the stele are extremely uncertain, since there are exceptions in some species, and even exceptions in different parts of the same stem in some species. 7. If the character of the stele is in any way dependent upon varying conditions, its use in phylogeny must recognize this fact. 8. The investigation made confirms the idea that the radial arrangement of the stele, retained persistently by the root, is probably the most primitive stem arrangement, from which most known stems have departed.

**Stigmaria.**†—O. Lignier discusses the interpretation of the stock of *Stigmaria*. In his résumé he states that:—1. The skeleton of the stocks of *Stigmaria* resulted from the dichotomy of a rhizome, one of the branches of which grew upwards and became the stem, while the other turned downwards and ramified dichotomously. 2. The basipetal extension of the secondary tissues due to growth in thickness of the trunk enveloped successively the first branches of this ramification of the roots and included them in the stock, which bore thus successively in proportion as it increased in thickness, one *Stigmaria* at first, then two laterally, then four diagonally, etc. 3. It is probable that an analogous structure developed also from the plantule derived from the macrospore. 4. Perhaps the obliquity and exogenous origin of the first roots of modern Lycopodiaceæ on their stem are a reminder of this ancestral arrangement.

* Bot. Gaz., lviii. (1914) pp. 61–85 (28 figs.).
† Bull. Soc. Bot. France, lx. (1913) pp. 1–8 (5 figs.).

**Lepidostrobus.***—R. Zeiller publishes a study of *Lepidostrobus Brownii*, founded on specimens derived definitely from the Lower Dinantian, one of them being particularly well preserved. He carefully describes the minute structure of the axis, sporophylls, sporangia, and demonstrates the presence of a ligule. He comes to the conclusion that *L. Dabadianus* Brongn., *L. Rouvillei* Ren., and *L. Lourenti* Zeill. must be referred to *L. Brownii*. But he separates off as *L. Schimperi* the specimen which Schimper believed to be the base of the type of *L. Brownii*, the structure of the primary wood being different. And another species which he separates off is *L. Delagei*.

**Wealdian Plants from Peru.**†—R. Zeiller describes and figures some Wealdian fossil plants or impressions collected by Capitaine Berthon near Callao and Lima in Peru. Among them are *Sphenopteris Berthoni* (new), and species of *Pecopteris Weichselia*, etc.

### Bryophyta.

(By A. Gepp.)

**Sporogonium of Cephaloziellaceæ.** —C. Douin discusses the sporogonium of the Cephaloziellaceæ, the special characters of which render this new family one of the best marked in the vegetable kingdom. He describes and figures the structure of the foot, pedicel, capsule, capsular wall, valves, apparatus for dehiscence, spores, etc. The peculiarities are the pedicel built up of four columns of cells; the capsule-base composed of eight large hyaline cells; and especially the four inferior and the four or five large basal external cells – three characters in such very intimate correlation that the presence of one argues strongly for the existence of the other two also; and they belong exclusively to the Cephaloziellaceæ. The family must be ranged between the tribes Trigonantheæ and Epigonantheæ. The organic perfection of the plants, the remarkable mechanism of dehiscence in the action of the basal cells, the activity of the elaters in scattering the spores, the simple structure of the pedicel so well adapted for rapid elongation, claim, in Douin's opinion, the highest rank for the family.

**Polar Bodies in Antheridia of Ricciocarpus.**§— Ruth S. Atwell describes and figures the appearance of polar bodies in the spermogenous tissue of *Ricciocarpus natans*. Centrosome-like bodies appear in both young and old antheridia in the earlier as well as in the diagonal division. The bodies are distinct and cannot be explained as accidental granules, for they are quite constant. But they are not permanent: they arise and disappear with each new division. Their position at the poles and their direct connexion with the spindle suggest that they may represent an important factor in the formation of the spindle.

* Mem. Acad. Sci., lii. (1911) 67 pp. (14 pls.) See also Bull. Soc. Bot. France, lix. (1913) pp. 661–3.
† Rev. Gén. Bot., xxv. bis (1914) pp. 647–71 (2 pls.).
‡ Rev. Gén. Bot., xxv. bis (1914) pp. 179–93 (1 pl.).
§ Bull. Torrey Bot. Club, xli. (1914) pp. 333–6 (1 pl.).

**Propagules of Hepatics.***—C. Douin gives an account of the propagules of the Cephaloziellaceæ and some other hepatics. 1. He restricts the meaning of propagules to those bodies on the gametophyte which having reached a more or less constant form can fall off, survive unfavourable periods, and eventually give rise to the different states of development seen in the germination of spores. In successive chapters he describes :—2. Different sorts of propagules. 3. Their development. 4. Their place of origin. 5. Causes that influence their production. 6. The role they play. 7. The amphigastria of propagules. 8. Importance of propagules in systematic botany. He adds a key and seventy-four figures.

**Riella.**†—R. Douin discusses the genus *Riella*, and describes and figures the structure of the gametophyte and sporophyte, the vegetative multiplication. He compares it point by point in parallel columns with *Sphærocarpus*, concluding that the two genera ought to form a special group divided into two tribes, Sphærocarpoideæ and Rielloideæ. He carefully considers Goebel's arguments that the group should be placed in the Marchantiales, and the arguments of others in favour of Jungermanniales and Sphærocarpales. The genus forms an isolated group, entirely different from all other hepatics in its winged stem, and allied to *Sphærocarpus* in its fructification.

**Lophozia Hatcheri.**‡—G. Dismier has made a study of the hepatics grouped round *Lophozia barbata*, with special reference to *L. Hatcheri*, a South Patagonian species, first described as *Jungermannia Hatcheri* by A. W. Evans in 1898, and since shown to be identical with the European *Lophozia Baueriana* Schiffn. Dismier, in examining the specimens of *L. Floerkei* and *L. lycopodioides* in the Paris Museum, found that most of the examples under *L. Floerkei* belong really to *L. Hatcheri*, but that none under *L. lycopodioides* can be so transferred. He gives a résumé of the points of structure which characterize *L. Hatcheri*, and states that it is well distinguished from *L. Floerkei*, but he regards it as a subspecies of *L. lycopodioides*.

**Hypopterygium.**§—J. M. Holzinger discusses *Hypopterygium japonicum* Mitt., and gives figures of its structure. From a comparison of specimens he is able to show that *H. canadense* Kindb. is a synonym, and that plants from Japan, Alaska, and British Columbia, are all one and the same species, the wide distribution being probably due to the Kuro Siwo, or Japan Stream, which traverses the Pacific Ocean as the Gulf Stream does the Atlantic. He objects to the use of the word "amphigastria" for the small medial leaves, and suggests "ventral bracts" or ventral leaves as preferable.

* Bull. Soc. Bot. France, lx. (1913) pp. 477–95 (1 pl.).
† Rev. Gén. Bot., xxv. bis (1914) pp. 195–202 (1 pl.).
‡ Bull. Soc. Bot. France, lx. (1914) Session extraord. 1913, pp. lvii–lx.
§ Bryologist, xvii. (1914) pp. 44–5 (1 pl.).

**Sematophyllum acutirameum.*** — H. N. Dixon discusses three mosses, the history of which has been confused. 1. *Stereodon acutirameus* Mitt., from Ceylon, is shown to be a composite species. the type of which is identical with *Hypnum monoicum* Bry. Jav., *Sematophyllum monoicum* Jaeg. Mitten confused it partly with *S. gedeanum*, partly with *S. sigmatodontium*. And there are further complications: but Dixon has disentangled the question, and makes clear the structural points of difference. 2. *Daltonia novæ-zelandiæ* Mitt. was published in 1859, and afterwards dropped as a synonym of *D. nervosa*. But Dixon shows that structurally these species are distinct. 3. *Brachythecium trachypodium* has been wrongly recorded as a British moss. Mitten's specimen is referred by Dixon to *B. velutinum*.

**Amblystegium.†**—H. S. Jewett discusses the identity of an aquatic moss found in the limestone walls of a spring in Ohio in three zones—(1) above the water-line (normal *Amblystegium filicinum*); (2) partly submerged (*A. filicinum*, in process of modification towards var. *spinifolium*); (3) entirely submerged (var. *spinifolium*). No normal *A. irriguum* was found. The question is whether the var. *spinifolium* is derivative of *A. filicinum* or of *A. irriguum*. He compares the structure of these plants, and quotes A. J. Grout's opinion that despite the contiguity of *A. filicinum* and the inflorescence, yet the submerged plants are *A. irriguum* var. *spinifolium*.

**New British Hepaticæ.‡** — W. E. Nicholson gives an account of the structure of *Riccia commutata* Jack, a species new to Britain and lately found in Sussex, Kent, Gloucester, and Worcester. He also describes *Fossombronia Husnoti* Corb. var. *anglica*, a new variety found at Babbacombe and Llandovery, and characterized by larger spores with less distinctly areolate markings, brownish rhizoids, and tri-spiral elaters.

### Thallophyta.

### Algæ.

(By Mrs. E. S. Gepp.)

**Symmetrical Protophyte.§**—C. A. Kofoid describes a protophyte with a cœnobium of exceptional regularity and remarkable resemblance to a lenticular egg with equal cleavage. It had sixteen cells. It was found in a local reservoir in Berkeley, California, U.S.A., in March 1912. No trace of the methods of reproduction was found. The author places it provisionally in Cœlastraceæ, since its structural relations, form of colony, and type of cell-protrusion agree more closely with that family than any other. He calls it *Phytomorula regularis*.

**Autogenesis of Nematocysts.‖**—E. Chatton records nematocysts or cindocysts in two Peridinieæ, *Polykrikos Schwartzi* and *Pouchetia*

* Journ. Bot., lii. (1914) pp. 119–24.
† Bryologist, xvii. (1914) pp. 42–4.
‡ Journ. Bot., lii. (1914) pp. 105–7.
§ Univ. California Publications, Bot., vi. (1914) pp. 35–40 (1 pl.).
‖ Comptes Rendus, clviii. (1914) pp. 434–7 (1 fig.).

*armata*, where they attain the shape and the high degree of complexity of those of Cœlenteratæ. He finds that they arise from pre-existing cindocysts and develop at their expense. Afterwards they multiply autogenously. The cindocysts of the second degree occur thickly in the cytoplasm, and without regard to the cindocysts. They are *cindoplasts*. The cindocyst is an element which, notwithstanding its autonomy, belongs really to *Polykrikos*. It presents no cellular structure and cannot be considered as a parasite, or part of a parasite. The structure of the stages of cindogenesis and the mode of formation of the filament, starting from a sort of centrosome, may be considered as a modified kineto-flagellate apparatus.

**Structure of Certain Parasitic Dinoflagellates.*** — E. Chatton writes on the evolutive and cyclic transformations of the Peridinian structure of certain parasitic Dinoflagellates. In *Blastodinium*, a genus of parasitic Peridinieæ found in the digestive tube of parasitic Copepods described by Chatton, the trophocyte is constantly bienergid and polarized. It represents a *Peridinium* which in course of its division seems to be arrested at the stage of the metaphase. All its growth takes place at this stage, which lasts 24 hours. The bienergid structure is retained in the sporocysts of all ages, but disappears at the maturity of the spore. Thus, typical Peridinieæ may, under the influence of hypernutrition, develop, in the course of their cycle, a complex nuclear system unknown in normal forms, which resembles in certain details that of *Noctiluca*. It is the result of a parasitic life. We have here an additional argument in favour of the affinity which proves to be continually stronger between these organisms and the Dinoflagellatæ.

**Fresh-water Algæ (Flagellatæ).†**—A. Pascher is bringing out a series of sixteen volumes by himself and other botanists, on the Fresh-water flora of Germany, Austria, and Switzerland. The first volume has appeared and consists of a general introduction to the Flagellatæ by A. Pascher, and the detailed treatment by E. Lemmermann of the Pantostomatinæ, Protomastiginæ, and Distomatinæ. The introduction deals with the most important points of morphology, development, and biology of the group, as well as methods of examination, culture, and preparation. The work is no mere compilation from previous works, but is a critical monograph embodying the original observations and conclusions of the authors.

**Notes on Fresh-water Algæ.‡**—E. Naumann continues his notes on fresh-water algæ, III and IV. He describes a deep chocolate-brown colouring of the water in a tank in the Botanic Gardens at Lund, caused by *Trachelomonas volvocina* Ehrenb., with about 150,000 individuals to the cubic centimetre. *Chrysococcus porifer* Lemm. was twice as numerous, and the other organisms brought the total production up to about 500,000 individuals per cubic centimetre. The accuracy of

* Comptes Rendus, clviii. (1914) pp. 192–5 (1 fig.).
† Die Süsswasser-Flora Deutschlands. Jena: G. Fischer, 1914, Heft 1, Flagellatæ, Sect. 1, 138 pp. (252 figs. in text).
‡ Bot. Notiser., (Lund, 1913) pp. 249–63; (1914) pp. 43–7, 89–92.

the working of the cubic centimetre chamber of Kolkwitz for counting the upper limit of production is discussed in detail.

**Fresh-water Species of Ceratium.***—J. Woloszyńska writes on the fresh-water species of *Ceratium*, *C. hirundinella*, *C. cornutum*, *C. curvirostre*, and *C. brachyceros*. The stability in the length of the cells in the three latter species is to be noted. The length of *C. hirundinella* varies between 100 and 400 $\mu$. *C. cornutum* is regarded as a very old form. The peculiar characteristics of each species are given in detail, and also set forth in a key. The geographical distribution is treated, and the genealogical origin of the species is indicated by a diagram. The author regards the development of the third posterior horn in *C. hirundinella* as a form of adaptation in order to increase its floating surface and its swimming capacity.

**Flagellatæ and Cyanophyceæ.†**—A. Pascher describes a symbiosis occurring between Flagellates and Cyanophyceæ, the alga being situated on or in a gelatinous envelope of the principal organism. The species of alga was different in each of the four examples investigated. The author proposes the name of syncyanosis for symbioses of this character. They appear to be specialized types of combinations between blue algæ and various organisms which possess gelatinous envelopes, such as have been known for some time among the higher blue algæ. Two new symbioses are described: between *Anabæna* sp. and a small net-forming species of Chroococcaceæ; and between a green alga and one of the Chamæsiphonaceæ. Points of physiology are discussed.

**Flagellum of Euglena.‡**—J. Burton writes a short note on a phenomenon which has been mentioned by a few authors, but not explained satisfactorily—the little disk attached to the distal end of the flagellum of some Euglenæ. The author believes it to be a coil of the flagellum, since he has seen similar loops or "kinks" at the sides as well as at the end. They appear to be only visible in a flagellum which has been cast off.

**Eudorina elegans.§**—W. Conrad publishes observations on the morphology of *Eudorina elegans* Ehrenb. The cells are always perfectly spherical, and their diameter varies from 15–25$\mu$. The small hyaline prolongation described by Goebel was not seen. The cells contain at least one pyrenoid, the mature cells often five to nine. The nucleus is globular, almost central. The stigma has the form of a watch-glass and is a brilliant red. Its size decreases in proportion as the rings of cells move away from the apical to the posterior pole. It takes no part in cell-division. There are two cilia, which protrude across a tube

* Kosmos (Lemberg, 1913) pp. 1262–80 (1 pl. and figs.). See also Bot. Centralbl., cxxvi. (1914) pp. 90–2.

† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 339–52 (1 pl.).

‡ Journ. Quekett Micr. Club, xii. (1914) pp. 291–4

§ Rec. Inst. Bot. Léo Errera, ix. (1913) pp. 321–43 (13 figs. in text). See also Bot. Centralbl., cxxvi. (1914) p. 13.

slightly enlarged outwards. The membrane only contains very little cellulose matter, but is richer in pectic substances. The cœnobia are more or less ellipsoidal or subglobose. The papillate pole always points backwards during movement. They measure when adult 170 × 140$\mu$. As regards the division and orientation of the cells in the cœnobium, the author finds that the position occupied by the five rings of cells after the first cross-division has taken place, remains always the same. The envelopes of the cœnobium present the same structural characters as those indicated for *Volvox globator*. Very fine intercellular communications occur. The author describes the natation of *Eudorina*, and adds some general considerations on the Volvocaceæ.

**Cytology of the Chroococcaceæ.***—Elizabeth Acton gives an account of her observations on the cytology of the Chroococcaceæ. In summarizing her results she says that :—1. In the Chroococcaceæ a highly specialized nucleus does not occur. 2. A gradual transition in cell-structure is found, from almost undifferentiated in the lower types to a somewhat specialized one in the highest (*Chroococcus macrocarpus*). 3. The protoplast consists of a ground substance traversed by a reticulum of delicate threads, with nodal thickenings, which are "plasmatic microsomes"—stores of reserve materials elaborated by the pigmented parts of the protoplast. 4. In most species there is no definite demarcation of central and peripheral regions, but the inner microsomes ("centralkörner" of Kohl) accumulate metachromatin, and the outer accumulate cyanophycin. 5. *C. turgidus* is of this type, but with some differences. 6. In it the number of metachromatin granules varies greatly in different specimens. If there be much metachromatin, it diffuses into the ground substance, and a period of active division takes place. At this time the microsomes of the central region react only with cytoplasmic stains. 7. Division occurs by the constriction of the cell into two halves. The central reticulum may now stain a little more intensely, and the threads tend to be drawn out parallel, but the cross-connexions are still visible. 8. Metachromatin may represent a stage in the formation of chromatin. 9. In *Glœocapsa* a deep staining of the central reticulum is often shown, simulating Olive's "spireme" stage. This may be an advance in specialization of the central region, or more probably an artefact. 10. In *Merismopedia elegans*, a higher type, there is a definite "central body" or "nucleus" at the time of division. This is not a nucleus of the higher-plant type, but simply an accumulation of chromatin, etc., at nodal points in a small central region. This "nucleus" seems to disperse itself along the reticulum after division. Divison of the "nucleus" takes place before it is reached by the ingrowing cell-wall. 11. *Chroococcus macrococcus* represents the highest type found by the author. It has a definite "nucleus" and cytoplasm. Only the peripheral portion of the "nucleus" stains deeply with chromatin stains, and contains a fine reticulum with chromatin at the nodal points. The interior of the "nucleus" is probably a sap-vacuole. The cytoplasm contains sap-vacuoles, and hence appears coarsely reticulate; but the fine reticulum is also present, though distorted. The

* Ann. of Bot., xxviii. (1914) pp. 433–54 (2 pls.).

microsomes are very small and indistinct. 12. The evolution of nucleus and cytoplasm may have been as follows. At first the excess of food-material elaborated by the pigment was stored in the plasmatic microsomes as a carbohydrate—cyanophycin. Later the reserve in the central region became more complex, and the proteid metachromatin granules were formed. In time, the accumulation of nucleo-protein became restricted to a very limited area in the cell, so as to ensure its equal distribution after cell-division; and this restriction only occurred on division, as in *Merismopedia*. Thus part of the cell became physiologically and morphologically separated by its function during cell-division, and it may be styled the "nucleus." At a later stage the "nucleus" became stable and persistent, as in *Chroococcus macrococcus*. The ground-substance also altered in character, forming a definite cytoplasm.

**New Protococcaceæ.**—W. Conrad* describes and figures the type of a new genus of Euprotococcaceæ, *Errerella bornhemiensis*, which is allied to *Golenkinia*, *Lagerheimia*, *Chodatella*, and *Richteriella*. It was found in August 1913 in a haul made at Bornhem from the "Vieil-Escaut."

H. Kufferath † describes a new species of Protococcaceæ, *Chlorella luteo-viridis* Chodat, with a var. *lutescens*. His paper consists of a study of its physiology.

**Structure of Diatoms.**‡—N. E. Brown publishes notes on the structure of the following species of diatoms: *Pinnularia* sp., *Pleurosigma balticum*, *P. angulatum*, *Surirella gemma*, *Navicula serians*, *Nitzschia scalaris*, *Amphipleura Lindheimeri*, *Coscinodiscus heliozoides*, *Stauroneis phœnicenteron*, and *Triceratium favus*. He describes in detail his observations on the different species, and concludes that we can no longer regard all the black dots usually seen upon diatoms as being pores through the shell, although there may be cases where they are so; for in the cases examined they are certainly nothing more than light effects or shadows. These are caused in *Pleurosigma* by the nodes of the grating structure: in *Stauroneis* by the membrane closing the meshes of the grating; in *Triceratium* by the membrane closing the pits in the cell-wall. The author considers that the true pores must be sought in the thin membrane of silex closing the meshes or pits. That diatoms have pores is beyond doubt in the author's opinion; also that some voluntary extrusion of motile living matter from the interior to the exterior of the diatom takes place. The pores are extremely minute. The method necessary for detecting them is described.

**Coscinodiscus oculus-Iridis.**§—J. Pavillard publishes some observations on *Coscinodiscus oculus-Iridis*, which is characteristic of the winter plankton of the Mediterranean. He describes the structure of the diatom, the formation of auxospores, and the formation of microspores

* Bull. Soc. Roy. Bot. Belg., lii. (1913) pp. 237–42 (3 figs.).
† Rec. Inst. Bot. Léo Errera, ix. (1913) pp. 113-320 (4 pls. and 28 figs.).
‡ Journ. Quekett Micr. Club, xii. (1914) pp. 317–38 (1 pl.).
§ Bull. Soc. Bot. France, lxi. (1914) pp. 164–72 (2 figs.).

or rather zoospores. He describes and figures the various stages in the formation of the latter and speaks highly of the investigations of P. Bergon published in 1907. The ultimate fate of the bi-flagellate zoospores is at present unknown. Pavillard figures a cell of *Coscinodiscus* invaded by a fungus, perhaps a *Synchætophagus*. Another intracellular parasite found in pelagic diatoms is the fungus *Olpidium*.

**Fossil Diatoms.***—A. Lauby gives a résumé of our knowledge of the fossil Diatomaceæ at the present time, their geological strata principally in the Tertiary and partly in the Quaternary epochs, their geographical distribution over the globe, and more particularly their distribution in French strata. He also discusses the constitution of diatomaceous deposits, the structure of diatoms in relation to their employment for industrial purposes: for instance, for absorption of liquids such as nitroglycerin. He considers also the proportion of soluble silica contained in them, and indicates the uses to which they are put—polishing powders, dentifrices, filters, absorbants, insulating material, etc.

**Austrian Diatoms.**†—R. Handmann and F. V. Schiedler write papers on the diatoms of the Almsee and the Ibmer Moos, in Austria. The Almsee near Grünau is shallow, and in parts overgrown with *Chara* and *Potamogeton*. Seventy-nine species of diatoms have been found among the *Chara*. A new genus, *Handmannia* (*H. austriaca* Peragallo), is described by F. V. Schiedler, resembling a *Cocconeis*. Among the *Potamogeton* were many species of *Cocconeis*, *Gomphonema*, and *Symbella Ehrenbergii*. The two latter also occurred plentifully among the *Chara*. In the mud at the bottom were found *C. Ehrenbergii* and *Navicula Gendrei* var. n., *Pantocsekii* M. Per. (intermediate between *Navicula Tuscula* and *N. amphibola* Cleve). The diatom flora of the affluent, the Kellerbach, consists of 61 species, and that of the marshy land 122. The total number of the region is 191, of which *Navicula* forms 43 p.c. A new species, *N. ramingensis* Handm., is described. From the Ibmer Moos, Schiedler records 65 diatoms, including a new *Cocconeis*, twice the size of *C. placentula*.

**Fresh-water Algæ in relation to Medium.**‡—J. Comère publishes a long paper on the action of the medium in relation to the general distribution of fresh-water algæ, which is of great importance in the study of the morphology of algæ owing to their extraordinary adaptability to varied conditions. It is divided into three parts. 1. Classification of aquatic formations; biologic nomenclature; florules corresponding to the conditions described. 2. Influences exercised on the algæ by the diverse ecologic factors. 3. General biologic distribution; factors determining dispersal of algæ; statistics of the principal groups found under the various conditions; periodicity of development.

* Rev. Gen. Sci. Décembre 1911, 20 pp. (19 figs.). See also Bull. Soc. Bot. France, lix., 1913, pp. 800–1.

† Mitt. Mikrolog. Ver. Linz, 1913, pp. 4–37. See also Bot. Centralbl., cxxv. (1914) p. 622.

‡ Bull. Soc. Bot. France, lx. (1913) Mém. 25, 96 pp..

**Spirogyra.*** — U. Kasanowsky and S. Smirnoff publish the first section of a Flora of the waters in the neighbourhood of Kiew. It deals with the genus *Spirogyra*, for which one new species and some new varieties are described. Twenty-five species are recorded. A table is given showing the distribution of forty-one species of *Spirogyra* round Kiew, Moscow, Charkow, etc.

**Division of Mitochondria in Vaucheria.†** — F. Moreau gives a résumé of what is known of chromatic bodies. He has studied them in *Vaucheria* in the light of Rudolph's recent work, and agrees with him that they are mitochondria. But he has gone further, and shows that the supposition that the mitochondria divide is an actual fact. He claims to have observed a clear division occurring. And this lends support to the theory that the mitochondria cannot form de novo in the protoplasm, but that each of the mitochondria springs from a pre-existing one.

**Dichotomosiphon and Mischococcus.‡**—J. Virieux publishes notes on two rare algæ. 1. *Dichotomosiphon tuberosus* is a rare alga gathered years ago by Braun in the lakes of Granson and Zurich, and recently found in North America, and by Virieux near Besançon. Ernst lifted it out of *Vaucheria* and made it the type of a new genus, *Dichotomosiphon*, with fruit unknown. Virieux has now found it in the fertile state. *Dichotomosiphon* is characterized by deep-green tuberous productions enclosing chloroleucites without pyrenoids and starch. These organs are not galls of Notommates nor aplanospores; rather they recall akinetes, and are altogether comparable with the tubercles of the higher plants. In germination they emit seven or eight tubes. Zoospores are unknown; but the sexual organs are developed in clusters of three to six oogonia, some of which can present a clear commencement of tuberization. *Dichotomosiphon* is a very valid genus, and cannot be included under *Vaucheria*, but rather shows relations with the Codiaceæ in its vegetative structure and reserve starch. 2. *Mischococcus confervicola* has a stage in its development which is characterized by the formation of loculi (pseudo-*Dinobryon* phase). This follows the formation of the characteristic ramification by a special process. The abundant mucilage of this alga is of a pectic nature. The genus belongs to the Botryococcaceæ, forming a tribe with *Chlorosaccus* and *Racovitziella*.

**Porphyridium cruentum.§**—H. Kufferath writes on the physiology and morphology of *Porphyridium cruentum* Näg. He has succeeded in obtaining pure cultures of it by methods which he describes. He notes the absence of a pyrenoid, and explains that its supposed presence

* Kiewsk. Oošcestvo Guit. prirod. dnepr. biolog. stan. No. 4 (Kiew, 1914) pp. 1–36 (1 pl. and 3 figs). See also Bot. Centralbl., cxxv. (1914) p. 622.

† Bull. Soc. Bot. France, lxi. (1914) pp. 139–42.

‡ Bull. Soc. Hist. Nat. Doubs (1911) 9 pp. (1 pl.). See also Bull. Soc. Bot. France, lix. (1913) pp. 657–8.

§ Bull. Soc. Roy. Bot Belg., lii. (1913) pp. 286–90.

was due to an optical illusion, produced by a convergence of luminous rays. No fatty matter was found. The non-amylaceous granulations appear to be metachromatic. This alga is allied morphologically to the Florideæ, and must no longer be classed with Cyanophyceæ and Protococcaceæ.

**Symbiosis between Planorbis and Batrachospermum.***—H. Iltis describes a symbiosis, which he found existing in a pool near Brünn, between *Batrachospermum vagum* Ag. f. *epiplanorbis* and a *Planorbis*, on the upper side of whose shell it was growing. He regards it as a case of symbiosis, not of epiphytism. In summer the alga grows only on *Planorbis*, in spring and autumn it is to be found elsewhere. This *Batrachospermum* lives in symbiosis not only with *Planorbis* but also with *Nostoc sphæricum* Vauch., which occurs in round or oval colonies between the branchlets. The symbiosis with *Planorbis* is continued to the second generation, the *Batrachospermum* growing on the spawn of the *Planorbis*. The advantages it gains are that it is carried into new surroundings rich in food, and is protected from the influence of high temperatures. The author suspects a further instance of symbiosis between *Chætophora cornu-Damæ* and *Limnæa palustris*.

**Parasitic Florideæ.**†—W. A. Setchell publishes the first part of a work on Parasitic Florideæ, wherein he treats of *Janczewskia*. The history of this genus is given, and a short account of the material used by the author. In all cases recorded the algæ grows on hosts of the same family as itself, Rhodomelaceæ. They are species of *Laurencia*, *Chondria*, and *Cladhymenia*. A section is devoted to the morphology of the genus, and then follows the systematic treatment. Six species are described, of which four are new. Three species "imperfecte cognitæ" are also given. The name *Laurencia subopposita*, one of the hosts supersedes the old *Chondriopsis subopposita* of J. G. Agardh. Relationships and distribution are dealt with. Thus far the species have only been found in temperate seas; but since the host-genera occur also in both the warmer temperate and the tropical waters it is not unreasonable to expect that *Janczewskia* may also be found there.

**New Japanese Algæ.**‡—K. Yendo describes some new species of marine algæ from Japan, and rectifies mistakes in identification of other species. One of the new species is a remarkable parasite, which he describes in detail, *Benzaitenia yenoshimensis*, a new genus.

**Algæ of Atlantic Islands.**§—L. Gain publishes a list of algæ collected by himself at Madeira and the Azores, followed by a list of species hitherto recorded at the Grande Salvage and the Azores. Fifty species are recorded from the Grande Salvage, the flora of which is very similar to that of the Canaries. The Madeira list numbers seventeen

* Biol. Centralbl., xxxiii. (1913) pp. 685–700.
† Univ. California Publications, Bot. vi. (1914) pp. 1–34 (6 pls.).
‡ Nyt. Mag. Natur., li. (1913) pp. 275–89 (2 pls.).
§ Bull. Inst. Océanogr. (1913) 23 pp. (1 fig.).

species. Among the 105 species from the Azores is *Polysiphonia havanensis* Mont. on the shell of a marine tortoise, with tetraspores, antherideæ, and cystocarps. A text-figure represents the plant in different states of fructification.

**Characeæ of France.***—F. Hy gives an account of the Characeæ of France—fourteen Nitelleæ and twenty Chareæ—with a structural introduction, keys to the genera and species, short descriptions of the species, and distribution in France: also critical notes and sixty-four figures of structure.

## Fungi.

(By A. Lorrain Smith, F.L.S.)

**New Chytridiaceæ.†**—A. Fischer united under *Cladochytrium* the three genera, *Cladosporangium*, *Urophlyctis*, and *Physoderma*, the distinctions between the three having been based on the characters of the zoosporangia, which are rarely found, the resting-spores only being visible as a rule. Of the new species, the first, *Cladochytrium Mauryi*, inhabits the leaves of *Colchicum autumnale*; it causes brown, more or less bullate patches on both surfaces of the leaf; the spores, one in each host-cell, are spherical, smooth, and chestnut-brown in colour.

The second species, *Cladochytrium Ollivieri*, grew in the leaf-tissues of *Orchis incarnata* and *O. laxiflora*, somewhat rarely in the latter. It forms dark-brown spots over the whole leaf; the spores, usually solitary, rarely two in a cell, are brownish and smooth. Although *Colchicum* grows abundantly in the locality, it is never attacked, nor are the orchids attacked by the *Colchicum* species.

**Observations on American Discomycetes.‡**—F. J. Seaver describes a species of *Sphærosoma*, and takes occasion to review the facts regarding the identity of the genus and its relation to other genera of Discomycetes. He judges from the type species, *S. fuscescens*, that the spores are reticulate and not echinulate. The plant studied closely resembled *S. echinulatum*, which in turn is very similar to *Boudiera areolata*, and probably an American form of the fungus. Considerable confusion has arisen in the examination of the spores, as it is often difficult to decide if they are echinulate or only areolate.

**Species of Peridermium.§**—J. A. Arthur and F. D. Kean publish an account of *Peridermium* species that occur on leaves and bark of various species of pine in North America. They first give the history of all known species, by whom discovered and described, and give also the record of cultures made, the latter in tabulated form. The writers emphasize the importance of microscopic examination, as "collections

* Bull. Soc. Bot. France, lx. (1913) Mém. 26, 47 pp. (3 pls.).
† Comptes Rendus, clviii. (1914) pp. 1705–7.
‡ Mycologia, vi. (1914) pp. 103–8 (1 pl.).
§ Mycologia, vi. (1914) pp. 109–38.

having similar gross appearance present well-marked microscopic differences, or two specimens with dissimilar appearance may yet agree under the microscope."

Keys to the foliicolous and caulicolous species are given, and in turn these are described in detail. There are eleven species on leaves and five on bark.

**New Hyphomycete.***—Henri Coupin states that on Raulin solution exposed to the air, numerous colonies of fungi develop, these being accompanied or covered by an organism forming a grey "veil." This was determined to be a form of yeast, but more careful examination and cultures have proved it to be a true Hyphomycete which forms filaments, breaking up into short lengths and swollen cells; these finally become thick-walled. Germination and development of the fungus were followed; it has been made the type of a new genus of Mucedineæ, *Polymorphomyces*.

**Development of Stropharia ambigua.**†—The plant studied was determined by Peck as a *Hypholoma*, owing to the appendiculate character of the veil and the entire absence of an annulus. S. M. Zeller has, however, followed the whole development, and finds that it does not correspond with that of *Hypholoma*. The first differentiation is the appearance of the primordium of the hymenium, a character pertaining to annulate forms as distinct from *Hypholoma* and others, in which the primordium of the pileus appears first. Careful examination also showed the presence of an annulus, hence the transference of the species to the genus *Stropharia*.

**Mycorhiza of Asclepiadaceæ.**‡—A study of root fungi in this family has been made by E. Buisch. He found *Mycorhiza* very frequently present. The succulent members generally possessed typical *Mycorhiza*; the non-succulent more rarely, and then the roots were imperfectly infected. The fungus showed the familiar characters: hyphæ, vesicles, dendritic branching sporangioles, and granular masses. Buisch found "knot-vesicles" in *Stapelia normalis* and *Hoja carnosa*. The functions and occurrence of these vesicles are discussed; it seems proved that they are resting conditions of the fungus. Cells containing calcium-oxalate crystals were frequently observed. It was observed that the Mycotrophic plants among the Asclepiads showed no reaction of nitrates, the opposite being the case with those not infected. These plants in particular possessed *Mycorhiza* that had a reduced transpiration current.

**Atmospheric Fungus Spores.**§—Paul Lindner explains the methods of exposing culture plates so as to secure growths of fungi from spores

* Rev. Gén. Bot., xxvi. (1914) pp. 245–8 (1 pl.).

† Mycologia, vi. (1914) pp. 139–45 (2 pls.).

‡ Verh. k.k. Zool.-Bot. Ges. Wien, lxiii. (1913) pp. 240–64 (pls.). See also Hedwigia, lv. (1914) Beibl., p. 17.

§ Die Biologische Nachweis von Pilzsporen in der Luft. Warmbrunn: Quilz and Co. (1913) 12 pp. (1 col. pl. and 16 figs.). See also Hedwigia, lv. (1914) Beibl., p. 19.

floating in the air. These methods have been adopted in various schools with great success. The technique of fungus cultivation, with the necessity for cleanliness and sterilization of plates, etc., is fully explained. A list of the pure cultures of fungi that can be obtained from the publishers of the paper is also given, and the macroscopic characters of each culture, such as colour, rate of growth, etc., are noted.

BY J. RAMSBOTTOM, M.A., F.L.S.

**North American Peronosporales.***—G. W. Wilson, in his sixth contribution to this subject, deals with miscellaneous species of this group. Notes are given on the history and occurrence of certain rarer species and their microscopic characters described. A new genus *Bremilla* is diagnosed, and two new species *Peronospora Chamæsycis* and *P. minima*. Several new combinations are made.

**Cytology of Sporodinia.**†—M. L. Keene publishes her results obtained in the investigation of the sexual process in *Sporodinia grandis*—a fungus which has been worked with by numerous cytologists. In the early stages of copulation of the sexual branches there is no difference morphologically between the two branches. Later, there is a characteristic retraction of the protoplasm of one of the gametangia. This may or may not be of sexual significance. The nuclei of the gametangia are small and show the same structure, size, and staining reaction as those of the mycelium. Vacuoles and cleavage furrows are formed. A new membrane is produced by ingrowth from the lateral walls. A central thickened portion is formed. The wall between the gametangia is dissolved, and the gametes fuse, the protoplasm of the one flowing into that of the other. Nuclear fusions occur progressively as the protoplasmic masses mix. As a result there are two sizes of nuclei present, large nuclei which result from fusions, and small nuclei which have failed to fuse. The formation of the second wall of the zygospore then takes place, and the unfused nuclei, as well as those of the suspensors, begin to show degeneration. Mucorine crystals are present through all the earlier stages. There next appear globular cytoplasmic structures, with which from their first appearance, oil is associated. They fuse irregularly, and produce ultimately one or two large bodies which are saturated with oil. These large cytoplasmic bodies are undoubtedly related to the elaioplasts described in many plants, and have for their function the elaboration of an oil for reserve food. In the mature zygospore there are numerous characteristic nuclei formed by the fusion of the two nuclei. The protoplasm is reduced to a thin parietal layer surrounding the oil plastid. The state of affairs persists until germination.

**Oil Drops in Discomycete Spores.**‡—E. Boudier again calls attention to the importance which should be attached to the oil drops or

* Mycologia, vi. (1914) pp. 192–210.
† Ann. of Bot., xxviii. (1914) pp. 455–70.
‡ Rev. Gén. Bot., xxv bis (1914) pp. 51–4.

sporidioles in fungi, particularly in Discomycetes. The role which they play in germination is important, for they act as food for the young mycelium. A description is given of the appearance and common variations of these guttulæ. Boudier considers that they are very useful in helping to distinguish between closely allied genera and species. The spores must be fresh when examined. In some cases there is difficulty in ascertaining whether a spore is septate or verrucose owing to these appearances being simulated. Iodine solution can be used to dissolve the oil when such is the case.

**West African Yeasts.***—A. Guilliermond describes five new species of yeasts, *Saccharomyces Chevalieri*, *S. Mangini*, *S. Lindnerii*, *Zygosaccharomyces Chevalieri*, and *Mycoderma Chevalieri*, from West Africa. Full accounts are given of the forms and dimensions of cells, temperature limits of budding, sporulation, macroscopic appearance in solid media, action in presence of sugar, etc. The characters which distinguish the three species of *Saccharomyces* are tabulated. *Zygosaccharomyces Chevalieri* possesses a heterogamic copulation which precedes ascus formation. Notes are given on the affinities of the species and their special biological characters.

**Morphology and Cytology of the Æcidium Cup.**†—F. D. Fromme finds that the essential features in the development of the æcidium cup in the Uredineæ are similar to those found in the development of the cæoma. The primordium is formed by hyphæ growing radially toward the centre of the cup. The cup is, however, the more deeply seated and produces a greater number of sterile cells and gametes to each gamete-bearing hypha. The gametes form a fertile layer two or more cells in thickness. The sterile cells that form the pseudoparenchyma of the cup are homologous with the "buffer" cells of the cæoma. Sexual cell fusions, by the breaking down of the cell walls between two equal gametes, were found in *Uromyces Caladii*, *Puccinia Claytoniata*, *P. Violæ*, *P. Hydrocotyles*, *P. Eatoniæ*, and *P. angustata*. No central organs ("fertile hyphæ") or multinucleated cells were found. The organization of the cup, therefore, is merely that of a remarkably unified colony of gametophores. Triple cell fusions were observed in *P. Claytoniata* and *P. Violæ*, and trinucleated æcidiospores were frequently found in both these species and in *U. Caladii*. Several quadrinucleate æcidiospores and a chain of quadrinucleate cells were found in *P. Claytoniata*. The first fusion cells are formed at the centre of the gametic tissue, and the subsequent ones are formed on all sides of this centre in centrifugal order until the lateral borders of the æcidium are reached. The fusing cells may have their long axes in general in the long axis of the cup, but in *P. Eatoniæ* they are tangential to its curved basal surface. Fromme holds that the presence or absence of a peridium is a natural but not very fundamental distinction between the æcidium cup and the cæoma; the production of a peridium is correlated with the deep situation of the cup and the extensive formation

* Ann. Sci. Nat., sér. 9 (1914) pp. 1–32 (5 pl.).
† Bot. Gaz., lvii. (1914) pp. 1–35 (2 pls.).

of sterile cells. As has long been known, the peridial cells are metamorphosed æcidiospores and æcidiospore initial cells. The central arch of the peridium is formed from the apical æcidiospores of the interior spore chains and the lateral walls from entire peripheral spore chains. The first peridial cells are produced at the centre of the arch and the peridium enlarges from this point centrifugally until the bases of the lateral walls are reached. Its subsequent enlargement is by the basipetal growth and sterilization of the peripheral spore chains.

**Biology of Uredineæ.***—E. Fischer gives an excellent account of the papers which have been published during 1913 dealing with the Uredineæ. The review is critical, and considers the work of twenty-four authors, who have made contributions from many different standpoints. A full bibliography is given.

**Wintering of Uredospores.**†— L. Montemartini gives a review of the results of other investigators on the persistence of the uredospore-stage of cereal rusts during winter. He states that in Italy rust occurs on wild and cultivated Gramineæ, which remain green after harvest, and may therefore reinfect wheat at any time. Autumn-sown wheat may thus be directly infected, and in warm and late seasons the disease appears. The uredospore seems capable of resisting several degrees of frost, though on this point the author's observations are not yet complete. Montemartini holds that in Italy it seems probable that the infection of the wheat crop takes place by means of uredospores from diseased plants during the autumn rather than by Eriksson's mycoplasm. The spread of the disease is influenced by the growth of grasses, the summer weather (for when the summer is hot and dry the uredo-stage is succeeded by teleutospores), the period of sowing, and the autumn and winter weather.

**Internal Spores of Rusts.**‡ — J. Beauverie, dissatisfied with the explanations suggested of the method by which rusts are able to exist through the winter, has endeavoured to find evidence of the propagation of the disease by the seed of affected plants. In the seeds of many cultivated and wild Gramineæ, he found sori of uredospores and teleutospores, or the mycelium of rust. If the seed is clothed, the sori are produced on the interior of the glumule, and project more or less in the contiguous pericarp; if the seed is naked, the sori form in the pericarp, usually in the parenchyma of the groove. These sori are not exceptional, but are very frequent in certain species. They are more or less general in barley (*Puccinia glumarum*). The wild grasses, *Brachypodium pinnatum*, *Bromis mollis*, *Agropyrum*, etc., show the phenomenon well. The frequency in wheat is not so easy to establish, but the author records clusters of uredospores on the surface of grains of wheat, which have arisen from the sori of the glumules and are re-

* Zeitschr. f. Bot., vii. (1914) pp. 625–36.
† Riv. di Palatog. veg., vii. (1914) pp. 40–4.
‡ Rev. Gén. Bot., xxv bis (1914) pp. 11–27.

tained by the stigmatic hairs or in the groove of the seed. In all the cases examined the mycelium was never found to penetrate into the albumin or embryo unless the cutinized and sclerified layer present is ruptured. Beauverie holds that the uredospores can pass the winter much better within the seed than when free. He formulates various hypotheses to account for the method in which the seedling could be infected by these spores. He favours the idea that the dissemination of the spores is brought about by the rupture of the seed-coverings during the germination of the seed. He indicates certain experiments which he intends to perform to establish whether the spores are really capable of retaining their capacity for germination, and also the method of infection of the young plant.

**Mycoplasm.***—J. Eriksson has given a result of his studies on *Uromyces Betæ.* His paper begins with an historical account of the knowledge of the fungus. The author found that where beetroot was attacked by the disease the latter is very unequally distributed over the field, and that in the case of neighbouring plants one may be diseased and the other healthy, this condition continuing until the roots are gathered. The fungus is autœcious, but during his experiments Eriksson did not find the æcidium stage, and therefore concludes that infection did not take place by means of teleutospores. To gain some idea of how the fungus survived the winter, five roots severely attacked and five roots slightly affected were taken in autumn, washed, the old leaves removed, and the roots planted. The following spring they were cleaned afresh. On the young leaves of one of the plants which had been badly attacked the rust appeared, and shortly afterwards all were attacked. No diseased plants were in the neighbourhood of Stockholm where the experiments were conducted, the author stating that the normal distribution zone ends a degree of latitude south of that place. Various reasons are given for believing that the fungus exists throughout the winter in the interior of the beetroot, not as a mycelium, but as a latent plasma ("mycoplasma") within the cells, probably at the top of the root from which it penetrates into the young leaves. Microscopic examination of various parts was made, but only in one case was any trace of mycelium found.

**Artificial Cultures of Basidiomycetes.**†—V. H. Young has succeeded in growing *Clitocybe illudens* in pure culture. Spores of the fungus were obtained and dilution cultures made on beef-malt-agar medium. The spores germinated readily, and in the course of three or four days numerous separate colonies appeared on the agar surface. These were transferred to sterile culture tubes of the same medium. Vigorous growth took place, and the tubes soon displayed thick felts of a brownish-white mycelium. Eventually mature fruiting bodies arose developing quite normally except for their size and the "re-curved" condition of the pilei. Examined microscopically the fruit-bodies were found to be sporulating profusely, giving rise to spores which were quite

* Rev. Gén. Bot., xxv. bis (1914) 247–58.
† Bot. Gaz., lvii. (1914) pp. 524–6.

normal in colour, shape, and size. From these spores numerous fruiting bodies have arisen showing such striking variations in form from the original parent, that the author has thought it best to discuss this phase in a future paper. Cultures were found to fruit in either light or darkness, although the first stages were always initiated in the dark. All cultures from the same fruit body made on one particular lot of medium, which had been slightly scorched in preparation, either fruited or produced abortive fruit bodies, while no fruiting was observed in other cultures. Young points out that this condition would give rise to substances not generally present in the culture medium, and suggests that this condition of nutrition may have been the determining factor. Cultures of *Armillaria mellea* were also prepared. Rhizomorphs soon appeared in the culture; but, whereas these in nature are shining black strands, "here, however, they are of a shining light-grey colour, and are flat and ribbon-like, often branching dichotomously." Upon penetrating to a free surface these rhizomorphs immediately give rise to the ordinary vegetative mycelium.

**Variations in Tricholoma nudum.***—L. Matruchot has investigated the influence of the environment on the variability of *Tricholoma nudum*. Previously the author in collaboration with Constantin had worked out the conditions of culture of this species. The present paper records the first series of investigations conducted with a mycelium which has been cultivated for twelve years in oak leaves. By choosing the young mycelium the fungus can be propagated indefinitely, and when cultivated in caves fructifies the whole year round—an important practical point as the fungus is a well-known edible species. The fungus cultivated in the subterranean caves in a normally hygrometric atmosphere at a constant temperature of 11° C. grows as vigorously as in natural conditions. It however loses certain of its characters, particularly its violet pigment which is a characteristic of the species *nudum*, and the sinuosity of the gills which is a characteristic of the genus *Tricholoma*. These changes are observed in all individuals without exception. In spite of these profound modifications in the form and colour of the fungus, the hymenium, the basidium, and the spore retain their normal characters of form, structure, and dimensions. The delicate taste and the smell of anise remain.

**Conidium Production in Penicillium.**†—C. Thom gives a series of notes on certain morphological features "common to the species, which for convenience are lumped together under the generic name *Penicillium*." The conidiopores, conidial apparatus, conidium formation, connective, melutæ, and the shape and measurements of conidia, are commented on.

**Fungi from Northern Palawan.**‡—H. and P. Sydow give a further list of fungi collected by Merrill in the Island of Palawan. The region is exceedingly rich in Pyrenomycetes and poor in Uredineæ, Ustilagineæ,

* Rev. Gén. Bot., xxv. bis (1914) pp. 503–9 (1 pl.).
† Mycologia, vi. (1914) pp. 211–15.
‡ Philippine Journ. Sci., ix. (1914) pp. 157–89.

and Discomycetes. The following new genera of Pyrenomycetes are diagnosed and figured :—*Microdothella*, *Heterodothis*, *Palawania*, *Stigmatodothis*, *Actinodothis*, *Aulacostroma*, and *Stephanotheca*. *Ichnostroma* and *Pycnothyrium* are new genera of Sphæropsideæ. Many new species of microfungi are described.

**Fungi from West Australia.***—W. B. Grove describes as new, *Puccinia Conostylidis*, *Pteroconium asteroides*, and *Hendersonia oligoseptata* from West Australia. *Harknessia uromycoides*, which was first recorded on Eucalyptus from America is here given from Perth.

**New Discinella.**†—J. Ramsbottom gives an account of the genus *Discinella* as it occurs in this country, and, together with D. Garnett, describes a new species *D. minutissima* which is exceptional in the remarkably small size of the apothecia.

**Atichia.**‡—A species of this peculiar genus is described from the West Indies by A. D. Cotton, *A. dominicana*. There is given a history of the genus which was first described as a lichen. An account of the structure of the fungus is given and notes on the life-history and systematics. A conspectus of the species of Atichiaceæ is appended.

## Lichens.

By A. Lorrain Smith, F.L.S.

**Lichen Acids.**§—G. Lettau has undertaken a micro-chemical research as to the presence and reaction of some lichen acids. The method of examining and testing minute portions under the Microscope, and determining the nature of the substance present by the characters of the colour and of the crystals formed, was recommended by Bachmann and Senft. Lettau's research had mainly to do with the presence of salazinic acid and its near allies. It has been found present in thirteen lichen species, but when these are tested there arises a great variety of results. Most of them colour yellow, but a change to rust-, wax-, or blood-red, or even brown, soon follows. Whether this is due to the presence of the acid has not hitherto been fully known. Lettau describes his methods of research, and gives the results of his examination of the thirteen lichens listed. He discusses the whole question of the reactions with several different reagents—potash, soda, and baryta water. Then there follows a long series of lichens, all tested by him with micro-chemical methods, and the results are given, many of them somewhat difficult to explain. Salazinic acid was proved by him to be much more wide-spread ; it occurred in seventy-two species out of twelve families. The location of the acid in the thallus varied considerably. It could be broken up and dissolved by hot or cold water.

* Hedwigia, lv. (1914) pp. 145–7.
† Journ. Bot., li. (1914) pp. 215–16.
‡ Kew Bulletin, 1914, pp. 54–63.
§ Hedwigia, lv. (1914) pp. 1–78.

**Contribution on the Study of the Apothecium of the Graphideæ.***—G. Bioret publishes a series of observations preliminary to a more complete study of apothecia in the family Graphidaceæ. In *Graphis* he finds that the paraphyses are vertical, parallel, and not branched. In *Opegrapha* they are also vertical and parallel, but less regularly so, and they are branched. In *Arthonia* the growth of the paraphyses is extremely irregular in direction, there are numerous branches, and anastomosis is frequent. The latter character more easily seen near the outside of the hymenium towards the walls of the apothecium. He finds that the paraphyses of *Melaspilea* are branched, and they anastomose. The direction of growth is vertical and regular, resembling in that character those of *Graphis*.

By J. Ramsbottom, M.A., F.L.S.

**Lichens on Flint.**†—Bouly de Lesdain describes the lichens found on a flinty road in the sand dunes at Dunkerque. Most of the flints are bare. Others are more or less covered, and some interesting species occur which are noted because of their rarity or because of the modifications which they undergo on this somewhat specialized habitat. Twenty-two species of lichens, three varieties, and one form were gathered. *Acarospora silicicola* is new. The hypothallus forms in many cases a very thin membrane, which only develops well on smooth surfaces as the hyphæ are very fragile, and break and shrivel on rough stones or bark. The author believes that the hypothallus in *Xanthorina parietina* and *X. polycarpa* has not been previously recorded. In both cases it is a very thin membrane, of the same colour or lighter than the thallus, reddening with potash, about 1 mm. broad, and with a whitish border.

## Schizophyta.

### Schizomycetes.

**Cockroaches and Ants as Carriers of the Vibrios of Asiatic Cholera.**‡—M. A. Barber remarks that cockroaches which have fed on human cholera fæces may harbour cholera vibrios in their intestines, and these may appear in enormous numbers in the insects' fæces for at least two days after the insects have fed, and may occur in smaller numbers seventy-nine hours after ingestion. By means of both fæces and vomit, cockroaches may act as carriers of cholera to human food. Cholera vibrios in cockroach fæces will survive on human food at least sixteen hours after discharge from the insect, and cholera vibrios in human fæces will survive in conjunction with numerous other bacteria in food at least four days. There is no loss of virulence for guinea-pigs in cholera vibrios after twenty-nine hours in the intestine of the cockroach. Cholera vibrios may be found in the bodies of ants at least eight hours after they have ingested cholera cultures in human fæces from cholera patients.

* Rev. Gén. Bot., xxvi. (1914) p. 249 (1 pl.).
† Rev. Gén. Bot., xxv. bis (1914) pp. 55-9.
‡ Philippine Journ. Sci., ix. (1914) pp. 1–4.

**Bacterial Disease of the Larva of the June Beetle, Lachnosterna.***—Z. Northrup has isolated a micrococcus (which he describes under the name of "*Micrococcus nigrofaciens*") from the lesions associated with disease of the larva of the June beetle (*Lachnosterna*). The condition manifests itself in the joints of the legs, spiracles, and dorsal and ventral segments of the grub, which become black and shiny; the affected limbs dropping off segment by segment. The micrococcus grows well on ordinary media, but the best growth is observed on "larva-media." Morphology on agar is characterized by flat, glistening, opaque, pale orange-yellow colonies. Experiments with regard to pathogenicity for Coleopterous larvæ (*Lachnosterna*, and the Southern United States June beetle, *Allorhina nitida*), the American cockroach (*Periplaneta americana*), and the "angle-worm," were carried out, but it cannot be said that the results of these experiments are very conclusive, nor has it been shown exactly what role another organism, described as the "gas-bacillus" (? *Bacillus septicus insectorum* Krassilstschik) plays in the etiology of the disease.

The humidity of the soil appears to be of great importance in the prognosis of the disease; moist soils favouring the rapid spread of infection. The micrococcus was found to be non-pathogenic for laboratory animals (guinea-pigs and rabbits).

**Bacterial Content of Coal.**†—H. Schroeder, working with sterile samples of coal, obtained from domestic coal cellars and from the mine face, was able to confirm Galle's observations regarding the presence of bacteria in coal. As to the origin of such bacterial contents, the most probable explanation is that they are derived from water percolating through the deposits in the coal mines, and should not be regarded as direct descendants of bacterial forms occluded in the original formations. This hypothesis is strengthened by positive experiments on the absorptive action of coal on bacterial solutions (*B. coli*).

The bacteria isolated (cocci, sporing bacilli, and *B. Welchii*) did not produce gas when grown in the presence of gas-free coal, and cannot therefore be held responsible for the production of methane and carbon-dioxide as stated by Galle, whose results may be attributed to the action of fluid (pepton broth) on gas contained in the coal sample. The importance of this question in relation to "gob-fires" in coal mines will readily suggest itself.

**Parendomyces pulmonalis** (Plaut).‡—H. Mautner describes the appearance of a kind of *Monilia*, not hitherto mentioned in the literature, which was isolated from the sputum in a case of bronchitis of many weeks duration. It appears probable that the infection was derived from pigeons. The sputum, which was of a peculiar malachite-green colour, was found to contain enormous masses of mycelial filaments and conidia of a fungus resembling *Monilia candida* Bonorden, except that the conidia were smaller. The fungus grew well on the

* Centralbl. Bakt., 2te Abt., xvi. (1914) pp. 321-38.
† Centralbl. Bakt., 1te Abt., xvi. (1914) pp. 460-9.
‡ Centralbl. Bakt., 1te Abt., lxxiv. (1914) pp. 207-8.

ordinary culture media, producing there conidia but not threads; copious thread production was, however, observed on beer-wort gelatin. The fungus is distinguished from *Monilia candida* by these peculiarities and by its fermentation reactions, and is held by Plaut to be a connecting link between *Zymonema* and *Endomyces*. Intravenous injections with rabbits induced nodule production in the kidneys but did not produce fatal results. The name *Parendomyces pulmonalis* Plaut, has been given to the organism, in accordance with its origin.

**Micro-organism isolated in Scarlatina.***—M. J. Cantacuzène describes a new micro-organism isolated from cases of Scarlatina. The organism is constantly found on the tongue and in the throat of scarlatina patients, and has also been isolated in pure culture from the miliary vesicles, which so frequently accompany the eruption. The organism, which appears to be exceedingly pleomorphic, is either found as isolated forms or as zooglœa masses. It stains generally with ordinary basic aniline dyes, and exhibits characteristic staining with the Romanowsky stains—i.e. the appearance of chromatic bodies and an intensely azurphile ground substance. The organisms are non-motile and are decolorized by Gram's method of staining. The best growth is observed on the surface of solid media to which defibrinated blood serum has been added; the colonies appearing as small transparent viscid points which gradually coalesce.

Pure cultures, injected subcutaneously into monkeys (*Macacus rhesus*) produced a typical polyadenitis accompanied by fever and focal desquamations. The temperature commenced to rise on the fourth day and after reaching its maximum (41° C.) in one or two days, descended by lysis. Post-mortem the animals showed signs of marked glandular enlargement and vascular engorgement. The organism was recovered from the spleen and other organs.

Positive complement fixation experiments were carried out with dilute emulsions of the organism and the serum of scarlatina convalescents. Controls made with normal serum were negative.

**Bacterium columbense.**†—A. Castellani re-affirms his statements made in 1905 regarding the specificity of *Bacterium columbense*. This germ produces in man a disease closely resembling typhoid fever of medium severity, and the organism has been isolated from the stools, urine, and blood of infected persons. In its cultural characters it resembles other organisms of the coli-typhoid group. When freshly isolated it is a non-lactose fermenter, but it acquires the power to ferment this sugar after several transplantations. The growth on agar is very luxuriant.

The claim to the specificity of the organism rests, however, principally upon its agglutination reactions. It is strongly agglutinated by the serum of patients suffering from *Columbense* infection, which sera do not agglutinate *Bacterium typhosus*, or *B. paratyphosus A* or *B*, even in dilutions of 1 : 20. The bacterium is not agglutinated by the serum

* Comptes Rendus, clxix. (1914) p. 381–3.
† Centralbl. Bakt., 1te Abt. Orig., lxxiv. (1914) pp. 197–200.

of persons recovering from the diseases caused by these latter organisms nor by the sera of hyper-immunized animals (*B. typhosus*, *B. coli*, *B. paratyphosus* A and *B*). The organism cannot be identified with *B. paratyphosus C* Uhlenhuth, as the latter (which is apparently identical with *B. suipestifer*) is apparently not pathogenic to man.

**Mutations of Plague Bacilli.***—J. G. Markl, working with agar plates which had been inoculated from buboes, blood, and spleen from cases of both human and rat plague, was able to identify three separate and distinct kinds of pest colonies which he distinguished as A, B, and C colonies respectively. The Type A colonies are described as delicate, translucent growths with strongly indented edges; they are non-slimy and are adherent to the culture media. The Type B colonies are large colonies with slimy yellowish centres and with bluish indented transparent edges. The Type C colonies are without border and are small, roundish, and opaque.

The A strain represents the youngest form, as it is in evidence on all cultures during the first 24 hours; the other types originate from the A colonies and may be regarded as conservative forms called into being through the needs of race preservation. Of the three races, the A race is the most virulent. The A race differs microscopically from the B and C race, being longer, ovoid, and uniformly staining, while the other races appear as cocco-bacilli, which, however, on introduction into the animal body, develop into the A strain. The different strains cannot be regarded as true mutants, as they do not preserve hereditary constancy.

**Flies in Relation to the Transmission of Leprosy.**†—J. A. Honeij and R. R. Parker have demonstrated the appearance of acid-fast bacilli in the excreta of flies, which have fed on the lesions of persons suffering from infection with the *Bacillus lepræ*. Various species of dipterous flies were tried in the experiments, but positive results were only obtained with the house-fly (*Musca domestica*) and the stable-fly (*Stomoxys calcitrans*). With the latter species 80 p.c. gave acid-fast bacilli in the excreta, but in only one case were such bacilli found in "vomit spots." Flies caught at a distance of 250 yards from the patients' dwellings, did not harbour acid-fast bacilli in their alimentary tract.

**Pigment-forming Vibrio.**‡—Jennie G. Drennan describes the appearance of a chromogenic vibrio which was isolated from the human alimentary canal in a case of intestinal disturbance.

The organism is a large motile vibrio producing a large white moist colony on alkaline agar, turning slowly to a dark rich brown coloration. The vibrio is an aerobe and facultative anaerobe, and liquefies gelatin slowly. It produces acid in dextrose and sacchrose peptone, but not in lactose, is slowly hemolytic, and does not form indol. It possesses but one flagellum, and is Gram-negative.

* Centralbl. Bakt., 1te Abt. Orig., lxxiv. (1914) pp. 529–40.
† Journ. Med. Research, xxx. (1914) pp. 127–30.
‡ Journ. Infect. Diseases, xiv. (1914) pp. 251–4.

# MICROSCOPY.

## A. Instruments, Accessories, etc.*

### (1) Stands.

**Binocular Microscopes.**—F. E. Ives, F.R.M.S., of New York, has drawn our attention to a form of binocular Microscope which he invented in 1902, which would appear to foreshadow the new types of binoculars now being placed upon the market. Ives' design was described in our Journal, 1903, p. 85, but it does not appear that it has been placed in the hands of the public. Conrad Beck informs us that he had not seen or heard of this instrument, or he would have included a description of it in his paper on Binocular Microscopes, although his paper was only intended to describe the better known types. The optical design of Ives' binocular consists of a cube of glass composed of two right-angle prisms cemented together with a partially silvered surface at their cemented junction, and a right angle reflecting prism on one side to receive the beam of light which is reflected from the partially silvered surface. This right-angle prism is made very thick in order to equalize the optical length of the parts of the two beams in a similar manner to that of the Leitz left-hand prism.† The chief difference between the design of the Ives' binocular and that of the Leitz or Beck lies in the fact that this side prism is provided with an adjustment to vary the angle of the two beams of light which enter the two eyes in order to vary the interocular distance, whereas the angle of the other instruments is fixed and the interocular distance is varied by mechanical means, the prisms being rigidly set so that they are permanently in adjustment. The draw-tubes of the two eyes in the Ives' instrument are not connected, and to adjust the tube-length each tube is pulled out separately, presumably to some fixed scale on each tube.

### (4) Photomicrography.

**Scheffer's Mirror-reflex Camera for Photomicrography; Scheffer's Microscope-table for Subjective Observation and Photography.**‡—In 1909 E. W. Scheffer described § the original form of his mirror-reflex camera. His experiences with the apparatus have suggested certain

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

† See this Journal, 1914, p. 7, pl. 1.

‡ Zeitschr. wiss. Mikrosk., xxxi. (1914) pp. 84–96 (6 figs.).

§ See this Journal, 1909, p. 648.

improvements, and the new form of the instrument has certain advantages which he considers adapt it for undertaking the most difficult tasks in the best way.

His Microscope-table is intended to give facilities for the ready photomicrography of any important detail when found, and for the immediate resumption of subjective observations. He gives full details of both pieces of apparatus.

**Obtaining Density in Photo-micrography.***—One of the chief difficulties, says C. F. Emeny, met with in photomicrography is—judging from the number of weak examples one sees, the product evidently of thin negatives—the securing of sufficient density in the negative so as to yield a print showing enough of contrasts to produce a pleasing effect; and in this article it is proposed to attempt to show how improvement may be secured. Let it be understood, however, that mechanical and microscopical conditions are assumed to be correct, and that only the photographic aspect is being considered.

Lack of density may be due to several causes, such as under-exposure, unsuitable developing agent, or unsuitable brand of plate—especially the use of a non-orthochromatic plate on an object more or less yellow in colour or put up in a more or less yellow medium. By the use of an orthochromatized plate of medium speed such as the "Imperial Non-filter," density is easily obtainable, always provided that sufficient exposure is given to allow the developer to give a good deposit of reduced silver in the film.

The choice of a suitable developer is a very important factor, and to the use of an unsuitable one may be ascribed much of the "lack of density" trouble. Amateur photographers are, from text-books and other sources, led to believe that the process of development is more or less automatic; but, while this may be to some extent true, it yet remains a fact that negatives of the requisite contrast and density are much more likely to be secured if thought is expended and care employed in the selection and use of a developer that will give the result sought for.

Two plates of the same subject and with identical exposures can yet be made to produce widely differing results—one a flat, dead picture, and the other a print full of brilliance and life, and this simply by the use of different developers. Metol-Hydroquinone developers (M.Q.) should never be employed where negatives giving brilliant results are desired; but the pyro-soda developer will be found much more satisfactory for the purpose, and if it is compounded according to the appended formula will be found to be practically non-staining.

Pyro-soda gives a negative having a deposit of far greater light-stopping properties than does the M.Q., and if two plates are developed to the same degree of *visual* intensity—one with each developer—the pyro-developed negative will be found to give a much more brilliant print than the other owing to the yellower and less actinic *colour* of the deposit in the film (quite apart from any question of *stain*); the M.Q.

* Journ. of Micrology, 1914, pp. 57–8.

developer gives a deposit of a bluer colour which allows the light to pass much more readily.

Then arises the important question of exposure. The action of the developer reduces to a metallic state the sensitive salts of silver present in the film which have been rendered reducible by the action of light: hence, in order that the developer may do its work efficiently, and reduce the requisite amount of silver, the exposure must be generous enough to allow full scope to the developer. If too little is given, no amount of prolonged development can make up the shortage, for, in other words, density and detail are settled by the exposure, and development simply makes visible the action of light.

With regard to any difficulty in securing density with high magnifications, it must be remembered that the plate used is not concerned with size of image, but with light-action only, so that if owing to high magnification, the light reaching the plate is dim, *sufficient exposure* must be given to compensate for the slow action of what light is passing. Even if exposed to so poor and slow a light as the red lamp of the dark-room *for a sufficient length of time*, full density (light-fog) will be obtained on any plate by development.

PYRO-SODA DEVELOPER.

| | | |
|---|---|---|
| (A) | Pyrogallic acid—crystals | 1 oz. |
| | Potass. Metabisulphite | 1 dram |
| | Potass. bromide | 1 ,, |
| | Water to | 80 oz. |
| (B) | Sodium carbonate—crystals | 8 oz. |
| | Sodium sulphite | 8 ,, |
| | Water to | 80 ,, |

To develop: take equal parts of each. Used at a temperature of 70° F. full density will be obtained in five minutes if the exposure has been correct.

Strong prints may sometimes be secured from thin negatives by making them on "gaslight" paper, though at the expense of "blocked shadows"; but it is far preferable to aim at the perfect negative, for then all is plain sailing. For photomicrographic prints "Enammo" paper is all that can be desired.

### (6) Miscellaneous.

**Possible Methods of Ruling used by Nobert.***—Nobert's ruled test-lines at one time, says John M. Blake, were the subject of much interest and discussion. They were regarded as marvels of mechanical skill. The rulings designed and used as a test of the performance of microscopic objectives were looked upon as the most wonderful of his productions.

It has been stated that, after his death, an investigation of his apparatus did not reveal his method of work. Possibly the apparatus

* Amer. Journ. Sci., xxxviii. (1914) pp. 147–8.

which he actually used appeared to the investigator so crude, and so far from what preconceived notions of what such an apparatus should be, that it was passed by as unworthy of notice.

The late William A. Rogers of Cambridge (Mass.) devoted much time and thought to the shaping of diamond points and edges for ruling purposes, and had much success in ruling fine and close lines. He took a great interest in what had been done by Nobert, and made measurements of the latter's bands of lines. Rogers' observations were published in the Proceedings of the American Academy of Arts and Sciences.

At that time the writer was interested in Roger's work, and it struck him forcibly that Nobert's bands could not have been ruled on a machine like that used by Rogers. Quite a different principle must have been employed. The writer went so far as to plan out an apparatus involving the supposed principle. This apparatus he hoped some time to make and put to the test. Its main features will be described, for we will assume that some interest in these rulings still remains, and that no better explanation of a method of ruling such bands of lines has yet been published.

The proposed method dispenses with all sliding ways, joints, and screws. The ruling point is to be held by a light spring bar, its motions controlled by electro-magnets; and the spacing of the lines accomplished by change of temperature of bars of dissimilar metals at measured time intervals.

In carrying out these conditions, a chronograph cylinder would be used with contact points suitably disposed on its surface. Provision would be made for heat storage in a medium surrounding the machine. This apparatus would be placed in a room that could be kept at a constant temperature.

With this much provided, a preliminary trial of the ruling apparatus would be made, and a line ruled at each revolution of the chronograph cylinder during the fall in temperature. These preliminary lines would be expected to diminish in distance apart from the beginning to the end of the selected time interval, and they would afford the data for calculation and measurement by which the final working electric contact-points could be located. Success would depend upon the possibility of repeating the temperature conditions, provided the chronograph worked with precision.

The ruling point is a vital part of the apparatus. Rogers' experience tended strongly to the use of ground and shaped points and edges. It is expected, however, that, with the light pressure needed in ruling these short bands covering a very small area, and with the pressure controlled by a very light spring, a suitable working point might be selected from minute chance-broken fragments of diamond. A very delicate point might remain intact for a long time, since no heavy moving parts would be involved as in a ruling machine.

The errors in spacing and the curvature of the lines on a Nobert diffraction grating were revealed by placing two photo copies so that the film surfaces were in contact, and the lines on the two made nearly parallel. Shaded irregular bands were thus produced indicating the errors in spacing. The writer has described this method in this Journal, July 1874.

These errors had apparently no periodicity such as would be expected to result from the screw motion on a ruling machine of the ordinary type. It also became apparent that the lines were curved, and it was estimated that the radius bar or spring-pole holding the ruling point was approximately eight feet in length.

We can see that this gives an insight into Nobert's methods; and the inference is that his most delicate ruled bands did not require the use of a screw or a sliding mechanism. The curvature of lines shown in his rulings would result from the ruling point being carried by a spring. The diminishing depth of ruling as the closest lines are approached may have been accomplished by placing the ruled surface in an oblique position rather than by a diminished magnetic pull on the spring carrying the diamond.

The indications are that in ruling his finest bands of lines, Nobert depended entirely upon changes of temperature through measured time intervals to give the required spacing.

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Simple Method of Preparing Tissue-cultures.†**—E. C. Rosenow recommends the following procedure for the bacteriological examination of pathological tissues. While in most infections, the investigation of normal body fluids and pathological exudates by the familiar laboratory methods give satisfactory results, in the case of extirpated lymphatic glands in Hodgkin's disease, the tissues in rheumatoid arthritis or arthritis deformans, gastric ulcers, and so forth, the ordinary methods of technique are not reliable, and the emulsification of the tissues under absolutely sterile conditions becomes necessary.

The apparatus consists of a metal drum, 23 by 19 cm., with a circular opening at one end, through which a long-sleeved thick-woven glove, lined with cotton-wool, is introduced and attached to the margin of the opening. On the upper surface of the drum a mica window is let in, for observation purposes, and at one side a round opening 2·5 cm., corked with cotton wool, is made. This opening is used for the purpose of introducing and abstracting material. The drum also contains a fixed shallow bowl, pestle, forceps, scissors, and test-tube. The whole apparatus is sterilized for an hour at 160° C. before use.

The aseptically removed pieces of tissue for examination are superficially sterilized by passing through the Bunsen flame, or by plunging into boiling water, and are then placed in sterile salt solution. The

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

† Centralbl. Bakt. 1te Abt., lxxiv. (1914) pp. 366–8.

right hand is now slipped into the glove, the tissue introduced and cut in pieces with the scissors, the fragments dropping into the shallow bowl. These small pieces are then ground up, salt solution or bouillon added, and the material again macerated. The resulting emulsion is then drawn up by a sterile pipette through the lateral opening, and inoculated into various media, as required. For the crushing of larger tissue masses a special apparatus can be adapted, and various modifications of technique can be made to suit individual circumstances.

**Egg Agar.***—A. Besredka and F. Jupille recommend the employment of "egg agar" as a culture medium for the rapid development of refractory organisms, such as the gonococcus, the bacillus of whooping cough, the pneumococcus, the meningococcus, etc.

The technique employed consists in adding 4 c.cm. of egg-broth to ordinary agar, contained in roux bottles. Before use the medium should be placed over night in the incubator, in order to complete the impregnation of the agar by the broth.

All the organisms mentioned exhibit luxuriant growth at the end of twenty-four hours, on this medium (with the exception of the bacillus of whooping cough, which requires forty-eight hours for satisfactory development). Tubercle bacilli (human and bovine) commence to grow after two days, and by the eighth day the surface of the medium is covered with innumerable granulations.

**Cultivation of Human Tumour Tissue in vitro.**†—D. and J. G. Thomson have succeeded in cultivating human tumour tissues in media composed chiefly of fowl-blood plasma. This is contrary to previous conceptions, as it was considered that the tissue of a certain animal could only grow in a medium composed of the blood-plasma of the same species of animal. The authors succeeded in cultivating papillomatous ovarian tissue in a medium composed of fowl-plasma 1 part, Ringer's solution (containing 0·5 p.c. of glucose) 1 part, and an extract of the tumour in Ringer's solution 1 part. On the third day of incubation at 37·5° C. definite growth appeared, which had increased considerably by the eighth day. The proliferation, like the original growth, consisted entirely of epithelial cells. Similarly, portions of carcinomatous gland grew most successfully in a medium composed of fowl-plasma 1 part, extract of embryonic chick 1 part. In this case the proliferation also resembled the original tissue, i.e. epithelial and connective tissue.

**Estimation of Gas produced by Gas-forming Bacteria.**‡—J. Cunningham suggests a method of estimating gas production by bacteria on a quantitative basis, with the employment of only very small quantities of sugar media. This is a matter of some importance when dealing with the higher priced sugars, such as dulcite and sorbite. The apparatus consists of a U-shaped pipette with limbs of unequal length, the long

* Ann. Inst. Pasteur, xxviii. (1914) pp. 576–8.
† Proc. Roy. Soc., Series B, lxxxviii. (1914) pp. 90–1 (1 pl.).
‡ Ind. Journ. Med. Research, i. (1914) pp. 735–40 (3 figs.).

limb being a capillary tube, with a small bulb (0·25 c.cm. capacity) in its upper part about 3 in. from the top of the tube. The short portion of the long limb above the bulb may be calibrated, and the long portion below the bulb should have an external diameter of about $\frac{1}{8}$ in. 0·25 c.cm. of the sugar medium is drawn up by teat-suction, followed by 10 c.mm. of a 24-hour culture of the gas-producing organism. The mixed fluid is so arranged that it occupies the glass bulb, its proximal end coming to lie at the commencement of the long portion of the capillary tube. The end of the pipette is then sealed, and the apparatus is placed in the incubator in the vertical position. As gas is formed during incubation, so the column of fluid is displaced downwards, and by careful marking of the level of the fluid at different times, the volume of gas evolved can be calculated.

**Inset Absorption Appliance for the Test-tube Culture of Anaerobes.***—R. M. Buchanan has devised an inset absorption appliance for the test-tube culture of anaerobes which obviates many of the disadvantages incidental to the ordinary use of pyrogallic acid and potassium hydroxide for this purpose. The device consists of a short inset tube (30 by 13 mm.), with the lower end sealed round a shorter and narrower tubule (20 by 3 mm.), which extends upwards in the centre as a vent. The upper end is fitted with a rubber stopper, which also suspends the inset tube in the tube containing the nutrient medium, and hermetically closes the latter tube. The approximate quantities of pyrogallic acid and potassium hydroxide to be used with this apparatus have been worked out as 0·25 c.cm. of a 40 p.c. solution of each reagent for every 10 c.cm. air space. The pyrogallic acid may also be used in tabloid form, which allows more time for manipulation. The method is equally effective for liquid or solid media.

**Disinfectant Action of certain Bacterial Stains.**†—A. M. Jansen has conducted an investigation into the question of the viability of bacteria under the action of some of the commoner laboratory stains. Aqueous solutions of methylen-blue or fuchsin have little or no bactericidal action, even in dilutions as low as 1 : 200. Aqueous solutions of gentian or crystal-violet (1 : 10,000 for 30 min.), on the other hand, show a marked disinfectant action on staphylococci but not on *Bacillus coli*. With regard to the action of staining reagents made up for laboratory use, it is concluded that organisms in slide preparations which have escaped destruction by drying and fixing, are not safe to handle when stained with methylen-blue, but are innocuous when stained with anilin-gentian-violet, Gram's stain, or strong carbol-fuchsin.

**Use of Glucose-Nasgar for Restoring lost Pigment-producing Properties.**‡—E. Emrys-Roberts has demonstrated the fact that stock cultures of *Bacillus prodigiosus* and *B pyocyaneus* which have lost their

* Centralbl. Bakt., 1te Abt., lxxiv. (1914) pp. 526–7 (1 fig.).
† Journ. Infect. Diseases, xiv. (1914) pp. 255–60.
‡ Journ. Path. and Bact., xix. (1914) p. 127.

capacity to form pigments, can have this function rapidly restored by growing for twenty-four hours on nasgar containing 1 p.c. glucose, and subsequently for twenty-four hours at room temperature. The pigment-producing property thus restored is, however, not transmissible to agar from the cultures on glucose-nasgar.

**Isolation of Bacillus Diphtheriæ by means of a Simple Medium containing Potassium Tellurate.***—J. F. Smith has found the following medium to give better results in the isolation of *Bacillus diphtheriæ* than the original medium of Conradi and Troch:—sheep serum, sterilized by intermittent heating for one hour at 57° C. 5 c.cm.; 1 p.c. potassium tellurate solution in distilled water 1·5 c.cm.; pepton-water agar (neutral to litmus) to 100 c.cm. On this medium *B. diphtheriæ* forms opaque white colonies after twenty hours growth at 37° C. Diphtheroids (Hoffman bacillus, Ozæna diphtheroids, etc.) also grow well. Such other organisms as grow, generally show colonies darkened by reduced tellurium. Streptococci form minute discrete colonies and are easily recognized as such.

**Modified Fermentation Tube and a New Medium for Gas-forming Organisms.**†—J. W. Hall and F. Nicholls describe a modified fermentation tube for collecting the gas produced by bacteria. It merely consists in a funnel-shaped expansion of the lower or open end. They also recommend as a good medium for *Bacillus coli* neutral veal broth with 2 p.c. silk pepton and 5 p.c. lactose. They note that silk pepton facilitates the growth of colon bacilli in solid media, e g. agar

**Change of Form of the Tubercle Bacillus when grown on Sperm-oil and Glycerin-egg Medium.**‡—A. H. Miller has found that the tubercle bacillus when cultivated on Dorset's medium (glycerin-egg) to which has been added a little sperm oil (a liquid wax) undergoes certain changes. It becomes plumper, longer, and its ends are pointed. It is beset with large acid-fast granules, the intervening portions being decolorized by the acid. To make the medium the sperm-oil is poured on to the beaten up and filtered egg, and glycerin in normal saline is added to the amount required. The mixture is then well shaken in a flask, poured into sterile test tubes, and set. Coagulation takes place in about three minutes, care being taken not to let the media rupture. It is then sterilized by steaming for about an hour on three successive days.

### (2) Preparing Objects.

**New Self-regulating Paraffin Bath.**§—A very simple form of paraffin bath for embedding tissue for the microtome has been used by C. W. Woodworth in his laboratory for several months, and has proved

* Journ Path. and Bact., xix. (1914) pp. 122–4.
† Lancet, 1914, ii. pp. 741–3 (1 fig.).
‡ Lancet, 1914, ii. pp. 739–40 (3 figs.).
§ Univ. California Pub. (Zool.) xiii. (1914) pp. 39–42 (2 figs.).

exceedingly satisfactory, being very convenient and maintaining a uniform temperature (figs. 48, 49).

The apparatus is simply a glass flask about one decimetre in diameter heated by vaporized chloroform. The neck of the flask is a slender

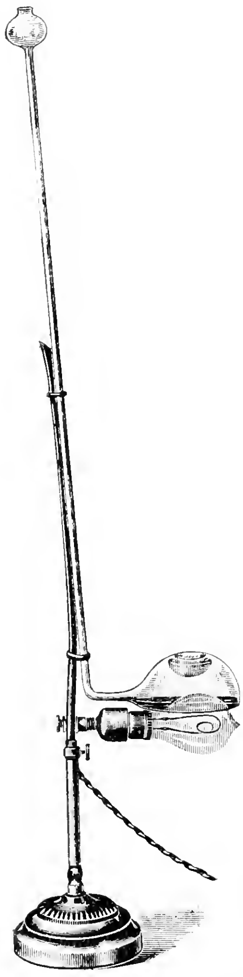

Fig. 48.—The new paraffin bath in operation.

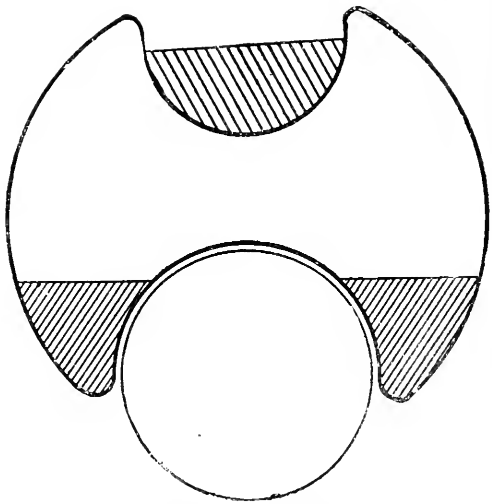

Fig. 49.—Cross section of paraffin bath shown in fig. 48. The shaded portion below near the electric lamp shows the chloroform; that in the cup above indicates the paraffin.

tube nearly a metre long, which ends above in a thistle tube-funnel for convenience in introducing the regulating fluid. A small quantity of chloroform is poured into the flask through the long neck. The heat from a sixteen candle-power electric bulb fills the flask with the vapour of chloroform at its boiling temperature about 58° C., which is exactly right for the melting of the paraffin. Since the tube of the flask is open to the air, the temperature within cannot rise above that of the boiling point of the chloroform in air, which rises only slightly with the barometer. Practically all the chloroform is condensed and flows back into the flask.

A piece of cardboard may be placed over the flask to keep the dust out of the paraffin, and a towel is usually thrown over it to conserve the heat when warming up the bath. It takes about half an hour in a room at 16° C. to melt the paraffin. After it is once warmed up it maintains an invariable temperature, except on very cold days (5° C.)

The advantages of this new form of bath are :—1. Simplicity : the bath requiring no adjustment, and having no mechanical apparatus to get out of order. 2. Precision of regulation, since no variation of temperature in the heating medium occurs such as is necessary in an apparatus with a mechanical thermostat. 3. Illumination of cup : a convenience in handling the object in filtrating and an aid in keeping the cup clean. 4. Inexpensiveness, the cost of the whole equipment being not over 10*s*. 5. Safety, the heat being by electric lamp and the regulating fluid being non-inflammable.

**Improved Method of Cleaning Diatoms.***—Diatoms, says John M. Blake, are microscopic organisms near the dividing line between animals and plants. It is important for our purpose that they have siliceous skeletons which take on very many symmetrical and beautiful shapes. The chlorophyll and organic matter with which they are associated can be destroyed by strong acids, but they still retain the clay and sand which were deposited with them. The process of cleaning consists in removing this foreign material. Unless this be done the forms will be obscured and difficult to detect.

Many observers have studied and classified the numerous species, and have spent much labour in preparing and mounting them for observation, for there is a fascination in these forms that appeals to all, and any plan for facilitating and lessening the labour of preparation would be likely to induce many more to take up the study.

An ordinary well-known method of separation is to digest the material with an acid, and then to dilute with water, and allow the heavier portions to deposit. After an interval, the lighter portions are poured away, and the process repeated until the clay, very fine sand, and broken diatoms have been removed, while those diatoms which have not been floated away during the process, remain with the coarse sand. This process takes up considerable time, and requires careful attention and timing to decant successfully, and, in spite of this care, some of the smallest and lightest forms can hardly fail to be lost.

The method now to be described was originated by the writer some twenty years ago, and recently, in recurring to the subject, it seemed that even at this date the method might appear novel, since it has not been exhibited during the interval, and no mention of a similar plan

* Amer. Journ. Sci., xxxv. (1913) pp. 19-22.

has been noticed in any published directions for treating diatoms. Therefore, the way seems open for a revival of interest in the subject, and this method by which, for instance, a small test sample of diatoms can be cleaned in five minutes' time from the acid-prepared material, should appeal to novices as well as experts, by reason of its saving of both time and effort.

The first attempt to supplant the ordinary method of separation and cleaning was made by using a cloth sieve made of partly worn cotton cloth stretched on a frame. The diatom material was treated in the usual way, in a separate vessel with acid. Then, when it had been largely diluted with water, the mass was placed in this cloth-bottomed tray, and agitated and jarred to carry off the clay through the cloth. More water was then added, and the process repeated until only sand and diatoms remained. This plan was not wholly satisfactory, since a large proportion of the diatoms passed through the cloth; yet a considerable bulk of partly cleaned diatoms was obtained, and by careful straining through a sieve the largest diatoms were separated from the smaller and the broken forms, and in this way were secured entirely free from debris. There was an abundance of this material for distribution.

Very soon after this first experiment, the writer originated an improved and more practical method which depended for its success upon the use of cross-sections of wood. Coniferous wood is the most suitable, since it has pores of nearly uniform size, whereas other kinds of wood nearly always have large and small pores commingled, which make them entirely unsuited for the purpose. These wood cross-sections bear dilute acid without injury, which would not be the case with a metal strainer of equally fine mesh, even supposing such a strainer could be made. Furthermore, such a strainer would be too frail to stand the required pressure.

A sharp, thin-edged chisel is used for making the sections, and the wood is kept in boiling water, and removed instantly before each cutting. It requires some care to secure an even thickness, which should be from one-quarter to one millimetre, as needed. The cut section is now to be wetted and surface-dried, and then cemented to a vial, the bottom of which has been cut off for the purpose. A very convenient size can be made from a two-dram vial, making the working aperture of the strainer about one-half inch The cement may be composed of rosin toughened by wax. Larger strainers may be made, but this size will answer for the first trials.

The digested diatom material, moderately diluted, is to be worked through the wood, a small portion at a time. The acid and the salts will pass with some freedom through this wooden grating, and the clay and fine sand are to be gradually worked out by the alternate pressure and release of a rubber compression bulb. The size used on camera shutters answers very well. This bulb is placed on the end of a glass tube 6 or 7 in. long. It is desirable, but not essential, to have a bulb blown in the middle of this tube. A short bit of rubber tubing of proper diameter is slipped over the free end of the glass tube, and this is to be inserted in the mouth of the vial so as to make a tight joint, but this joint should be easily separable. In operation we take up a small portion of the material in a dropper, and squeezing it into the vial, we insert the rubber tip of the glass tube, and holding the strainer under water, press on the bulb, which will cause the air, acid, and salts to flow out together with a cloud of fine waste material. The pressure is now to be alternately applied and released, and the waste material is thus gradually removed. The discharge of clay and fine sand at last ceases, and the diatoms are left with the coarse sand and mica which can be removed by other means.

By thus eliminating the clay we will have disposed of one of the most serious obstacles to the cleaning of diatoms. One very important advantage of this method of working is the small quantity of material required, because there is very little waste. Successive portions as they are cleared can be united to make up the needed amount.

It is important that the strainer should not be overloaded, for that would cause it to pack and choke. This pack has to be broken up by shaking after each compression, more particularly in cleaning filamentous forms, in order to allow the imprisoned debris to escape at the next compression. As a general rule, and with the more granular forms, this packing requires only a little attention to avoid trouble. Violent compression will fracture many of the larger and more fragile forms of diatoms. The strainer vial should be kept in water when not in use, to avoid injury to the wood-section from contraction.

After the section has been in use for a considerable time the pores gradually become stopped with fine sand. Clay alone does not cause this condition. The only remedy is to cement on a new section.

An interesting point in this connexion is that when we burn an old strainer-section for the purpose of studying this clogged condition, we find that the ash will crumble if dampened, and will fall into numerous "sticks," each the length and diameter of a pore of the wood, and each of these "sticks" will be found to be packed with the small sand grains.

It may be said in regard to the selection of wood, that white pine—*Pinus strobus*—is excellent for ordinary use, since the strainers cut therefrom work freely. Certain light diatoms that would as a rule have been floated away in the usual settling and pouring-off process, are here retained by the pine section, because their length enables them to bridge across the pores. Some very short forms, however, will pass through to a considerable extent.

By saving the tailings from the pine and passing them through a spruce strainer, the majority of these short forms were retained. The spruce here referred to was a piece of flooring, and of a very white species of spruce. It was not identified. There are several other species that would probably answer equally well. In using spruce, the sections should be thin. The clay will be found to pass through the pores of spruce with some freedom, but not so rapidly as through pine.

There are some gatherings that will require a strainer of still finer grain. This may be said of the very smallest diatoms that grow on water plants. The majority of these may be retained by a quite thin section cut from the white outer wood of the red cedar *Juniperus Virginiana*. In one experiment some of these very minute forms which had passed through the spruce were almost wholly retained by the red cedar.

It follows that from these three species of wood we can obtain a graded series of strainers, each capable of separating the clay from the diatoms, and at the same time furnishing a ready means of grading as regards size.

The pine strainer works the most rapidly and makes a very good separation, and will meet ordinary requirements. The spruce strainer can follow if we want a more thorough gleaning of the smaller forms: and then we have the red cedar section as a final resort to aid in securing the very smallest diatoms.

**Method for Cleaning Diatomaceæ.***—There are a number of methods to be found in various books on microscopy for cleaning Diatomaceæ, none of which, says E. R. Darling, proves to be perfect in all details. The method generally resorted to is to boil with nitric acid. This does not, however, remove all of the organic matter, and leaves a mounted specimen contaminated with black specks. Another method is to boil the specimen with sulphuric acid and potassium chlorate. This, too, has its disadvantage, as in boiling neutral potassium sulphate is formed, this salt being sparingly soluble in water. The following method, which is a modification of that of Edwards,† will be found to work with great success.

The sample is first dried, and then about 5 grm. taken and well washed with distilled water. The washing is best done by placing the sample in a filtering paper fitted to a glass funnel, and replacing the water as it runs out. The washing is complete when about 250 c.cm. has run through. A hole is then punched in the apex of the filter paper and the sample washed into a 250 c.cm. beaker with concentrated hydrochloric acid, about 50 c.cm. being required. This is allowed to boil gently for 30 minutes, 100 c.cm. of hot water is then added, and the whole filtered. The sample is washed with hot water until it gives no white coloration when a drop is added to a weak solution of silver nitrate. The sample left on the filter-paper is then washed into the beaker with 50 c.cm. of concentrated nitric acid and gently boiled until red fumes cease to be given off. This is then diluted with hot water, filtered, and washed until free from acid.

The above method removes all the mineral matter except silica, Diatomaceæ, and a large part of the organic matter. The product from the last operation is removed to a beaker by means of a small spatula. To this is added a mixture of concentrated sulphuric acid and water, 8 parts of acid and 2 parts of water. In mixing care should be taken to add the acid to the water. This is boiled for about 30 minutes, or until the organic matter is charred. As soon as the acid starts to boil weigh out about 2 grm. of potassium chlorate and add to the acid in small quantities until the solution becomes colourless. The acid solution is then poured into 250 c.cm. of distilled water, filtered, and washed free from acid. The product is then washed into a beaker with about 20 c.cm.

* Amer. Journ. Sci., xxxviii. (1914) p. 282.
† See this Journ., 1859, p. 167.

of concentrated hydrochloric acid, and gently boiled for about 15 minutes. It is then diluted with hot water, filtered, washed first with distilled water acidified with hydrochloric acid, and then with hot water until free from acid, which is determined by adding a drop of a weak solution of silver nitrate.

By the addition of the potassium chlorate to the sulphuric acid solution the organic matter is destroyed. The neutral potassium sulphate which is formed is changed into the chloride by the addition of the hydrochloric acid. The chloride is soluble in hot water and is removed in this way. When thus purified the Diatomaceæ should be kept in a mixture of 6 parts of alcohol and 4 parts of water, to prevent them from matting together.

**New Water-jet Air-pump, and the Fixing and Embedding of Microscopical Objects in vacuo.***—M. Wolff describes a new water-jet air-pump recently placed on the market by the firm of Erich Koeller, of Jena. The working principle consists in the fact that the entering jet of water passes with a whirlpool action round a glass funnel, into which the tube connected with the evacuation vessel fits. This tube is fitted with a reaction valve to prevent the overflowing of water into the vacuum. The apparatus is very powerful. A 2-litre vessel with 720 mm. air-pressure and 2·5 to 3 atmospheres water-pressure (and a water temperature of +13° C.) is evacuated up to 711 mm. mercury in seventy seconds. This apparatus is especially useful for fixing and embedding tissues in vacuo. Delicate structures (larvæ of arthropods and the like) are particularly suitable for vacuum embedding, as the processes are very much shortened and a minimum amount of injury is sustained by the tissues.

### (3) Cutting, including Embedding and Microtomes

**Leitz's New Rotary Microtome.†**—S. Becher describes this apparatus in the course of an article on New Microtome Constructions. In this instrument (Figs. 50, 51), the delivery of the object part is combined with a circular cutting motion together with a push and drop movement of the knife. This combination gives to the instrument its individual character and distinguishes it from older types, and not only guarantees extraordinary facility but also astonishing uniformity of action. The object part consists essentially of a metal disk about 8 mm. thick and of 14 cm. diameter, whose perpendicular axis is secured above and below by a tapering steel bolt, thus securing easy rotation without the least vibration. The under bolt is attached to the base-plate, but the upper is inserted into a strong cast-iron arm whose other end is likewise attached to the base-plate. This arm is bent in such a way that the object clamped to the disk can easily pass under during the rotations. The object-clamp is rotatory about its axis and is universally inclinable; it is attached to a brass block, shaped like a segment of a sphere, which itself has a universal movement in a corresponding saddle

* Zeitschr. wiss. Mikrosk., xxxi. (1914) pp. 19–22.
† Zeitschr. wiss. Mikr., xxxi. (1914) pp. 103–13 (2 figs.).

of the disk and can be firmly clamped from below. The mean rotation-point of this spherical clamp arrangement lies only very little under the clamp, so that in changing the inclination of the object the height of

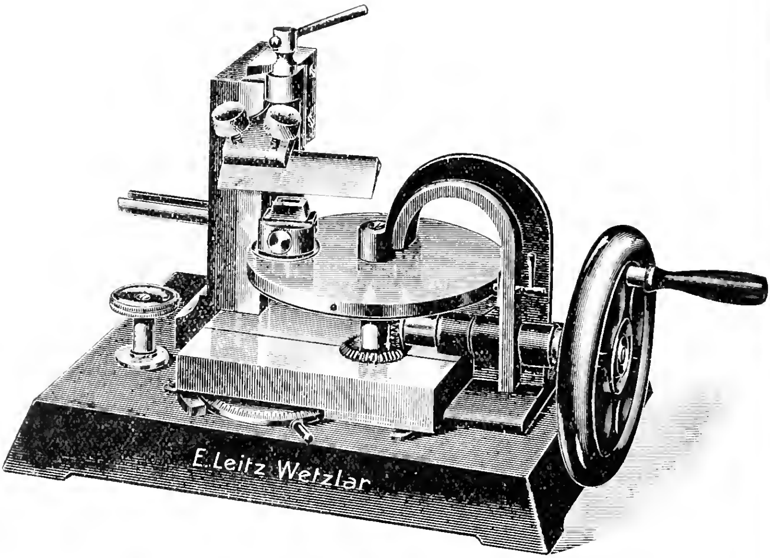


Fig. 50.

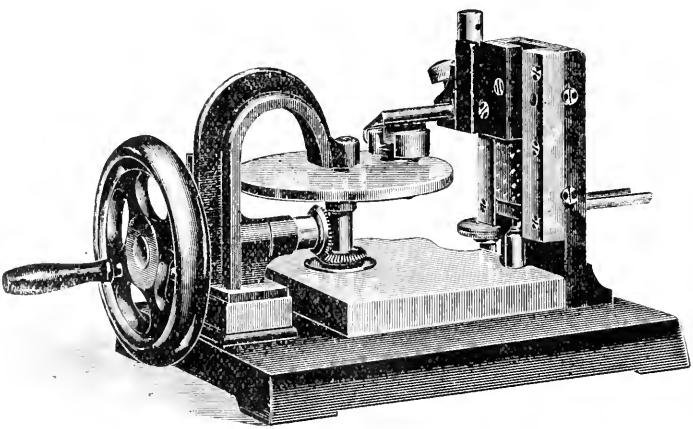

Fig. 51.

the object is only slightly altered. Blocks of wood or grooved metal disks with their paraffin or celloidin beds can be secured to the clamps, and by the addition of a little more molten matter the object and mean-rotation point are brought still closer. The rotary gear consists of a winch-wheel whose axle passes through the base of the bent arm, and by means of two obliquely toothed wheels imparts its motion to the disk. As the winch is turned disk and object rotate with uniform velocity and always in the same direction. The mutual adjustment of knife and object depends upon the drop-movement of the knife, but it is automatic, being an effect of the gear motion transmitted by a micrometer spindle. This spindle is coupled with another axle, which carries at its upper end a saw-toothed wheel, rotatory by means of a connector. This connector is drawn forward at each rotation of the main disk by means of an eccentric disk fastened near the lower end of the connector in order to slide back afterwards. The number of teeth set in action in the wheel, the consequent drop of the knife and the resulting section-thickness are governed by a scale, every division of which corresponds to a thickness of $\frac{1}{1000}$ mm. It is possible to cut sections whose thickness may be any integral number of mikrons between 1 $\mu$ and 20 $\mu$.

### (4) Staining and Injecting.

**Differential Staining of Fats.***—E. T. Bell employs a modification of Dietrich's and Ciaccio's stains for demonstration of fat in tissue sections. The technique enables him to distinguish fat droplets consisting mainly of triolein from those droplets that principally contain lipoids. The former appear in annular shape, the latter are quite solid. In the former case the central portion of the droplet is not chromated, and therefore dissolves out in the xylol used in embedding. The technique employed is as follows:—Fix tissue in 10 p.c. aqueous potassium bichromate 100 c.cm., glacial acetic acid 5 c.cm.; wash, dehydrate and embed in paraffin, cut in sections and fasten to the slide with albumin. Remove paraffin with xylol and xylol with absolute alcohol and transfer to freshly prepared saturated solution of Sudan III in 80 p.c. alcohol for 10 minutes. Rinse off excess of stain with 50 p.c. alcohol and transfer immediately to water to stop action of the alcohol. Counterstain with Delafield's hæmatoxylin and wash in water, differentiate with acid alcohol, wash and mount in glycerin-gum arabic.

**New Hæmatoxylin Solution.**†—A. von Szüts recommends the following modification of Mallory's phosphomolybdate or phosphoarsenate stain, which latter, although giving very beautiful results, especially in the investigations of nervous tissues, has the disadvantage of being somewhat expensive. The composition of the new solution is as follows:—1 p.c. watery hæmatoxylin solution 100 c.cm., 10 p.c. ammonium molybdate solution 25 c.cm. For fixation of sections of the central nervous system of Vertebrates formol-alcohol or formalin is suggested. After staining for one or two minutes, wash with distilled water and blue in strongly alkaline tap water for about five minutes. A metachromatic effect is produced by variation in the time of blueing of

* Journ. Path. and Bact., xix. (1914) pp. 105–13 (1 pl.).
† Zeitschr. wiss. Mikrosk., xxxi. (1914) pp. 17–18.

the various structures. Delicate tissues such as muscle, nerve, connective tissue, etc. quickly become blue, while the ground substance of cartilage, bones, etc. retain the red and violet for a longer period. An advantage of this stain is that it does not colour the celloidin of celloidin sections.

**Employment of Fat Stains for Differentiation in Preparing Museum Specimens.***—R. H. Malone has employed fat stains in the preparation of museum specimens with good results, especially in the case of breast tumours, pancreas, and degenerated heart-muscle. The tissues are hardened in 10 p.c. formalin for one or two days, the excess of formalin washed off and the tissues transferred to a saturated solution of Scharlach R in 70 p.c. alcohol for two hours. Large quantities of staining fluid should be used, as the penetrative powers of the stain are very weak. The specimen is then washed and differentiated in a saturated solution of bichloride of mercury. The organ is then mounted in 5 p.c. formalin. This method is particularly good for showing up the "tabby-cat" striation of fatty degeneration of heart-muscle. Counterstaining with alum-hæmatoxylin will be found helpful in differentiating normal breast tissue from tumour growth :—stain with Scharlach R as above, counterstain with hæmatoxylin for one minute, wash and transfer to lithium carbonate (saturated solution) until the tumour is pale blue.

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

**Mounting of Diatoms in Realgar.**†—Chapman Jones says, "My attention was first directed a few years ago to the particular subject indicated by the title above‡ when I wanted a slide or two of the smaller diatoms mounted in realgar. Slides of this kind were included in the lists of all firms that deal in microscopical slides, but no one could supply me, and I was told that the individual who prepared them, after poisoning himself by the process, had made up his mind to have nothing more to do with it. It seemed to me that this was a highly unsatisfactory position for so valuable a means of investigation, and I began to look about . . . hoping to find some medium, or more than one, of high refractive power that should be workable without risk of poisoning by the microscopist who is not a chemist.

"Some objects need to be rendered more transparent for microscopical examination that their dark details may be made visible . . while others that are thin and transparent . . . are advantageously arranged so as to render the detail as conspicuous as possible. Thus in photomicrography we need media of various refractive powers.

"It will simplify matters if we limit our consideration to diatoms prepared in the usual way so that only the siliceous skeletons of them remain . . . stated to have a refraction index of 1·43. Diatoms are, therefore, fairly visible in air ("dry"), with its refraction index of 1·0. In water, refraction index 1·33, they are less visible, and some of the

* Journ. Path. and Bact., xix. (1914) pp. 102–4 (1 pl.).
† Journ. Roy. Photo. Soc., Jan. 1914.
‡ "On Media of High Refractive Power for Photomicrography."

more delicate kinds are invisible unless sought for by special means of illumination. In Canada balsam, refraction index 1·52, we have a medium of refractive power about as much above that of diatoms as water is below it, and which therefore gives much the same difficulty. Styrax, refraction index 1·58, is markedly superior to Canada balsam . . . Monobromnaphthaline, a liquid with a refraction index of 1·66, is very convenient for temporary use . . . and it is stated that in a few months mounts made with it lose the advantage of its high refractive power. . . . Piperine, with a refraction index of 1·68 , . . serves excellently for temporary purposes, as when the preparation is not wanted for more than a few months. . . .

"Canada balsam, styrax, and piperine allow of full advantage being taken of homogeneous immersion systems, and hence secure the maximum resolving power, while with air (a "dry" mount) the angle of illumination is limited to something under N.A. 1·0. But neither of these three media differs so much from the refractive power of diatom silica as air does, and therefore none of them equals air as a medium for the visibility (or photographability) of the object. When we approach a refraction index of 2·0 we surpass air in this matter. Sulphur alone has approximately this index, and realgar (pure $As_2S_2$) is stated to have an index of refraction of 2·45, so that such media give us advantages that we can never approach by media of refractive powers lower than that of diatom silica. . . .

"Realgar is a substance of definite composition ($As_2S_2$) which occurs as a mineral and can be prepared artificially, but when the word "realgar" is used to describe a medium for mounting it appears to mean no more than that arsenic and sulphur enter into its composition. . . . We may, for example, prepare a substance that contains arsenic and sulphur in definite proportions (1) by direct combination of the two elements; (2) by heating together arsenious oxide and sulphur; (3) by heating together realgar ($As_2S_2$) and sulphur; (4) by heating together the precipitated yellow sulphide of arsenic, or the mineral orpiment ($As_2S_3$) and sulphur; and the only matters for consideration are convenience and the purity of the materials. Purity is the most important matter, and it may be taken for granted that any tinge of browness is due to dirt. Attempts at purification make matters worse rather than better . . . We see when the sun shines how full of motes the air is, and . . . none of these preparations nor the sulphur used in making them should be ground up or subjected to any avoidable friction . . . and any preparation made with sulphur that has been ground is obnoxiously dirty, though the sulphur may originally have been pure.

"In working with preparations such as we are speaking of, one always gets some small fragments, and if the preparation has proved good and clean, there is a temptation to melt up these small fragments so as to get a piece of useful size. But it is useless, for the mere manipulation of them seems to gather these aerial motes, and the stuff is brown after refusion.

"*Purification of Materials.*—I obtain the sulphur in a commercially pure condition and distil it twice. I have distilled the same portion seven or eight times successively, but there always remain in the retort some black specks of foreign matter . . . and I now believe that they are nothing else than aerial motes attracted to the sulphur . . . I distil the sulphur in a small retort at such a rate that it condenses in the beak and flows down into a porcelain basin put to receive it. After a few hours, or next day, the cake in the basin is detached by gently warming the basin until the sulphur in immediate contact with it melts, and displacing the cake or turning it over. When cool again the cake is broken up with as little friction as possible and put into a bottle. Dust and even small fragments should be rejected. The distillation is repeated in exactly the same way for the sake of being as sure as possible of purity, though I have no direct evidence that the second distillation is necessary if the sulphur started with is fairly pure. If "pure" sulphur cannot be obtained, roll sulphur is preferable to flowers.

"The arsenic is also distilled twice, starting with the commercial substance. The second distillation should leave no residue whatever. A hard glass tube is appropriate for this distillation, as it requires a red heat. The tube is broken to get the arsenic out, and only the clear shining black crystalline parts are preserved.

"We must first make a definite preparation, and then use it so that it remains of the same composition throughout. The sulphur and the arsenic, purified as already described, are weighed out in proper proportions with as little manipulation as possible, and the quanity taken may be such as will extend about two-thirds up a test tube 3 in. long and $\frac{3}{8}$ in. in diameter, when the materials are in as large lumps as possible for the weighing and putting into such a tube. (The total weight of materials taken may conveniently be from 30 to 40 grains, or 2 to $2\frac{1}{2}$ grm.) The tube is then gently heated in the flame of a Bunsen burner till the sulphur melts and runs down to the bottom, carrying the arsenic with it. The lower part of the tube is then heated rather more strongly until an internal glow and commotion indicate that combination is taking place. Just at this time it is well to withdraw the tube from the flame to moderate the action. In a few seconds heat is again applied and continued until the material, which is now throughly fused, boils. It may be boiled up two or three times to ensure uniformity, and then put away to cool. After some time, preferably an hour or two or more, the tube is broken away from the little lump of material, the bits of glass are carefully removed from it, and the brittle preparation may be cut up by the large blade of an ordinary pocket knife into suitably sized pieces for preservation or for use. For the reason already given it should be handled and rubbed as little as possible. It should be very bright and of a rich amber colour. Any suggestion of brownness indicates impurity.

"*Mounting the Diatoms.*—The covers and the slips must be thoroughly clean. The best method that I know of is to put a drop of glacial acid in the middle of a slip, and to put another slip upon it so that the drop spreads over the central portion of both. As many as will be required are so treated, and then each pair is separated, well rinsed under the tap, and wiped and polished with an old soft linen pocket handkerchief, and the specially cleaned sides of the pair may be put together again to keep them until wanted. The covers are put into a small vessel, such as a porcelain crucible, that contains two or three drops of glacial acetic acid, dropping in each cover separately to see that the acid wets it all over. Water is added and poured off two or three times, and then the covers are removed one at a time and dried and polished likethe slips

"The covers that are to be used are placed on a suitable level surface, such as a piece of plate glass; if the prepared diatoms are in alcohol this is poured off and replaced by distilled water and a drop of the liquid is put upon each cover, seeing that it spreads suitably over the cover. A bell-glass is put over them, and they are left to dry spontaneously. Each cover is then examined all over its surface under a suitable low power, such as an inch, and hairs and other obnoxious things are removed, using either a bristle or a needle.

"They are now ready for the actual mounting. For this purpose I prefer a tray made of thin sheet copper with two sides and one end turned up about $\frac{1}{4}$ in., and of a size to just take a $3 \times 1$ slip easily. This is supported across one corner of the triangular top of the usual iron tripod as used in chemical laboratories, and by its side is placed a sheet of thick sheet copper about 4 in. $\times$ 3 in. A stout glass slip is put in the tray, and a Bunsen burner arranged so that a flame about $\frac{3}{4}$ in. high may be brought under the tray, the top of the burner being about $1\frac{1}{2}$ in. below the tray. The flame must be small so that the heating may be very gradual.

"One of the covers with the diatom on it is now finally examined under the Microscope, and any hairs, etc., that may have settled on it are removed; it is put on a flat piece of platinum foil that has two edges turned up and heated over a very small flame to just below redness. This gets rid of volatile matter, and any minute threads of organic matter are carbonized. The cover is placed, diatoms uppermost, on the slip in the tray, a piece of the medium of suitable size is put on the cover, the cleaned slip that is to be used is put on the plate by the tray, and the small flame as already described is brought under the centre of the tray. I place a rather large funnel over the tray and resting on the plate to prevent dust falling on the cover. In from 20 to 30 minutes the little lump of medium will have assumed a cushion shape, or it might be called spherical, except for the flat side upon which it rests on the cover. The heating must not be hurried or the medium will get too hot, and a good crop of small bubbles is likely to result. The assumption of this shape indicates that it is thoroughly softened. The cleaned slip is now removed from the plate, where it has got hot, dusted lightly with a soft brush in case anything may have fallen upon it, and gradually brought with its clean side downwards upon the softened drop of medium, and by means of the forceps it is pressed, at first gently and afterwards more strongly, down upon the medium, which is thus gradually flattened out. As it becomes thinner the process becomes slower, so that it is likely to be ten minutes or even more before it is thin enough. During the operation the reflections of the window frame or of the lamp, or some other convenient object, are watched from time to time to see that the slip that is being pressed down is parallel to the slip beneath that supports the cover glass, and finally the reflection from the cover-glass (through the medium) is examined to see that there is no preceptible amount of distortion. It is well to allow the heating to continue for at least a minute or two after any pressing with the forceps, that the glass may resume an unstrained condition. This completes the mounting proper, though I prefer to use so small a quantity of the medium that when flattened out the disk does not quite reach the ridge of the cover glass, and to run in a little melted paraffin wax round the remaining space. The slide can be rung as usual when thoroughly cold."

### (6) Miscellaneous.

**Simple Method of Collecting Centrifugates.*** — G. C. Van Walsen has devised a simple method of collecting centrifugates for examination, the peculiarity of the method consisting in the fact that the centrifuge tube and the transport pipette are one and the same instrument. The following particulars refer to urine examination, but various modifications may be made to suit other purposes. The "centrifuge pipette" consists of a glass tube some 9 cm. long, which, at its lower end, tapers to a circular opening of 1 mm. diameter. The upper end of the tube is closed with a small cork stopper. The pipette is filled by closing the lower opening with the finger and introducing the fluid through the upper opening with a suitable pipette. The cork is then put back, the tube rotated and the cork gently screwed in until all air bubbles have been driven out. The centrifuge pipette is then placed in the centrifuge cup (11 cm. depth), which is filled with water just to cover the cork stopper. After centrifugalization, the pipette is removed, the outside cleansed as much as necessary, and a drop of the sediment allowed to fall on to a glass slide, for subsequent examination.

* Zeitschr. wiss. Mikrosk., xxxi. (1914) pp. 40–2 (1 fig.).

## Metallography, etc.

**Oxidation of Type-metal.***—R. Meyer and S. Schuster have examined, microscopically and otherwise, specimens of type of various ages up to seventy-five years, to ascertain the cause of the oxidation which occasionally results in the comparatively rapid destruction of the type. Oxidation was found to be due not to unsuitability of chemical composition, but in part to porosity, indicated by the presence of numerous microscopic holes, facilitating the absorption of moisture. A 10 p.c. solution of nitric acid in alcohol was used for etching.

S. Zinberg† gives some results showing the influence of moisture in promoting oxidation.

**Electrolytically-produced Alloys.‡**—R. Kremann, J. Lorber, and R. Maas have made metallographic studies upon various binary alloys electrolytically deposited from solutions containing salts of the two metals. Copper-antimony alloys differed from copper-tin alloys in that they showed a lesser tendency to form solid solutions. Iron-nickel alloys deposited at high temperatures contained solid solutions, and showed a concentric structure. Iron-magnesium alloys contained a solid solution or compound.

**Antimony-lead-tin Alloys.§**—In the course of an exhaustive study of the antimony-lead-tin bearing alloys, E. Heyn and O. Bauer describe the microstructure of numerous alloys prepared under different conditions of casting and cooling. Segregation was observed in slowly cooled but not in rapidly cooled alloys. The rapidly cooled alloys were finer in structure. Crystals of tin oxide were observed in certain alloys which had been heated to a high temperature. The effect of variations in rate of cooling upon the structure of antimony-lead-tin alloys to which 6 p.c. copper had been added is described.

**Sulphide Inclusions in Steel.‖**—S. Steinberg has sought to determine whether sulphide inclusions are present as such in liquid steel (either as liquid globules or as solid particles), or are in solution in the liquid steel and separate during solidification or subsequent cooling. Small melts of steel containing known percentages of manganese and sulphur were heated to high temperatures, were maintained for given lengths of time at temperatures above the melting point, and were cooled quickly or slowly, through given ranges of temperature. Sections of the ingots obtained were examined microscopically. Neither the

* Zeitschr. Angew. Chem., xxvii. (1914) pp. 121–7 (11 figs.).

† Zeitschr. Angew. Chem., xxvii. (1914) pp. 436–7.

‡ Monatsh. Chem., xxxv. (1914) pp. 581–601, 603–34, and 731–53, through Journ. Soc. Chem. Ind., xxxiii. (1914) pp. 752, 791–2.

§ Verh. Ver. Beförd. Gewerbfl., 1914, Suppl., 235 pp. (234 figs.).

‖ Rev. Soc. Russ. Met., i. (1913) pp. 514–21, through Rev. Métallurgie, xi. (1914) Extraits, pp. 313–16 (10 figs.).

treatment of the liquid steel, nor the mode of cooling from below the temperature at which the steel became completely solid, had any influence upon the quantity, form, and distribution of the sulphide inclusions. The rate of cooling during solidification, however, had a considerable effect upon the size and distribution of the inclusions. These observations indicated that the sulphides were present in solution in the liquid steel and separated from it completely during solidification. The inclusions in forged or rolled steel were not affected by heating, unless the temperature approached the melting point. Long heating of one specimen at 1200° C. caused each elongated sulphide inclusion to break up into a string of rounded inclusions. When the heating was sufficient to cause incipient fusion of the steel, the form and distribution of the inclusions were completely changed, and network formations resembling those found in steel castings resulted. Sulphide inclusions thus appear to be wholly soluble in liquid steel and wholly insoluble in solid steel.

**Changes in Mild Steel caused by Annealing.***—A. Stadeler has studied the influence of length of time of annealing on the growth of grain in mild steel. Specimens cut from rolled plate, 15·5 mm. thick, of steel containing 0·1 p.c. carbon, were annealed for periods of 1½ hours to 25 days, at a mean temperature of 860° C. A plate annealing furnace in which the atmosphere contained a slight excess of carbon monoxide, was used. Decarburization of the outside had begun after 3 hours, and was complete after 15 days annealing. Grain growth was observed after 3 hours annealing. In the outer layers, which had undergone some cold-work, the maximum grain diameter increased from 0·04 mm. to 2·5 mm. in 72 hours, while in the interior of the plate there was a regular but much less rapid grain growth, a maximum diameter of 1 mm. being reached in 25 days. The normal laminated microstructure of the plate became more distinct on annealing, and was evident until the pearlite disappeared.

**Tungsten Steels and Nickel Steels.**†—In the course of a paper dealing with the chemical and mechanical relations of iron, tungsten, and carbon, and of iron, nickel and carbon, J. O. Arnold and A. A. Read describe the structure of the alloys prepared. In the tungsten steels the pearlite was sorbitic. Tungsten does not form a double carbide with iron, but when sufficient tungsten is present iron carbide is replaced by tungsten carbide (tungsten cementite). The presence in steel of nickel in large proportion favours the separation of graphite, which appears to be a product of the decomposition of the unstable carbide $Ni_3C$.

**Hardness of Iron-carbon Alloys.**‡ — R. Vondráček criticizes Andrew's suggestion that the hardness of quenched steels is due to the presence of finely-divided cementite embedded in a ground-mass of austenite and $\alpha$-iron. The total carbon in quenched steels is practically all in solution. It is probable that the ferrite in hypoeutectoid steels

* Ferrum, xi. (1914) pp. 271–6 (27 figs.).
† Proc. Inst. Mech. Eng., 1914, pp. 223–79 (17 figs.).
‡ Int. Zeitschr. Metallographie, vi. (1914) pp. 172–82 (3 figs.).

has an appreciable carbon content, which increases as the total carbon increases, and that eutectoid ferrite contains in solution 0·06 to 0·14 p.c. carbon according to the temperature.

**Malleable Cast-iron.***—O. W. Storey has made a microscopical study of the changes which occur in the annealing process in the manufacture of malleable castings. Specimens of white iron containing 2·6 p.c. carbon, all combined, were heated under different conditions, the factors that were varied in different series of experiments being: (1) maximum temperature; (2) length of time for which the maximum temperature was maintained; (3) rate of cooling; and (4) packing material. The nature of the packing material did not affect the structure of the interior of the annealed casting, but had some influence on the structure of the skin. In general, the outside layer consisted of ferrite when the conditions of annealing were distinctly oxidizing, while under less oxidizing conditions a steely outside layer containing pearlite resulted. The interior of a well annealed "black-heart" casting consists of ferrite and temper-carbon. Slow rates of cooling are necessary to produce this, and pearlite is formed if the cooling is too rapid. Annealing temperatures exceeding 800° C. are necessary to cause the cementite to decompose within a reasonable time. The higher the annealing temperature the shorter is the time required. The author suggests that the cementite decomposes while it is in solution in the iron, that free cementite does not decompose, and that consequently no decomposition of cementite occurs below $Ar_1$.

**Diffusion in Solids.**†—L. Guillet and V. Bernard describe their experiments on "reserves" in cementation, which have led to the study of the more general question of diffusion in solid metals. In the operation of case-hardening it is frequently necessary to prevent the cementation of portions of the surface of the article undergoing treatment, since the hardened skin is desired only on the remainder of the surface. Protection of the surfaces which are to remain soft is secured by covering them with substances calculated to prevent the access of the solid or gaseous cementation medium. Clay and similar materials are only partially effective, since they are porous at case-hardening temperatures and permit the access of carbon monoxide to the coated surface. The effectiveness of any coating is most readily determined by microscopic examination of a section through the coated surface after the case-hardening operation. Copper deposited electrolytically or by the Schoop spraying process, was found to be effective if the layer was sufficiently thick. Nickel did not prevent cementation, unless used in very thick layers, apparently because nickel is permeable to carbon monoxide. In the experimental study of diffusion in solids, specimens in which two metals were in perfect contact were prepared by mechanical means or by electrolytic deposition, and were heated as shown in the table below. In each case the temperature of heating was below the melting point of either metal, and was in a range in which a solid solu-

* Met. and Chem. Eng., xii. (1914) pp. 383–9 (12 figs.).
† Rev. Métallurgie, xi. (1914) pp. 752–65 (32 figs.).

tion of the two metals was stable. Microscopic examination of cross sections of the specimens after heating indicated that diffusion had taken place in every case, frequently to a marked degree.

| Pair of Metals. | Time of Heating, and Temperature. | |
|---|---|---|
| Iron-aluminium .. .. .. .. .. .. | 50 hours at | 635° C. |
| Iron-copper .. .. .. .. .. .. | 5 ,, | 1000° |
| Copper-nickel .. .. .. .. .. .. | 10 ,, | 1000° |
| Copper-bronze (20 p.c. tin) .. .. .. | 50 ,, | 750° |
| Copper-zinc .. .. .. .. | 50 ,, | 400° |
| Copper-tin .. .. .. .. .. | 50 ,, | 218° |
| Copper-brass (42 p.c. zinc) .. .. .. | 50 ,, | 800° |

**Micro-actions of Acids and Metals.***—J. Scott describes the microscopic appearance of the salts obtained when small fragments of metals were dissolved in a few drops of nitric acid on glass slips and the solutions allowed to evaporate. The preparations were photographed with oblique illumination.

**Structure of Fire-brick.**†—G. Rigg describes the microstructure of a number of specimens of fire-brick, examined in the form of thin slices. The more compact and close-textured bricks possess good resisting power against the penetrating action of corrosive slags and gases.

**National Physical Laboratory.**‡—Among the subjects of metallurgical investigation to which microscopic methods have been applied were the aluminium-zinc and aluminium-zinc-copper alloys, the effects of strain in metals at high temperatures, brittleness in steel, structure of steel at high temperatures, and intercrystalline cohesion in metals. In the study of cases of failure of rails, tyres and similar articles, the microscopic examination of complete cross sections proved useful, since local defects do not readily escape detection when this method is used.

* Foundry Trade Journ., xvi. (1914) pp. 523–5 (6 figs.).
† Journ. Ind. and Eng. Chem., v. (1913) pp. 549–54 (7 figs.).
‡ Nat. Phys. Lab. Ann. Report, 1912.

# JOURNAL

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# ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1914.


## TRANSACTIONS OF THE SOCIETY.

### IX.—*Notes on some Focometric Apparatus.*


By Frederic J. Cheshire.



(*Read November* 18, 1914.)


(Figs. 52–55.)

*Telecentric Adjustment.*—When the magnifying power of an objective is determined in the usual way, by projecting an image of the divisions of a stage-micrometer on to a scale in the eye-piece, it is important that the image of the stage-micrometer be focused accurately in the plane of the eye-piece scale, as, otherwise, a fallacious reading will be obtained. Fig. 52 shows diagrammatically how this occurs. The simple lens O projects an image of a scale S into the plane E. Since the lens is working at full aperture, the principal rays of the imaging pencils will all pass through the centre of the lens, and diverge outwards in the image-space. If the eye-piece scale, therefore, is adjusted within the plane E, the length read off as that between the images of the stage-micrometer divisions, will be the length between the intersections of the principal rays with the plane of the eyepiece-scale, and will therefore be too small. If the eyepiece-scale, on the other hand, is adjusted outside the plane E, the length read off will be too great, for a similar reason. Abbe has pointed out that this source of error can be avoided in optical measuring instruments generally, whenever it is possible to place a small aperture in the principal focus of the lens on the object side, so as to secure what he terms "telecentric adjustment" on the image side. Fig. 53 shows the effect of this stop. The principal rays of the imaging pencils now all pass through the principal focus of the lens, so that on the image side of the lens they are parallel to one another, and to the axis of the lens. If now the eyepiece-scale be adjusted, either within or without the plane E, no error will be introduced, because the distance read off will be that between the intersections of the principal rays with the plane of the eyepiece-scale, which is a constant.

The use of a small circular aperture in this way, however, is sometimes open to objection, because it cuts down so seriously the

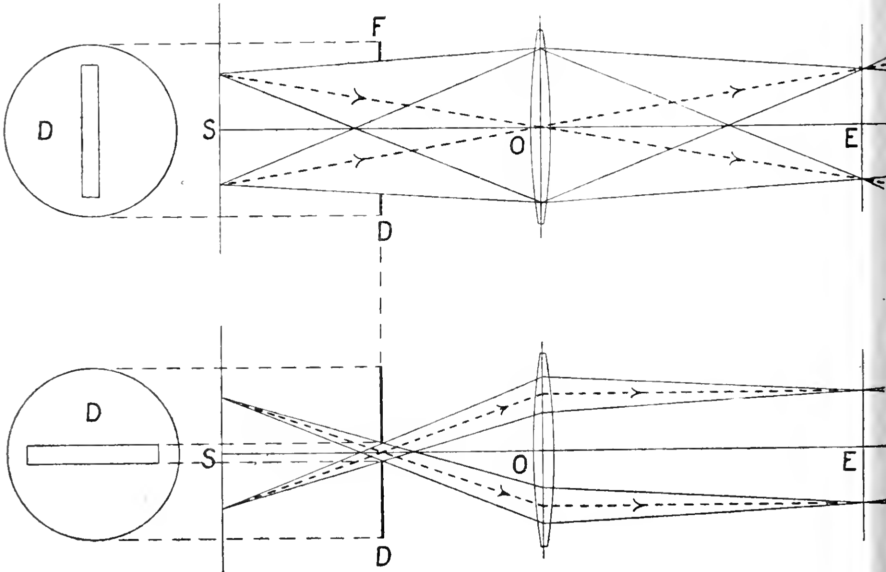


FIG. 52.—A simple projecting lens. FIG. 53.—A telecentric system.

amount of light passing through the lens for imaging purposes. Further, since in practice no adjustment can be made with certainty, the most reliable results are obtained by adjusting, as accurately as possible, the stop in the focal plane, and the eye-piece scale in the image plane. But the latter adjustment is very difficult with Abbe's arrangement, because the angular aperture of the imaging pencils is so small. The light and focusing difficulties can, however, be got rid of in a very simple way. To do this it is only necessary to draw a horizontal line across the scale S at right angles to the direction of the usual scale divisions, and to use with it, in the plane of the principal focus F, not a circular aperture, but a disk D in which is cut a narrow slit with its length parallel to the scale divisions, as indicated to the left of Fig. 53. With this device the area of the slit determines the amount of light passing through the lens from each point of the scale S, the length of the slit determines the effective focusing aperture of the imaging pencils for the horizontal line, in a plane at right angles to it, whilst the width of the slit only is effective in a plane at right angles to the direction of the scale divisions. The adjustment of the eye-piece scale in the plane E, can thus be effected by focusing up the horizontal line of the scale S, with what is for this purpose the full aperture of the lens, whilst the telecentric adjustment for the scale divisions is still retained.

Figs. 52 and 53 may be taken to illustrate the action of a slit telecentric disk by supposing that in the former figure the horizontal auxiliary focusing line referred to, and the length of the slit, are respectively normal to, and in the plane of the paper. In Fig. 53 both the scale divisions and the length of the slit must be considered as normal to the paper.

*Substage Focometer.* —Mr. Blakesley in his "Geometrical Optics" (1903), in discussing various methods for finding short focal lengths "such as those of eye-pieces and object glasses of Microscopes," states that, "a collimator of about 3 cm. focal length and with a small hole or two fine parallel lines in its principal focus as an object may be mounted in a hole of the stage of a Microscope. Any lens to be experimented upon is then placed over this arrangement and the final image measured." After considerable experience I have come to the conclusion that when certain precautions are taken, which I shall proceed to explain, this method is the best and most convenient one for the needs of the ordinary microscopist. In the form which I prefer the collimator consists of an achromatic lens system, with an equivalent focal length of 26 mm. mounted at the middle of a short tube, which is fitted at its lower end, in the plane of the lower principal focus of the lens, with a millimetre scale, and at its upper end, in the plane of the upper focus of the lens, with a metal disk D in which a narrow diametral slit (1 mm. wide) is cut to secure telecentric adjustment in the way already described. This collimator is slipped into the condenser ring so that the slotted disk is practically flush with the surface of the stage. The lens to be tested, if an objective, is screwed into the nose of the Microscope body and focused on the telecentric slit, when upon looking down the tube an image of the collimator scale will be seen in the upper principal focal plane of the objective. To measure this image it is only necessary to fit up the draw-tube as an auxiliary Microscope by screwing a low-power objective into its lower end and fitting its upper end with an eye-piece, carrying a micrometer scale—conveniently, 1 cm. divided into a hundred parts. A second image of the collimator scale is projected on to the eye-piece scale and its length read off in the usual way. Fig. 54 shows a diagrammatic plan of the apparatus together with the ray diagram necessary for demonstrating the optical principle of the method.

The scale division $h$, in the principal focal plane of the collimating lens of focal length $f_c$, is projected into the principal focal plane of the lens L being tested as a length $h_1$; this again is projected by the objective of the auxiliary Microscope on to the scale in the eye-piece as a length $h_2$. Let the focal length of the

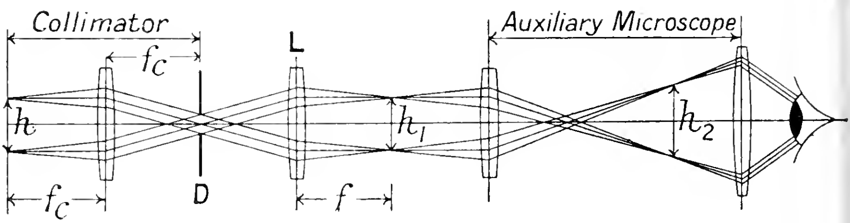


Fig. 54.—Diagram of substage focometer system.

lens L which it is desired to find be $f$, and the initial magnification of the auxiliary Microscope be M. Then

$$\frac{h_1}{h} = \frac{f}{f_c} \quad \text{and} \quad \frac{h_1}{h_2} = \frac{1}{M}$$

whence

$$\frac{h_2}{M\,h} = \frac{f}{f_c} \quad \text{or} \quad f = \frac{f_c\,h_2}{M\,h}$$

But $\dfrac{f_c}{M\,h}$ is a constant for the instrument, $k$ say, thus

$$f = k\,h_2$$

For convenience in use it is very desirable to make $k$ equal to some simple number, as 10.

To do this when $h$ is a millimetre it is clear that the focal length of the collimator ($f_c$) in millimetres must be made equal to ten times the initial magnification (M) of the auxiliary Microscope, then

$$f = 10\,h_2.$$

If with these dimensions of the optical elements the eye-piece scale is a centimetre divided into a hundred parts, each division of it will correspond to a millimetre of focal length. Should, for example, in a particular case, 1 mm. of the collimator scale project on to 16 divisions of the eye-piece scale, then the focal length of the lens being tested is 16 mm.

When the telecentric disk is placed in the plane of the coincident principal foci of the collimator lens and the lens being tested, the system formed by these two lenses is a telecentric one, both on the object and the image side, so that no error is introduced if the scale $h$ is not correctly adjusted in the principal focal plane of the collimator lens. As has already been pointed out, this system is also independent of any focusing error of the auxiliary Microscope. This arrangement, therefore, gives the best possible results, although as a matter of fact results of quite sufficient accuracy for most of the purposes for which focal lengths are required, can be obtained by supporting the lens being tested on the telecentric disk itself. With eye-pieces it is desirable to employ a yellow-green colour-

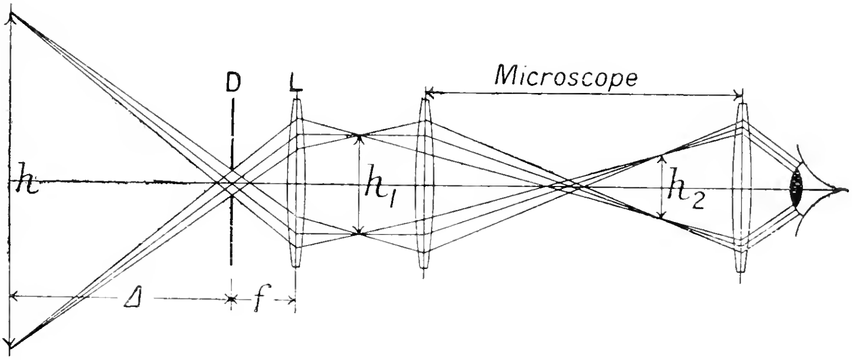


FIG. 55.—Diagram of optical-bench focometer system.

screen to limit the light, more or less, to the most visible part of the spectrum. The focal lengths of negative lenses, provided they are not greater than the working distance of the objective of the auxiliary Microscope, can be determined with equal facility.

*Optical-bench Focometer.*—In a paper, read before this Society in 1884, entitled "Note on the Proper Definition of the Amplifying Power of a Lens or Lens System," it was laid down by Professor Abbe that "the reciprocal of the focal length of an [optical] system is by itself the proper definition of its amplifying power, because this reciprocal expresses numerically the visual angle (measured by its tangent) under which the unit of length appears through the system." Curiously enough the French physicist Verdet* had anticipated Abbe by some twelve years in the formulation of this definition.

* See Œuvres de Verdet, iv. (Paris 1872) p. 944.

Now I have for many years past used in my laboratory a method of determining focal lengths based directly upon this definition of the power of a lens. A plan of the apparatus is shown in Fig. 55.

A scale with two vertical lines upon it, at a distance $h$ apart, is mounted at a distance $\Delta$ away from a telecentric disk D, placed in the principal focal plane of the lens L to be tested. This lens projects an image $h_1$ of the scale $h$, which image is again projected by the objective of a Microscope as a length $h_2$ on to an eye-piece scale. Let this Microscope have an initial magnifying power M.

Then, since $$\frac{h_1}{h} = \frac{f}{\Delta} \quad \text{and} \quad \frac{h_1}{h_2} = \frac{1}{M}$$

$$\therefore \qquad \frac{h_2}{h\,M} = \frac{f}{\Delta}$$

That is, $$f = \frac{\Delta\, h_2}{M\, h} = k\, h_2$$

where $k$ is a constant of the instrument, to which we can, by suitable designing of the optical elements, give any value we please.

Let $$k = \frac{\Delta}{M\, h} = 10$$

and let $$M = 2 \cdot 5$$

Then $$\frac{\Delta}{h} = 10 \times 2 \cdot 5 = 25$$

If then $\Delta$ is made equal to a metre, $h$ must be made equal to 4 cm. If with these dimensions of the elements of the system, the eye-piece of the observing Microscope be fitted with a scale 1 cm. long, divided into one hundred parts, then the fccal length of any lens being tested can be read off directly, by reading each scale-division as 1 mm.

*Rotating-table Focometer.*—When a well-graduated circular table, rotating about a vertical axis, such as that found on a theodolite or spectroscope, is available, it can be employed as a focometer giving excellent results. A milimetre scale, say, should be fixed very accurately in the principal focal plane of the lens to be tested, and the two then secured in some way on the table. The latter should then be rotated until some distant vertical object, a flagstaff it may be, is focused on a central scale division of the millimetre scale. The azimuth reading of the table should then be taken, and the table again rotated until the image of the distant object is coincident with the next scale division. By taking a second azimuth reading and deducting it from the first one, the angle $a$ is obtained, through which the table must be rotated to move the image through a distance of 1 mm. in the focal plane of the lens. Then it follows that,

$$\frac{1}{f} = \tan a$$

When a distant object is employed, no appreciable error is introduced by the lateral displacement of the lens being tested, which must generally occur as the table carrying it is rotated. Theoretically, a near object might be employed, if the first nodal point of the lens were adjusted in the axis of rotation of the table. But this is such a difficult adjustment to make, that it renders this modification of the method valueless when compared with the first and simpler one.

To obtain the greatest accuracy a telecentric disk, with the length of its slit vertical, should be mounted in the anterior principal focal plane of the lens, and a distant *horizontal* line should be employed for adjusting the millimetre scale in the posterior principal focal plane.

# SUMMARY OF CURRENT RESEARCHES

RELATING TO

# ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

# MICROSCOPY, ETC.*

## ZOOLOGY.

### VERTEBRATA.

#### a. Embryology.†

**Eggs and Egg-laying of Purple-striped Gudgeon.**‡—Albert Gale has studied the breeding habits of *Krefftius adspersus* Castelnau. They first bred when three years old, and there was but one spawning in the year. The male cleared a site (on the side of a glass aquarium) for the eggs, nibbling off confervoid growths and the like. The ova were laid in strings in a circular patch of about two inches. All the chains were placed horizontally, no one crossing another, and there were about twenty eggs to the lineal inch. Each egg had a gelatinous base, by means of which it adhered to the glass. As the eggs were deposited, they were fertilized by the male.

After the spawning was completed, the male placed himself above the eggs and remained over them for nine days. In thirty-six hours the gelatinous base of each egg had become elongated into a peduncle the eggs themselves being also larger, and provided with a globule of air

* 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.

‡ Australian Zoologist, i. (1914) pp. 25-6.

on the yolk. On the third day the male began to fan them by continually oscillating his pectoral and caudal fins. These actions kept the ova in a constant swirl, and were continued until the fry emerged and took shelter in the weeds. There they were still guarded by the male for about twenty-four hours. For about thirty-six hours after they emerged, the fry hung head downwards from the empty egg-capsules by means of their tails, which were bent like the curve of a fish-hook.

**Observations on Development of Toad.***—Laura Marchetti notes that the adhesive suckers of the larvæ of *Bufo vulgaris* appear at the time of the medullary groove, as a V-shaped ventro-lateral groove. The halves of the V form two suckers. The development of the suckers is wholly due to the ectoderm or peri-ectoderm. The cells exhibit amœboid movement during the process of forming the groove.

**Pluripolar Mitoses in Regenerating Testes of Frog.**†—Arnold Lauche describes the occurrence of numerous pluripolar mitoses in the testes of *Rana fusca* regenerating after partial castration shortly before the breeding season. The peripheral spermatogonia show three indirect nuclear divisions without any cell division. The case differs from previously described instances of the pluripolar mitoses in Amphibian testes, inasmuch as the cells affected do not come to an end, but complete the suppressed divisions, and from the 16-cell stage onwards follow a normal course. The condition of the pluripolar mitoses is in part to be found in the abnormal pressure-conditions resulting from the partial castration.

**Inheritance in Pigeons.**‡—L. J. Cole has made a study of the inheritance of certain colours in tumbler pigeons and of some of their modifications. The colours are red, black, yellow, dun, blue, silver, and white, but only two kinds of pigment are concerned, red and black. Red is potentially present in all birds, but shows only when not inhibited, and when black is absent. For the full development of red and black an intensity factor is necessary; in its absence red appears yellow, and black, dun. Blue results in the absence of a factor which is assumed to cause the pigment to spread throughout the barbules of the feather. The dilute condition of blue is silver. White is due to an indefinite number of factors which inhibit the production of pigment in the areas which they influence. "Reversion" in domesticated pigeons is due simply to a recurrence of the particular combination of factors present in *Columba livia*. The ratios of intense to dilute birds from heterozygotes mated with other heterozygotes or with dilutes closely approximate to Mendelian expectation, that is, 3 : 1 and 1 : 1 respectively. Matings of the different colours give the results expected according to theory. A considerable number of illustrative matings are presented.

* Anat. Anzeig., xlv. (1914) pp. 321–47 (6 figs.).
† Arch. Mikr. Anat., lxxxii. (1913) 2te Abt., pp. 261–71 (1 pl.).
‡ Bull. Agric. Exper. Station, Rhode Island State College, No. 158 (1914) pp. 313–39 (4 pls.).

**Regeneration of Muscular Tissue in Metamorphosis of Frog.*** W. Smirnowa refers to Metschnikoff's observation that during the metamorphosis of tadpoles, the caudal muscles break down into cells which consist of sarcoplasm with muscle-nuclei. These cells digest the products of the disruption of the muscle and become muscle-phagocytes.

Smirnowa finds that a portion of the trunk musculature of the larva is also subjected to phagocytosis and complete degeneration. The remainder is adapted to the new function of skeletal muscles. The process begins with a disruption of the old muscles, but this stops at different stages and regeneration sets in. The new muscles develop from the nuclei and sarcoplasm of the old muscles. In adaptation to their new function the muscles change their direction and acquire new insertions.

**Development of Connective Tissue.†**—Serafino d'Antona has studied in particular the athero-sclerotic thickenings of the aorta. In connective tissue as a whole, he distinguishes (*a*) the formed elements—cells and fibres—and (*b*) the un-formed constituents—the matrix and the cement substance. All are enveloped by the nutritive plasma. The matrix, the cement substance, and the fibres, may be called "intercellular substance," but this is a topographical distinction.

In the aortic thickenings the formation of fibres takes place in two ways. In the one case, they arise in a primitive amorphous substance (metaplasm) independently of any direct relation to the cell-bodies. In the other case, they arise directly from a modified peripheral portion (ectoplasm) of the cell-body. The matrical substance of the fibrils is best regarded as a modified protoplasm or metaplasm, but the author does not exclude the possibility that it may arise in part as excretion products of the cells. The ectoplasm is cell-protoplasm in process of changing into fibrils.

Whether the first fibrils arise from the metaplasm or from the ectoplasm, they are neither collagenous nor elastic fibres. They are "primitive fibril-structures," on which the differentiated fibres of the definitive tissue are modelled. The collagenous and elastic fibres are stages in developmental processes which have a common starting-point in the "primitive fibril-structures."

**Histogenesis of Cartilage.‡**—K. von Korff has studied the histogenesis and structure of the cartilage-matrix in Salamander, Selachian, and Mammals. He finds that the first primordium of the cartilage-matrix, the pre-cartilage or prechondral substance, is not homogeneous, but is composed of acidophilous connective-tissue fibrils which are formed from indifferent connective-tissue cells. After the formation of fibrils, the fibroblasts are changed into pre-chondral and cartilage cells.

Between the pre-chondral cells the connective-tissue fibrils form a framework of interwoven acidophilous fibrillar strands, the pre-chondral intercellular scaffolding of the cartilage. This increases in mass as the

* Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 300–5.
† Zeitschr. wiss. Zool., cix. (1914) pp. 484–500 (2 pls.).
‡ Arch. Mikr. Anat., lxxxiv. (1914), 1te Abt., pp. 263–99 (1 pl. and 7 figs.).

fibrils multiply. The meshes or interstices of the interwoven fibrillar strands are the primary cartilage cavities, which are enlarged by the growth of the pre-chondral and cartilage cells. As the cavities are enlarged, there is a displacement of the fibrils of the framework. This is the first fibrillar stage of the cartilage primordium.

By the deposition of a homogeneous cementing substance on the part of the cartilage cells, the matrical fibrils of hyaline cartilage are "masked." The matrix appears homogeneous and becomes basophilous. This is the second basophilous stage of hyaline cartilage. In fibrous cartilage and elastic reticular cartilage there is no "masking"; they persist histogenetically at the first fibrillar stage of hyaline cartilage.

Typical cartilage cells are not found in the first stage of histogenesis. They appear in the last stage. Their role is not clear, but they probably form the cementing substance, perhaps also the chondroitin-sulphate. Cell divisions occur only in young, just differentiated cartilage cells. In perichondral chondrogenesis they occur only at the margin of the cartilaginous tissue. These divisions give rise to the cell-territories of the cartilage-matrix, which have nothing to do with the histogenesis of cartilage. They are not seen in bone and ivory.

**Chemistry of Development.*** — R. A. Gortner has enquired into the relation between the chemical compounds in trout-eggs, whether they enter the growing tissues in the form in which they are laid down in the egg, or whether there are modified synthetic changes. If not, we must think of the various egg-proteins – ovalbumen, ovomucoid, ovoglobulin, etc.—as containing not only all of the amino-acids necessary for the formation of such complex proteins as hæmoglobin, but also that each amino-acid is present in the egg in exactly the quantity which will be needed later by the growing organism.

His results show that synthetic action does take place, that the simpler mon-amino-acids are in some way transformed into the more complex constituents of the cell nucleus. It was also found that there was a selective utilization of the nitrogen fractions which were "burned" to furnish the energy of development.

**Permeability of the Shell of Selachian Eggs.**† — E. Peyréga publishes a preliminary note on experiments on the shell of the dog-fish egg. The embryo is enclosed in a thick firm egg with four clefts, two at each end on opposite sides. In advanced embryos these clefts are widely open, and give easy communication with the exterior, but in the very young stages they are much less wide, and seem entirely closed. Experiment showed that in the young stages the shell itself is permeable by osmosis, both as regards water and salts. The results of the different experiments are given in tabular form.

* Yearbook Carnegie Inst. Washington for 1913, pp. 106–7.
† Bull. Soc. Zool. France, xxxix. (1914) pp. 211–14 (3 figs.).

### *b*. Histology.

**Nuclear Substance and the Origin of Fibres.***—Gaylor Swindle has previously sought to show that neurofibrils and neuroglia-fibres are due to elongated nuclei or elongated chromatin particles. He has extended this idea to other tissues, e.g. to the connective-tissue fibres of the urinary bladder. The fibres of the mesentery, of the cutis, of epithelial cells, and so on, are all due to nuclear metamorphosis. The same is true of the tail of the spermatozoon.

**Nissl's Granules.**†—M. Mühlmann defends the conclusion which he previously argued for, that Nissl's granules, which occupy the spaces between the neurofibrils in the nerve-cell, have a nuclein content along with a globulin body. This is supported by Herwerden's experiment on the influence of nuclease on the nerve-cell. It appears from Mühlmann's observations, especially on the action of weak soda-solution, that the nuclein of Nissl's granules is different from the nuclein of nuclei. The tigroid nuclein of Nissl's granules is soluble in soda; the nucleus nuclein is not. The author criticizes Unna's conclusion that Nissl's granules consist of albumose.

**Structure of Vagus Nerve in Man.**‡—S. Walter Axon has discovered a pyridin-silver technique, which gives a stain of the axons as sharply differentiated as is the osmic acid stain of the myelin sheaths. This shows that axons devoid of myelin sheaths are present in great numbers in many parts of the cerebrospinal nervous system where it had been supposed that only medullated fibres were to be found. A cross section through the cervical trunk of the human vagus some distance below the nodose ganglion shows that non-medullated fibres are present in enormous numbers. Medullated axons are stained yellow, and are surrounded by a colourless ring of myelin. Non-medullated fibres are stained black and are sharply differentiated from the light yellow endoneurium. Most of the medullated fibres in the thoracic vagus leave it through the bronchial and œsophageal branches, so that the vagus as it passes through the diaphragm is composed almost entirely of non-medullated fibres and only a few scattered medullated fibres. Few if any of the non-medullated fibres of the vagus are derived from the sympathetic.. They belong properly to the vagus and are present in its roots.

**Minute Structure of Nerve-cord of Amphioxus.**§—W. Stendell describes the various forms of cell found in the central grey matter of the spinal cord of the lancelet. "Edinger's cells" are well marked, and their resemblance to the sensory spinal cells of the lamprey is emphasized. According to Tretjakoff, these cells of the lamprey repre-

* Anat. Anzeig., xlvi. (1914) pp. 560–5 (4 figs.).
† Arch. Mikr. Anat., lxxxv. (1914) 1te Abt., pp 361–3.
‡ Anat. Anzeig., xlvi. (1914) pp. 522–5 (1 fig).
§ Anat. Anzeig., xlvi. (1914) pp. 258–67 (7 figs.).

sent a sensory apparatus pertaining to the spinal cord. The same is probably true in the lancelet. Since the central canal arises from an ectodermic sensory plate, it is not surprising that it should retain sensory cells.

**Culture of Spinal Ganglia in vitro.***—G. Marinesco and J. Minea have continued their observations on isolated pieces of the spinal ganglia of the rabbit, cat, and dog. The pieces are kept in autogenous or homogeneous plasma and show some vital activity. There is an intra-plasmic growth of the connective cells and of nerve fibres which originate from the surviving nerve cells. There is a reaction in the interior of the fragment; prolongations of surviving cells form a pericellular or periglomerular plexus, as is also seen in grafts. There are also neuro-fibrillar metamorphoses in the surviving nerve cells.

The authors have observed direct division of connective cells. The nerve cells show no division, but only the formation of new outgrowths and internal chemical and structural changes of neurofibrils. The neo-formations sometimes show an extraordinary exuberance. Fragments of cat or dog ganglion in a culture of rabbit plasma exhibit all the phenomena which are seen in grafts. The differences of results with autogenous and heterogeneous plasma are quantitative rather than qualitative. Pure plasma is most suitable for the culture of ganglia, and dilution is disadvantageous. A cell kept alive for twenty days with four changes of plasma showed twelve outgrowths with terminal swellings—a maximum exhibition of vitality. It should be noted that connective-tissue cells survive more readily than nerve cells, being less differentiated. They multiply and can live longer.

**Culture of Tissues.**†—C. Champy discusses his experiments on the culture of tissues in plasma outside of the body. The fragment of tissue is plunged in the liquid plasma and kept in contact with the surface. The plasma coagulates and is kept in a saturated humid atmosphere at 37–38° C. The preparation is washed daily with the serum of the animal which furnished the plasma. This removes waste-products and the results of autolysis.

The cells do not retain their characteristic qualities, but exhibit de-differentiation. There is often a return to a blastoderm-like state on the part not only of embryonic tissues but of those from the adult as well. Mitosis may be seen in fragments of kidney, thyroid gland, and smooth muscles, and even in Müller's fibres from the retina.

Champy discusses in particular the behaviour of smooth muscle from the bladder and the arteries. In the former the cell becomes swollen around the nucleus and a mitosis occurs, and the two cells first formed continue to divide, so that a series results from one smooth fibre. An indifferent tissue results, but the most differentiated (fibrillar) part of the original cytoplasm is left by itself and degenerates. The muscle of the arteries, which is less differentiated, is even quicker in showing

* Anat. Anzeig., xlvi. (1914) pp. 529–47 (13 figs.).
† Arch. Zool. Expér., liii. (1913) Notes et Revue, No. 2, pp. 42–51 (8 figs.).

de-differentiation. During the first mitosis the fibrils are dissociated and are gradually dissolved. In the less differentiated element the cytoplasm is itself able to destroy the specific differentiation.

**Nerve-endings in Chelonia.***—R. Hulanicka describes the various kinds of nerve-endings in the tongue, the jaws, and the skin of *Testudo græca* and *Emys lutaria*. She deals especially with the tactile cells of the epidermis, and the taste-buds on the tongue and on the margin of the mouth. In hibernating specimens those on the margin of the mouth sink into the deeper parts of the epithelium, like the sensory buds of the newt.

**Comparative Study of Heart-muscle.**†—W. Lange has made a study of the heart-muscle in a variety of Vertebrate types, from Fishes to Mammals, with particular reference to the question of the myogenic or neurogenic nature of the heart-beat. He discusses the histological and embryological facts. In all classes of Vertebrates there is a muscular basis for the transmission of stimuli. Purkinje's fibres are not remains of embryonic muscle-cells. Even in very young Mammalian embryos they are clearly distinguishable. They form a sarcoplasmic reticulum, consisting of fibrils disposed in elongated strands or roundish cell-like bodies. They contribute to the syncytial character of the Vertebrate heart and to the non-nervous apparatus for conducting stimuli. The Vertebrate heart-beat is myogenic; the Invertebrate heart-beat is neurogenic.

**Comparative Embryology, Anatomy, and Histology of the Vertebrate Heart.**‡—G. Favaro deals with a representative series of hearts —e.g. lamprey, hag, dogfish, sturgeon, frog, newt, tortoise, lizard, snake, crocodile, bird, guinea-pig, mole, bat, and monkey—and discusses them comparatively. He proposes to follow this up with a volume on the human heart. He pays particular attention to the endocardium. In his view the endocardium corresponds to the intima plus the media; the interstitial connective-tissue and the immediate envelope of the myocardium, to the adventitia. Thus the heart has four, not three envelopes or layers. Compared with the peripheral blood-vessels, the heart is distinctive in its external layer, which has cross-striped muscle.

**Lymphatic Nodules of Birds.**§—H. Fürther has made a study of the lymphatic nodules of birds. So far, these nodules have not been demonstrated for all birds, but they appear to occur in water, marsh, and shore-birds irrespective of their systematic position. The Anatidæ, which were specially investigated, have two pairs of true lymphatic nodules, which are spindle-shaped structures of considerable size occur-

* Anat. Anzeig., xlvi. (1914) pp. 485-90 (1 pl. and 3 figs.).
† Arch. Mikr. Anat., lxxxiv. (1914) 1te Abt., pp. 215-62 (2 pls.).
‡ Ricerche embriolog. ed. anat. intorno al cuore dei Vertebrati. Part I (1913, Padova) 563 pp. (272 figs.).
§ Jen. Zeitschr. Naturw., l. (1913) pp. 359-410 (2 pls. and 15 figs.).

ring in the course of the larger lymph-channels. The first pair are known as the cervicothoracic nodules. Each represents a widening of the lymphatic vessel which runs beside the jugular vein and is closely apposed to the terminal course of the jugular. The second pair lies close under the vertebral column at the level of the reproductive organs; they are formed from the lymphatic vessels which run along each side of the aorta, and are known as the lumbar nodules.

The lymphatic system arises by budding from the venous system at the two points where a permanent communication between the two systems exists—that is from the superior venæ cavæ and from the pelvic veins. The lymphatic nodules begin to develop about the fifteenth day. A thickened zone of mesenchyme is laid down round the previously simple tube-shaped lymphatic vessel, and strands of mesenchyme grow forward into the lumen so that it is transformed into a reticulated system of smaller lymph-spaces Up to this point the development has been analogous to that of the nodules in Mammals, but it now diverges, for instead of a peripheral sinus, a "main lymphatic space" is formed, which runs a central course as a direct continuation of the primitive lymphatic vessel, from one pole of the rudiment to the other. It is everywhere connected with the smaller peripheral spaces. The infiltration of leucocytes takes place round the main space, and gives rise to central lymph follicles.

Thus the arrangement of elements in a typical lymphatic nodule in Birds is the opposite of that in Mammals, and a cortical and medullary substance cannot be distinguished. As the follicle grows towards the "main lymph space" the latter becomes narrow and irregular, so that in the later stages it is difficult to recognize. Towards the end of the first month after hatching lymphoblasts appear in the follicles and there is a subsequent appearance of germinative centres; towards the end of the second month the development of the lymphatic nodules is complete. No capsule is developed in the lymphatic nodules of birds, and therefore all the structures arising from the capsule in Mammals are also absent. The delimiting portion of the bird's lymphatic nodule is itself composed of glandular substance, and is not divided up by partition walls; the lymphatic tracts are entirely free. The main substance may be divided into the walls, the lymphatic strands, and the lymphatic follicles. The first two are exactly alike and of very simple structure; they consist of fibrillar connective tissue whose wide meshes are quite full of leucocytes. The lymphatic follicles are simple extensions of the strands in which the meshes have been pushed farther apart by the more abundant infiltration of leucocytes. The walls, lymphatic strands, and follicles are divided off from the lymph spaces by a fine layer of endothelium. As in Mammals, the germinative centres form one of the specific constituents of the lymphatic follicles, and they are definitely bounded by circular connective tissue fibres, and surrounded by a fine network of capillaries. They are more constant structures in the lymphatic nodules of Birds than in those of Mammals. There is no hilum in the lymphatic nodules of birds; blood-vessels and lymph-vessels may enter them at different points.

**Structure of Swim-bladder of Umbra.***—M. Rauther describes the minute structure of this organ in *Umbra pygmæa*, a fish that has an inadequate branchial apparatus and uses the swim-bladder when it is out of water. It can remain out of water for nine hours without suffering more than transient bad effects.

The swim-bladder is a long sack with delicate walls extending under the backbone for the greater part of the body cavity. Anteriorly there is a longitudinally plaited expansible pneumatic duct, opening in a deep groove on the dorsal surface of the gut behind the last gill-cleft. The swim-bladder shows an internal epithelium with which capillaries are closely associated, a dense layer of connective tissue, a simple layer of longitudinal smooth muscle-fibres, a thick loose layer of connective tissue, and a strong layer of circular smooth muscles. The anterior end shows remarkable vascular plexuses or retia mirabilia, both arterial and venous. There is no gas gland. The posterior portion of the swim-bladder receives most of its blood from the intercostal arteries. The highly vascularized epithelium in *Umbra* points indubitably to a respiratory function.

**Vascular System of Myxine.**†—F. J. Cole communicates some account of the cardinal veins, the venous trunks associated with the heart, the sub-intestinal vein, and so on. The feature of greatest interest in the Myxinoid vascular system is the extensive series of spaces now known as veno-lymphatics. In *Myxine* they always contain blood in considerable quantity, and there are grounds for believing that they are only enlarged veins, and not comparable with the true lymphatics of higher animals. Blood enters the peribranchial sinuses from the afferent branchial arteries and the contents of these sinuses must drain posteriorly into the inferior jugular vein.

**Vascularization of Skin in Newts.**‡—R. Despax has made a histological study of the skin of a Pyrenean newt (*Triton asper* Dugès), with a view to determining the importance of cutaneous respiration. He found that the capillaries were very closely associated with the epidermic epithelium. In *Triton asper* the thickness of the integument is relatively greater than in other species of the same genus. The epidermis, in the region where it is thickest, includes, in addition to the two-layered stratum corneum, four or five layers of epithelial cells. The nuclei of the deepest layer of epithelial epidermic cells are oval, with the long axes directed at right angles to the surface of the skin; those of the median layers are more or less regularly spherical, while those of the lower layer of the stratum corneum are flattened. The average thickness of the dermis is at least equal to, and sometimes greater than that of the epidermis above it. It attains its greatest thickness in the space between the cutaneous glands. In the most superficial region of the

* Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 339–64 (10 figs.).
† Anat. Anzeig., xlvi. (1914) pp. 478–85 (1 fig.).
‡ Bull. Soc. Zool. France, xxxix. (1914) pp. 215–221 (2 figs.).

dermis it is possible to distinguish a vasculo-pigmentary zone containing pigment and blood-vessels. The latter are very abundant and run exactly between dermis and epidermis. In some places the capillaries push before them an extremely thin layer of connective tissue and penetrate into the epidermic epithelium, which is thinner at such places. The thinness may be so great that the capillary is separated from the surface only by the stratum corneum with its flattened cells. This arrangement of capillaries is found over the whole surface of the body, but is particularly marked on the abdomen, the top of the head, and the sides of the tail. The species in question, which has the skin thus highly vascularized, is also the species among pulmonate Urodela which shows the greatest reduction of the lungs. It spends a part of the year in pure water, cold, and usually flowing, therefore highly oxygenized. Experiments with water containing oxygen and water partly deprived of it by boiling, showed that in boiled water, though bucco-pharyngeal respiration was not accelerated, the newt rose more than twice as often to the surface to gulp mouthfuls of air.

**Structure of Muscle-columns.***—H. Marcus discusses the conclusion of Holmgren and Heidenhain that the muscle-columns are homogeneous on cross section. He cannot accept this view, and supports his position by evidence drawn from a study of the muscles of dragon-flies. The muscle-column shows (1) the elementary fibrils; (2) the matrix; and (3) an outer limiting sheath. It is no homogeneous histomere in a homœotypic series, but a very complicated structure, as, indeed, the mechanism of contraction demands.

### c. General.

**Pattern Development in Birds and Mammals.**†—Glover M. Allen has taken a wide survey of colour patterns. In mammals and birds that are normally completely pigmented, there are certain definite points of the body from which as centres the tendency to develop pigment in the epidermal structures may become less and less. Outward from each of these centres, pigment formation spreads to include very definite areas which in wholly pigmented animals overlap slightly at their borders, or are at least contiguous.

A reduction in the area covered by any of these primary patches results in a white mark at the line of junction of two contiguous colour patches, where no pigment is produced. These white marks between the primary patches are spoken of as primary breaks.

By a study of the breaks in pied individuals, the author has sought to define the boundaries of the primary patches in domesticated birds and mammals. They are "homologous" in the two groups. They include a median crown patch, and five paired patches—corresponding to the ear, neck, shoulder, side, and rump. These patches are physio-

* Anat. Anzeig., xlv. (1914) pp. 425–9 (1 pl.).
† Amer. Naturalist, xlviii. (1914) pp. 385–412, 467–84, 550–66 (62 figs.).

logically independent of each other, and may be differently coloured in the same individual.

Pied patterns among many wild species have been brought about through the areal reduction of these pigment patches in a definite way, so that the white markings resulting as breaks between the reduced patches have become fixed, and form a permanent part of the normal pattern.

In several wild species this development of white markings is shown to be even now taking place, but the amount of pigment-reduction is still fluctuating, so that the white markings vary much in extent in different individuals.

The development of such white markings takes place probably little by little, so that the departure from the normal type is not so great as to arouse antagonism against the varying individual on the part of others of its species. Also, the slow rate of the change allows the species to become accommodated to any disadvantage that might concomitantly arise.

The converse of this centripetal style of pigmentation is present in many species, and results in pigmentation (commonly black) at the extremities or along lines where primary breaks occur in the centripetal form, namely, at the tip of the nose, ears, tail, or toes. The black dorsal stripe may also be due to centrifugal pigmentation. Patterns may develop, as in certain antelopes, by a white break between patches of the two types.

**Study of Hooded Fowls.***—Fr. Neumann has made an anatomical study of the hooded fowls of the Houdan breed. A large tuft of feathers decorates the head; the comb is much reduced in the hens, less so in the cocks. It is of the "butterfly type," with two lateral lobes. The skull is raised in the region of the frontals. Below the comb there are sometimes large vesicles containing serous fluid. All the Houdans have five toes.

The most noteworthy peculiarity is the special development of the brain. The cerebrum is greatly enlarged anteriorly, and this is sometimes further increased by hydrocephalus. Several investigators have referred the peculiarity of the brain to hydrocephalus, but cases are known with no hydrocephalus, but with the peculiar shape as marked as usual.

The telencephalon has an unusual tendency to grow in the direction of the longitudinal axis. The corpora striata increase in thickness in their rostral portion mainly. There is an arching over the olfactory lobes. As the caudal portion of the cerebrum is poor in cerebral substance, the cerebrum becomes narrowed posteriorly, and a kind of neck is formed, which slightly separates off the cerebrum from the rest of the brain. This is increased by a slight elongation of the thalamencephalon. The skull is transformed in correlation with the change in the shape of the brain. This is particularly the case in the region of the frontals. Another peculiarity is in the vascular supply. The

* Jen. Zeitschr. Naturw., lii. (1914) pp. 209-68 (1 pl. and 42 figs.).

frontals are traversed by a strong artery, or by several, springing from the cranial branch of the cerebral or from its branch, the median cerebral, and uniting in the hood with the branches of the external facial. This peculiarity in the arterial system is connected, not with the peculiar shape of the brain, but with the hood.

**Nutrition of Striped Muscle.***—Nanna Svartz refers to the view that nutriment simply passes from the blood to the tissues through semi-permeable membranes without any specific activity on the part of the cells. Another view is that there are intermediate cells which transport and prepare the nutriment. Following Holmgren, Svartz directs attention to the importance of trophocytes (œnocytes of Prenant, sarcosomocytes of Thulin), which are intermediate between the blood and the highly differentiated muscular and nervous tissue. The relation of the trophocytes to the various stages of muscular activity is discussed. The appearance of the trophocytes changes so much during the contraction wave that we cannot think of them as remaining indifferent. A direct transference of substances from the trophocytes to the muscle fibres has been seen in many cases, especially when the muscle fibres after contration are in need of replenishment. When the trophocyte has supplied the need of the muscle fibre it shrivels and leaves a few scarcely perceptible granulations.

**Physiological Theory of Muscle Contraction.**†—H. E. Roaf believes that the contraction of striated muscle can be explained on the hypothesis that lactic acid is set free, and that this combines with protein to form a salt, with a consequent rise of osmotic pressure. Muscle can shorten by osmotic processes until its length is somewhere between 37 and 3 p.c. of its original length. The osmotic process can occur in frog's sartorius in less than 0·04 of a second. In order to determine whether all cases can be explained by this hypothesis it is necessary to have measurements of the structures concerned. Insects' muscles, for instance, should be the test as regards the rapidity of contraction. The amount of lactic acid formed during muscle contraction can cause sufficient rise in osmotic pressure to account for the force exerted by muscle contraction. The electrical changes in muscle can be explained by the formation of a protein salt of lactic acid.

**Temperature and Development.**‡—E. D. Sanderson and L. M. Peairs have studied the influence of temperature on the hibernation, æstivation, development, growth, and reproduction of insects. The rate of development within normal limits depends, other factors being equal, upon the temperature. It increases directly with the temperature, the curve for the increase within normal limits being a true mathematical hyperbole. The authors discuss the index of development, the developmental zero, the thermal constant, and other technical points.

* Anat. Anzeig., xlv. (1914) pp. 538–48 (5 figs.).
† Proc. Roy. Soc., Series B, lxxxviii. (1914) pp. 139–50.
‡ Bull. New Hampshire Coll. Agric. Exper. Station, No. 7 (1913) pp. 1–125 (23 curves).

**Relation between Thymus and Generative Organs.***—E. T. Halnan and F. H. A. Marshall have made a series of experiments on guinea-pigs with a view to investigating the relation between the thymus and the generative organs, and the influence of these organs on growth. They find that removal of the thymus in young guinea-pigs does not alter the growth. Removal of the testes and epididymes in young guinea-pigs does not affect the growth of the animals before sexual maturity, nor does the simultaneous removal of the thymus and testes. Thymectomy is not followed by hypertrophy of the testes. Castration leads to an arrested atrophy and subsequent hypertrophy of the thymus. This agrees with the conclusion reached by other investigators. There is no evidence of a compensatory mechanism between the testes and the thymus.

As some of the conclusions differ from those reached by Noel Paton in his work on the same subject, the figures on which they are based have been statistically treated by G. Udny Yule in an appendix to the paper.

**Rectal Gland of Elasmobranchs and Appendix vermiformis in Man.**†—Arturo Morgera calls attention to the results of an investigation, published in 1909,‡ in which he maintained that the rectal gland of Elasmobranchs was homologous with the appendix vermiformis, and was also analogous, having an "ectoproctal" function, i.e. conducing to the expulsion of the undigested material. He made experiments showing the effect of the secretion of the gland when introduced into the intestine. The same view has been recently maintained, he points out, by R. Robinson,§ who appears to have overlooked Morgera's work.

**Fauna of a Coal-pit at Great Depths.**‖—James Ritchie reports thirteen species from a Midlothian coal-pit at a depth of 750 feet and a quarter of a mile from the shaft. Most had doubtless come in with the pit-props and the horse-fodder; and the flies had perhaps been helped by the air-currents. No special modifications, e.g. in colour or in eyes, were observable. The list includes: common mouse; brown rat; house sparrow; the great slug (*Limax maximus*); a small spider, *Lessertia dentichelis* (an addition to the known fauna of Scotland); a "clocker" beetle, *Quedius mesomelinus*, and a larva probably of this species; another beetle, *Thanasimus formicarius*, common in the open country on logs of Scotch fir; two Diptera (*Psychoda humeralis* and *Phora* (*Aphiochæta*) *rufipes*); springtails or pit-fleas (*Tomocerus minor*) in great abundance; two earthworms (*Eiseniella tetrædra* and *Helodrilus* (*Dendrobæna*) *rubidus*); and a Mycetozoon on the pit-frogs (*Stremonitis fusca*). The chief interest of the collection is that it illustrates the incipient stages of a cave fauna.

* Proc. Roy. Soc., lxxxviii. (1914) pp. 68–89 (5 figs.).
† Anat. Anzeig., xlv. (1914) pp. 429–30.
‡ Boll. Soc. Nat. Napoli, xxiii. (1909) pp. 51–2.
§ Comptes Rendus, 1913, pp. 790–1.
‖ Scottish Naturalist, 1914, pp. 158–61, 181–8.

**Nannoplankton of the Lake of Zug.***—Kurt Lantzsch has made a study of biological conditions of the Lake of Zug, with special reference to the nannoplankton and its relation to the zooplankton in deep lakes. The nannoplankton shows a characteristic layering in summer and autumn. At these seasons the lower limit of the occurrence of the nannoplankton is about 80 m. Its representatives at these depths consisted of Schizophyceæ (?) (*Chroococcus* and *Gomphosphæria*) and diatoms (Cyclotellæ). The Flagellates (*Chromulina ovalis*) seem to be confined to the upper 40–50 m. They show active phototactic migrations. Towards autumn the optimal zone of the components of the nannoplankton becomes more marked, and is specific for each type (*Chroococcus*, *Gomphosphæria*, *Binuclearia*, Cyclotellæ). It is apparently determined by the transparence and by the quantity of light at the time. The winter convection-currents break up this layering and a distribution of the nannoplankton takes place, so that it extends without a well-defined maximum, from the surface to the bottom (0–200 m.). In May the summer boundary of 70–80 m. is again observable. In regard to the zooplankton, the author confirms Burckhardt's dictum that the distribution of Copepods, Cladocera, and Rotifers depends on the presence of a food-supply in solid form. The depth-limit of the Copepoda undergoes the same seasonal changes as that of the food-supply. Light-changes determine the daily migrations of the Copepods, Cladocera, and Rotifers, a change in transparence corresponding to the change in the maximal depth-limit of Rotifers. The maximal accumulation of Rotifers at a particular level seems to be conditioned by intensity of light rather than by abundant food, and it is specific for the different forms of pelagic Rotifers.

**Plankton of the Mansfeld Lake.†**—F. V. Colditz has made investigations, extending over eighteen months, into the biological conditions of the Mansfeld Lake, with special reference to the nannoplankton and its relations to the zooplankton. He finds that in this lake, which is of medium depth, there is a direct relation between the distribution of nannoplankton and the food-supply, and that light and wave-motion have also a direct influence on distribution. The quantity of nannoplankton directly determines the quantity of Copepods, etc. Details as to the physical and chemical conditions of the water, and of the composition of the zooplankton and nannoplankton, are given.

## Tunicata.

**Fertilization in Phallusia.‡**—Fr. Meves has investigated the fertilization of the ovum in *Phallusia mamillata* with particular reference to what happens to the plastosomatic portion of the spermatozoon. He gives an account of the structure of the spermatozoon, which shows a plastosomatic tubular sheath surrounding the median part of the head.

* Zeitschr. wiss. Zool., cviii. (1914) pp. 631–92 (6 figs.).
† Zeitschr. wiss. Zool., cviii. (1914) pp. 520–631 (1 map and 32 figs.).
‡ Arch. Mikr. Anat., lxxxii. (1913) 2te Abt., pp. 215–60 (4 pls. and 7 figs.).

The ovum is filled with yolk-spherules, among which are scattered vesicular mitochondria or plastochondria. At the lower pole there is a cupola-like accumulation of plastochondria, with an irregular surface, with bays and prominences both externally and internally. The plastosomatic portion of the spermatozoon is traceable for some time in the fertilized ovum. It probably represents a protoplasmic hereditary material. Meves discusses various other possible interpretations of the minute body, and defends his general position that the plastosomes are of significance in inheritance.

**Regeneration and Budding in Diazona.***—M. Caullery describes *Diazona geayi* sp.n., found by F. Geay on the coast of French Guiana—a new region for the genus. He also discusses the remarkable retrogression which occurs in *Diazona* in unfavourable conditions, and the subsequent regeneration. There is a degeneration of the thorax region of the ascidiozooids and then repair. But the process may be complicated by multiplication, the abdomen becoming fragmented into several pieces in a line, each of which becomes a new ascidiozooid. The author discusses in particular what happens in regard to the digestive tube.

## INVERTEBRATA.

### Mollusca.

#### γ. Gastropoda.

**Structure of Trochidæ.**†—E. J. Frank has studied *Monodonta turbinata*, *Gibbula cineraria*, and *Photinula tæniata*, to which we shall refer by their initials. The shell consists of a periostracum, an ostracum (3-layered in *G.c.*, 2-layered in *M.t.* and *P.t.*), and a hypostracum. In *P.t.* there is no pigment in the skin, and there are no head-lobes as in *M.t.* and *G.c.* There is cross-striping in the muscles of heart and pharynx. The left kidney (papillary sac) is probably a blood-gland; the other is a true kidney; both have a reno-pericardial canal communicating with the pericardium, but they do not communicate with one another. The gonad opens into the right kidney, and the ureter functions as a genital duct. There is a crop rich in villi; the stomach has a cæcum; the mid-gut gland has an absorptive as well as a secretory function, and has two kinds of glandular cells. The nervous system is carefully described. The pedal strands are elongated pedal ganglia, and form a morphological and histological unity. They are connected by cross commissures, and give off sole-nerves, lateral nerves, and epipodial nerves. The anterior pedal nerves show no transverse commissure. The epipodium is innervated from the pedal strands and the cerebro-pedal connectives, and is strictly part of the foot. The statocyst nerve passes through the cortex of the pleural ganglia into the cerebro-pleural connective, and probably belongs to the cerebral ganglion.

* Bull. Soc. Zool. France, xxxix. (1914) pp. 204–11 (2 figs.).
† Jen. Zeitschr. Naturw., li. (1914) pp. 377–486 (1 pl. and 55 figs.).

**Study of the Clausilium.***—M. v. Kimakowicz-Winnicki has studied the "clausilium," or closing lid, which is found in some Gastropods. It has been compared by some to the operculum, by others to an epiphragm. He discusses (1) the emergence of the body of the snail from its shell by gas-pressure or by water-pressure; (2) the structure of the shell in various types; (3) the making of the epiphragm; (4) the nature of the true operculum; (5) the nature of the clausilium apparatus in *Alopia* and other types. The complicated lamellar structure of the clausilium is described. Its significance is as an accessory apparatus in carrying the shell, which is relatively heavy in proportion to the animal.

## Arthropoda.

### α. Insecta.

**Flies and Disease.**†—G. S. Graham-Smith has done a very valuable piece of work in giving a compact account of non-bloodsucking flies in their relation to disease. Many of the non-biting flies frequently walk over and feed on decaying substances and excreta in which disease-producing bacteria may be present; the flies can carry bacteria on their limbs and bodies for several hours, and internally for several days; they may thus infect human food and spread infectious diseases. The book is admirably clear and methodical, with effective illustrations and a copious bibliography. Among the subjects dealt with are the following: the species of non-bloodsucking flies found in houses; the life-history of the common house-fly; the habits of flies; the bacteriology of city flies; the relation of flies to typhoid, summer diarrhœa, cholera, tuberculosis, anthrax, and some non-bacterial diseases. There is a discussion of myiasis, the diseases of flies, the parasites of flies, the enemies of flies, and the prevention and control of flies. The last chapter sums up the conclusions arrived at. The book is in every way effective and merits great success.

**Urticating Properties of Porthesia similis.**‡—H. Eltringham has made a further study of the barbed spicules in the anal tuft of *Porthesia similis*, the spicules to which, as he has already shown, the urticating properties of the female are due. The spicules are apparently identical with those of the larva, in which they occur on every segment except the first and second. In the larva they are borne in tufts on small chitinous papillæ, each of these being in direct communication with a double layer of cells. Large branched hairs, and white plume-like structures, looking, to the naked eye, like white spots are distributed all over the body, and apparently serve to hold loose spicules, though they are probably mechanically protective as well. The larva spins a thin tough cocoon interwoven with its own large hairs. Spicules are scattered throughout the looser silk lining the cocoon, and are also arranged in a

* Zool. Jahrb. Abth. Syst., xxxvii. (1914) pp. 283–328 (1 pl.).
† Flies in Relation to Disease: Non-Bloodsucking Flies. Cambridge, 1913, xiv and 292 pp. (24 pls. and 32 figs.).
‡ Trans. Ent. Soc. London, 1913, pp. 423–7 (1 pl.).

belt round the anterior portion. When the pupæ were taken out of the cocoons before emerging from the pupal skin they never showed spicules in the anal tuft. Male imagines immediately crawled out of the cocoon and assumed a position suitable for expanding the wings, but females only crawled half out and then went through a curious series of contortions of the abdomen, so that the anal tuft, opening and shutting continually, described a succession of circles where the spicules were thickest. The female moth, by thus collecting her own larval spicules, materially adds to the protective qualities of the tuft of hair with which she ultimately covers her eggs.

**Tenth Abdominal Segment of Beetle Larvæ.***—P. Brass has made a study of the tenth abdominal segment of beetle larvæ—its differences in different groups, its use as an auxiliary to locomotion, and its manifold adaptations to the different conditions of larval life. As to the origin of the "seventh foot," he finds that it is not a devagination of a portion of the hind-gut, as some observers have stated, but is a secondarily invaginated modified portion of the integument, which in some forms can be clearly recognized as belonging to a typical abdominal segment. The stages of development in various types are described.

**New Termitophilous Beetle from Formosa.**†—Sanji Hozawa describes *Ziaelas formosanus* sp. n. from the nest of *Odontotermes* (*Cyclotermes*) *formosanus*. It appears to be closely related to *Z. insolitus* Fairmaire, which Wasmann referred to his family Rhysopaussidæ, a remarkable series of termitophilous beetles. The new form was about 8 mm. in length, reddish-brown above, somewhat lighter below, and was capable of but very sluggish movements. It showed some peculiarities which may be associated with its life in the nest of the termite, as, for instance, the elongated eyes and the degenerate hind wings.

**Irregular Cyclical Parthenogenesis in a Weevil.**‡—Guido Grandi calls attention to what looks like cyclical parthenogenesis in *Otiorhynchus cribricollis* which he studied both in captivity and in the field. He never found a male, nor any trace of spermatozoa in the somewhat reduced spermotheca of the females. The ovarioles showed abundant ova at different stages. Parthenogenesis has been recorded in *O. turca* by Ssilantjew and in *O. ligustici* by Wassiliew.

**Structure of Water-beetle.**§—H. S. Cheavin publishes a number of excellent photographs illustrating the structure of *Dytiscus marginalis*, and gives an outline of the life-history and structure. The female lays one egg at a time in incisions made by the ovipositor in the leaves and stems of water-plants. The larvæ emerge in about three weeks and

* Zool. Jahrb. Abth. Syst., xxxvii. (1914) pp. 67–122 (4 pls. and 7 figs.).
† Annot. Zool. Japon, viii. (1914) pp. 483–8 (1 pl.).
‡ Boll. Lab. Zool. Agric. Portici, vii. (1913) pp. 17–18.
§ Knowledge, xxxvii. (1914) pp. 222–6 (14 figs.).

become 2 in. long in four or five weeks. The full-grown larva ceases to feed and digs a cavity in the mud in which pupation occurs, the process lasting about a fortnight in summer, but months in winter. The fully formed beetle that creeps out of the burrow is at first very light in colour, and it takes several days before the familiar dark-bronze appearance is assumed. The author's reference to the closed mouth during the action of the hollow mandibles is not clear to the recorder.

**Life-history of Psylla isitis.***—A. J. Grove and C. C. Ghosh have investigated the life-history of *Psylla isitis* Buckton (*Psyllopa punctipennis* Crawford), the cause of the "Psylla" disease of Indigo. Eggs are laid all the year round if suitable food-plants are available, and the whole development may be gone through in fourteen days in hot weather, but may take forty-six in cold weather. The number of broods in a year is from twelve to fourteen. The eggs are laid in almost any part of the plant. Each is attached by a curious protuberance which is thrust into the tissues of the plant. The different larval and nymphal stages are described. At all stages greyish-white globules of fluid consisting of liquid excreta are extruded from the anus, and six different species of ants were found to attend on the *Psylla* at different stages and to lick up this fluid. Some species of Psyllidæ only weaken the plant by sucking its juices, others cause gall-like growths. The species in question causes distortion of the leaves but no galls. Harm is done chiefly by the larvæ, but infection of fresh areas is mainly due to adult females. The Indigo "Psylla" is attacked by a parasite in the nymphal stage, and both nymphs and adults are preyed upon by numerous enemies, but nothing has been found to attack the eggs.

**Egg-laying of Trichiosoma.†**—T. A. Chapman has observed the whole process of egg-laying in *Trichiosoma betuleti* (?), and describes the exact action of the "saw" in cutting the leaf of the willow. The insect chooses a spot quite close to the margin of the leaf and rests there with two apical plates of the saw-sheath pressed closely against, but not gripping the leaf. When the saw is first seen to have entered the leaf, the darker, posterior (in the then position) portions of the saw (the supports), advance slowly, steadily, and uniformly together, while the anterior portions, the "saws," are seen to be in rapid motion. The saw is curled right round the end of its support, and goes to and fro rapidly without altering its position. One portion advances as the other retreats, and the cutting is done by the margins of these two pieces. Actual cutting occupied 1 minute 50 seconds, then a rest of 10 seconds intervened, and in 15 seconds more the egg was laid, and the saw withdrawn. Eggs laid on April 22, showed on May 1 a rhythmical to and fro movement of the larvæ within them, and on May 4 the larvæ were hatched. The cutting of the saws is really a scissor-like action. Each of the projections of one of the saws, in passing a similar projection of the other, acted with it as a pair of scissors, cutting through the scrap of

* Mem. Dept. Agric. India, iv. (1914) pp. 329–57 (6 pls.).
† Trans. Ent. Soc. London, 1913, pp. 173–84 (7 pls.).

tissue caught between them. The two saws are strengthened, lattice-girder fashion, by transverse thickenings on their outer surfaces, which are thus uneven and irregular, but their opposed faces are quite flat, and slide smoothly on one another.

**Bird-lice of British Auks.***—James Waterston gives an account of five species of *Docophorus* found on razorbills, guillemots, little auks, and puffins. They fall into two sets: (*a*) *D. acutipectus*, *D. calvus*, and *D. celedoxus*; and (*b*) *D. megacephalus* and *D. merguli*. About fifty specimens is regarded as about the normal number to be expected on one host, but taking the concomitant *Nirmus* and *Menopon* into the reckoning, 100–120 may not be an excessive estimate of the mallophagous parasites of a bird before the moult. Each of the five auks in British waters has a species of *Docophorus* peculiar to itself within that area, but "straggling" of an interesting kind is also exhibited.

**Monograph of Jumping Plant-lice of the New World.†**—David L. Crawford has accomplished the task of taking a survey of the Jumping Plant-lice or Psyllidæ of the New World. A complete re-arrangement of the genera is presented, based on the form of the head, the vertex, the pleurites of the prothorax and of the pronotum, the armature of the hind tibiæ, the venation of the wings, and so on. Six sub-families are recognized: Liviinæ, Pauropsyllinæ, Carsidarinæ, Ceriacreminæ, Triozinæ, and Psyllinæ. Numerous new forms are described. The Psyllids are usually very active little creatures, with an interesting combination of leaping and flying. When disturbed a Psyllid throws itself into the air by means of its powerful hind legs, which are doubled-up like a letter Z with a short base. Once in the air it vibrates its wings and thus increases the rapidity of its leap and the distance covered. The wings are scarcely strong enough to permit of rapid or prolonged flight unaided by the preliminary leap. By this combined leaping and flying, however, the insect is able to travel several yards, although more often it merely leaps a few inches or feet from the point of disturbance.

**Saws of Female Dolerids.‡**—F. D. Morice continues his work on the terebræ of this difficult group by publishing a beautiful series of photographs, thirty-six in all, showing specific differences not in outline alone, but in surface, especially as regards the remarkable alternating elevations and depressions. He believes that, taking them as a whole, and considering all their characters, the saws he figures can be divided into more or less definite groups, and that these groups to some extent, but not altogether, correspond to sub-divisions already pointed out by various authors—subdivisions founded on external characters only, and without any consideration of the structure of the saw. These groups are discussed in detail.

* Proc. R. Phys. Soc. Edinburgh, xix. (1914) pp. 149–58.
† Smithsonian Inst. U.S. Nat. Museum, Bull. 85 (1914) ix and 186 pp. (30 pls.).
‡ Trans. Ent. Soc. London, 1913, pp. 428–35 (3 pls.).

**Faceted Eyes of Libellulids, etc.***—K. Zimmermann has made a comparative study of the eyes of Libellulids, Phasmids, and Mantids. In all the forms examined he finds that the chief pigment-cells and the corneagen cells are homologous structures Continuations of the chief pigment-cells reach right up to the cornea; the small triangular interpolated pieces between the cornea and the nuclei of the circular cells belong to the chief pigment-cells. In those Libellulids in which the eye is divided by difference of pigmentation into two regions, it is only the darkly pigmented latero-ventral portion which functions during the larval stage. The retinula is originally made up of eight cells, of which one usually becomes rudimentary. Usually only the nuclei of the eight cells are demonstrable, but in Sipyloidea the remains of a cell-body can be seen. The Mantid eye possesses an iris-tapetum.

**Spinning Apparatus of Embiidæ.†**—M. Rimsky-Korsakow has studied the structure and development of the spinning apparatus which is found in the expanded first tarsal joint of the fore-legs in all species of *Embia*. There are three kinds of hairs on the under surface of the tarsal joint—ordinary hairs, much smaller spine-like hairs (perhaps moulting-hairs), and hairs through which the ducts of the spinning glands open. Four types of glands are carefully described. The plasma of the glands is used up in forming the secretion. Each efferent duct shows a peculiar ampulla which opens into the gland by four oval apertures and also shows several fine hair-like processes. It seems that the spinning process is under voluntary control. The glands which compose the apparatus increase in number as growth goes on: there are 14–15 at hatching; there may be over a hundred in the adult. The cells which form them are segregated from the hypodermis and are at first amœboid. They migrate more or less into the interior of the tarsal joint and form a syncytium, whereas in other insects with spinning glands the cell boundaries are distinct. The author indicates that the spinning glands of Embiidæ might arise from skin glands like those (unicellular, however) known as Stein's glands. There is also some resemblance between the glands of Embiidæ and those in Pantopod larvæ and in second antennæ of *Oniscus murarius*.

**Copulation and Spermatophores of Gryllidæ and Locustidæ.‡** Ulrich Gerhardt has published a second paper in which he deals with pairing in many additional types of Gryllidæ and Locustidæ. The investigator does not find any warrant for referring the process of copulation, still less the structure of the spermatophores in the two families, back to a common form, yet there are many common features that justify certain general conclusions. The primitive position in pairing is more consistently maintained among the Gryllidæ than among the Locustidæ, where there is differentiation of the cerci and of the subgenital plate in the male: thus structural progress has been associated with changes in habit. In regard to the spermatophores, there are three types only comparable in their general features. The sperm-sac in the

* Zool. Jahrb. Abth. Anat. xxxvi. (1913) pp. 1-36 (2 pls. and 3 figs.).
† Zeitschr. wiss. Zool., cviii. (1914) pp. 499–519 (2 pls. and 1 fig.).
‡ Zool. Jahrb. Abth. Syst., xxxvii. (1914) pp. 1–64 (3 pls.).

spermatophores of the forms with only slightly differentiated cerci, in the Gryllidæ and in *Diestrammena*, is unpaired. But all the Locustidæ have, as regards their spermatophores, followed a path of evolution which has led them very far away from the Gryllidæ, and transition forms have still to be discovered.

### β. Myriopoda.

**Genus Watobius.***—Ralph V. Chamberlin gives an account of this genus of Centipedes, at present known to occur only in the south-eastern United States. Attention is drawn to some of its important characters. The eyes are composed of several ocelli; the outer branch of the first maxilla is biarticulate; the sternite of the prehensor segment is absent, no transverse ventral sclerite or collar being developed; anal pores are not present in the adult; the gonopods of the male are small, and consist of but a single reduced joint. Definitions are given of the family Watobiidæ and the genus *Watobius*; the type *W. anderisus* Chamberlin is described.

**New Cavernicolous Myriopod.†**—H. W. Brölemann describes *Spelæogervaisia jonescui* g. et sp. n., a new Millipede found by C. N. Jonescu in a Carpathian grotto. It is rather over 4 mm. in length and without pigmentation. Its position is in close vicinity to *Gervaisia*, but it is markedly adapted to a life in caves. As in *Gervaisia*, the skin-glands secrete calcareous matter, but not nearly to the same extent. The organ of Tömösváry near the antennary pit is not a more or less elongated horseshoe, as in *Gervaisia*, but is short, broad, and almost circular. The four ocelli on each side are quite without pigment.

### γ. Prototracheata.

**New Peripatus from Colombia ‡**—Charles T. Brues describes *Peripatus* (*Epiperipatus*) *vespucii* sp. n., which falls near *P. edwardsii*, and also shows a striking resemblance to *P. brasiliensis*. The collection from Colombia also included *P. edwardsii* and *P. imthurmi*. In some field notes by A. S. Pearse it is stated that specimens of *Peripatus* may crawl backward as well as forward, and that the white or colourless secretion which they eject anteriorly hardens rapidly and acts like glue.

### δ. Arachnida.

**Littoral Mites.§**—L. A. L. King publishes some interesting notes on the habits and characteristics of certain littoral mites at Millport. The first is *Gamasus* (*Eugamasus*) *immanis* Berl., a giant among Gamasids, the female reaching a length of over 2·5 mm., and a breadth of over 1·6 mm. This mite fed on living Oligochætes, using its chelicerae, which are chelate and retractile into its body. It plunged these into the

* Bull. Mus. Comp. Zool. Harvard, lvii. (1914) pp. 107–12 (2 pls.).
† Arch. Zool. Expér., liv. (1914) pp. 99–104 (1 pl.).
‡ Bull. Mus. Comp. Zool. Harvard, lviii. (1914) pp. 375–82 (2 pls.).
§ Proc. Roy. Phys. Soc., xix. (1914) pp. 129–41 (9 figs.).

worm and tugged off a piece, which it carried about, tearing and sucking it till nothing but the cuticle remained. The palps are cleaned by being passed through the pincers of the cheliceræ, and also by being rubbed together. The legs of the first pair are combed by the palpi, and, at the tip, by the mandibles. The abdomen is combed by the legs of the first two pairs. King describes the elaborate process of coition—during which the male, carried about beneath the female, plunges his mandibles deeply into the genital opening of the female and inserts a spermatophore. The process is similar in general features to that described by Michael for other Gamasids. In captivity the males died a few days after coition ; the females survived for several weeks. Two eggs were deposited several times in succession. They usually hatched at night or in the dark, the egg-shell splitting longitudinally. The newly hatched larvæ showed considerable activity, but did not eat. They retired into crevices, and there the first moult took place. The first nymph, white and slender, but larger than the larva, emerged in search of food, and not meeting with anything else, attacked one of the larvæ of its own species, which it reduced to an empty husk. Its outlines became more rounded, and it assumed a pinkish hue.

The second mite dealt with is *Gamasus* (*Halolælaps*) *glabriusculus* Berl. and Trouess., found on and under stones between tide-marks. It was proved to be able to endure complete immersion for at least forty-eight hours. In the experiment it was noticed that air remained present in the peritreme tube all the time. During the hours of tidal submergence, the mite probably finds a reservoir of air in the crevices of the stones or amongst the encrusting organisms of its habitat.

The third mite described is a Bdellid, *Molgus littoralis* (L.), a large scarlet form 2·5 mm. in length, found for the most part above high-water mark. It was only once observed feeding—on a small living Dipteron, apparently the Borborid *Limosina zosteræ*. Another Bdellid, smaller and brighter and more gregarious, was also found, commonly associated with the Collembolan *Anurida maritima*, which probably forms its food. It seems to be *Bdella longicornis* (L. 1758), Sig Thor, 1912. In the autumn it spins a silken tent, open at the top, in which apparently it prepares to spend the winter. The tent, with one or more mites inside, is found in the fissures of the sandstone.

### ε. Crustacea.

**Nervous and Vascular Systems of Amphipods.***—H. Schmalz has made a study of *Lanceola*, *Vibilia*, *Rhabdosoma*, and *Oxycephalus*, with reference to the nervous and vascular system. An account, with considerable histological detail, is given of the brain, the œsophageal ring, the ventral chain, the static organs, the eyes, the heart, the arteries, and the sinuses.

**New Epicarid.†**—S. Ishii describes *Athelges takanoshimensis* sp. n., an Epicarid Isopod parasitic on *Eupagurus samuelis* Stimps. As in

* Jen. Zeitschr. Naturw., lii. (1914) pp. 135–208 (71 figs.).
† Annot. Zool. Japon, viii. (1914) pp. 519–30 (1 pl.).

other Epicarids, the species shows marked sexual dimorphism. The male is very diminutive in comparison with the female, and very different in appearance. The female is found attached, by means of its prehensile legs, to the anterior part of the dorsal surface of the metasome of its host. It is in contact with the host by the entire extent of its own dorsal metasome surface. Consequently, all the prehensile legs are more or less twisted and dorsally directed. The marked concavity of the dorsal surface is due to the mode of attachment. All the females were found with the head directed backward in relation to the host's body. The male is usually found clinging to the metasome of the female in the manner of a parasite. It has a thick oblong body of a white colour, and the total length is about 3·2 mm. as compared with 8·5–12 mm. in the female. The brood-chamber of the adult female contained larvæ in the microniscus-stage.

**Indo-Pacific Stomatopoda.*** — Stanley Kemp gives a systematic account of species of *Squilla*, *Pseudosquilla*, *Lysiosquilla*, *Coronida*, *Odontodactylus*, and *Gonodactylus*. As of importance in classification may be noted the various carinæ of the carapace, abdomen, and telson; the form of the eye, e.g. the relation of the corneal and peduncular axes; and the presence or absence of the mandibular palp, and the number of its segments. Stomatopods are burrowers, but not fossorial in the sense in which this term is generally used among the Decapoda. The curious form and geniculation of the second maxillipedes must be admirably suited to an animal which lies in wait for its prey at the mouth of a burrow, while the small carapace and loose segmentation of the body somites enable it to reverse its position in a narrow tunnel without difficulty. The peculiarly modified branchial system is also in all probability an adaptation to this special mode of life, and it may be noticed that among the Decapoda the attachment of the branchial plumes to the swimmerets is known in one aberrant genus, *Callianidea*, the species of which also appear to make burrows. The author regards the Stomatopoda as a lateral offshoot from the main stem of the Malacostraca; but the precise affiliation remains obscure.

**Entomostraca from Durban Bay.**† — G. Stewardson Brady reports on some pelagic Entomostraca collected by J. Y. Gibson in Durban Bay. It appears that the Crustacean plankton of that region has not hitherto been at all carefully examined. A new form, *Aphelura typica*, g. et sp. n., which resembles an immature stage of some Pontellid, is described. The body is somewhat tapered in front; the forehead is produced into a sharply bifurcate rostrum; the urosome in the male is three-jointed, in the female two-jointed; the anterior antennæ are shorter than the metasome, with twelve to fourteen (?) joints; the posterior antennæ, mandibles, and maxillæ are as in *Pontella*; the outer branches of the first four pairs of swimming feet are composed of two joints, the inner branches of one joint only; the fifth pair are absent in the female; they are cylindrical, rudimentary, composed of two joints,

* Mem. Indian Museum, iv. (1913) pp. 1–217 (10 pls.).
† Ann. Durban Museum, i. (1914) pp. 1–9 (4 pls.) and 25–8 (2 pls.).

and bearing a very minute supplementary branch in the male: there is a pair of lenticular eyes. The form may turn out to be only a stage, but several precisely similar specimens were obtained. Descriptions are given of new species of *Acartia*, *Centropages*, *Temora*, *Calanoides*, *Corycæus*, and *Evadne*.

## Annulata.

**Enigmatical Eunicid.***—P. Fauvel describes a small Polychæte, *Iphitime cuenoti* sp. n., found by Cuénot on a hydroid fixed to the back of a young *Maia squinado* at Arcachon. It was 12 mm. in length by 3 mm. in breadth (including the parapodia) and had when living a curious resemblance to a Nudibranch. It has the head and appendages of *Ophyotrocha*, the setæ of *Staurocephalus*, the parapodia and cirri of *Halla*, the unbranched branchiæ of *Eunice*, and a quite special maxillary apparatus. It is to be placed in beside *Iphitime döderleinii* Marenzeller, a parasite of the branchial region of the giant *Macrocheira kæmferi* of Japan. There is a rounded prostomium with two rudimentary processes; the parapoda are uniramose; there are large foliaceous dorsal cirri; the branchiæ are simple and restricted to a few segments; there are two kinds of cirri; there is a rounded pygidium with two short urites; and there is a unique jaw apparatus.

**Neurofibrils of Leech.**†—G. Ascoli describes networks of fibrils within the giant-fibres of Hirudinea. The networks coalesce to form several strand-like fibrils. According to Cajal's school there are bundles of parallel fibrils. Another point emphasized by Ascoli is, that in the course of the cell-processes there is a neurofibrillar lattice-work independent of the cellular reticulum. Separable neurofibrillar apparatus may be distinguished in the coalescence of the latticed processes from several cells.

## Nematohelminthes.

**New Human Parasite.**‡—Kotaro Jimbo describes *Trichostrongylus orientalis* sp. n., a minute Nematode from the duodenum of Japanese. In some cases it was found in the jejunum and stomach. The male varies from 3·8–4·8 mm., the females from 4·9–6·7; the colour varies from greyish-white to nil. The distinctiveness of the species rests mainly on the characters of the spines, the gubernaculum, and the bursal ribs in the male, and of the post-anal portion of the body and the ovijector in the female. The parasites do not seem to do any harm.

**Occurrence of Oxyuris vermiformis in the Human Vermiform Appendix.**§—J. A. Innes and A. E. Campbell publish the results of an examination of 100 unselected appendices. The object of the investigation was to determine as accurately as possible the number which contained intestinal parasites. They found that the percentage infected

* Arch. Zool. Expér., liii. (1913) Notes et Revue, No. 2 pp. 34–7 (1 fig.).
† Arch. Mikr. Anat., lxxxii. (1913) pp. 414–25 (10 figs.).
‡ Annot. Zool. Japon., viii. (1914) pp. 459–65 (1 pl.).
§ Parasitology, vii. (1914) pp. 189–200.

with *Oxyuris vermicularis* was a fairly high one—17 p.c. for the cases examined. Normal appendices show a much lower percentage of infection. The appendices of children showed a higher percentage of infection than those of adults. The recurrent type of appendicitis is most frequently associated with *Oxyuris* infection, and there is probably a clinical type of *Oxyuris* appendicitis. The suppurative type has practically no relation to *Oxyuris* infection. *Trichocephalus trichiurus* was not found in any of the cases examined.

## Platyhelminthes.

**Studies on Distomidæ.***—G. Mühlschlag has made a study of *Otodistomum veliporum* (Creplin) from Selachians, *Distomum fuscum* Poirier from *Coryphæna*, and *D. ingens* Moniez from a Labrid. He gives an account of the integnment, the musculature, the alimentary, nervous, excretory, and reproductive systems. The third species, *D. ingens*, was represented by three ampulla-like specimens, 35 mm. in length, and 15 mm. in breadth—huge dimensions for a Distome. In a specimen described by Owen in 1834, the dimensions were 54 mm. in length and 21 mm. in posterior breadth.

**Chromatin Changes in Germ-cells of Distomum.**†—Fritz Levy describes the various permutations of the chromatin observed in the spermatogenesis, oogenesis, and fertilization of a species of *Distomum*, which is probably *D. turgidum* Brandes. One of the features in the mitosis is an "amphimetasyndesis" of the chromosomes, not an end-to-end association (metasyndesis) with subsequent folding, nor a parallel association (parasyndesis), but a parallel or strepsitænic apposition, without true zygotænia, followed by a more or less firm union at both ends, forming a ring or cross.

**Endoparasites from Kamtschatka Salmonidæ.**‡—F. Zschokke and A. Hertz report on a collection of Cestodes, Nematodes, and Acanthocephala from species of *Oncorhynchus* (which feeds in sea- but spawns and dies in fresh-water), and from *Salvelinus malma*, which keeps to fresh-water. Among the Cestodes was *Pelichnibothrium caudatum* sp. n. of the "scolex polymorphus" type, which may perhaps attain to a mature strobila stage in some predacious fish. Among the Nematodes was *Dacnitis lævis* sp. n. which has not the cuticular annulation of other species of the genus. Among the Acanthocephala was *Acanthocephale* g.n. with a peculiar shape. It shows a short cylindrical armoured proboscis, a short unarmoured neck, a somewhat bell-shaped anterior body with very numerous minute hooks, and a narrow posterior body at first straight and then curiously coiled. A Myxosporidian, *Henneguya zschokkei* Gurley, was also found in *Oncorhynchus kisutch* (Walb.). The authors make an interesting comparison of the parasites in *Oncorhynchus* and those in the related salmon.

* Zool. Jahrb. Abth. Syst., xxxvii. (1914) pp. 199–252 (2 pls. and 15 figs.).
† Arch. Mikr. Anat., lxxxv. (1914) 2te Abt., pp. 125–34 (1 pl. and 1 fig.).
‡ Rev. Suisse Zool., xxii. (1914) pp. 195–255 (1 pl.).

**Regeneration of Gunda ulvæ.***—D. J. Lloyd has made a series of experiments on the marine Turbellarian, *Gunda ulvæ*, with the object of discovering how far it could be made to undergo variation while regenerating lost parts, and if possible, of correlating the variations with definite physical conditions. It was found that *G. ulvæ* is capable of living indefinitely in water having an osmotic pressure of more than 2 and less than 33 atmospheres. The rate of regeneration of the posterior end in *G. ulvæ* depends on the osmotic pressure of the medium. This osmotic pressure has an optimum value for regeneration at 18 atmospheres, i.e. just below that of sea-water, and limiting values at 5 and 33·5 atmospheres. Restoration of lost parts in *G. ulvæ* is brought about entirely by the undifferentiated parenchyma cells which migrate to the region of the wound and build up the lost parts. For values of the osmotic pressure lying between the optimum and the limiting values, this migration of the parenchyma cells is retarded, and the rate of restoration is retarded to a similar degree. At the limiting values of the osmotic pressure there is no migration of the parenchyma cells, and no restoration of lost parts. Under starvation conditions *G. ulvæ* undergoes reduction. This consists in absorption of the genital system and in reduction in size. Both these are brought about by the activity of the parenchyma cells. During the process of restoration of lost parts the same reduction processes occur as in starvation. Where the restoration of lost parts is retarded, e.g. by raising or lowering the osmotic pressure, reduction is retarded to precisely the same extent. In sea-water or hypertonic solutions removal of the posterior half of the body inhibits further production of sperm. In hypotonic solutions sperms continue to be produced for a varying length of time. In strongly hypertonic solutions examination of the gut cells shows that these have diminished and become more dense. In strongly hypotonic solutions they have increased in size and become vacuolar.

**Thalassema and a New Related Genus.**†—L. D. Wharton describes *Thalassema sorbillans* Lampert, *T. semoni* Fischer, *T. formulosum* Lampert, and *T. griffini* sp. n., all from the Philippines. A full account is given of the body-wall of the new species. It consists of cuticle, epidermis, dermis—the muscular layer, and an endothelium. It is divided into eighteen longitudinal intermuscular spaces, or "intervals," by eighteen longitudinal muscle bundles; and these intervals are again divided transversely into rows of narrow compartments, or "stomata," by septal bands and oblique bundles. An unusually clear diagram is given, of a type which should be imitated. Each of the stomata is connected with the cœlom and filled with cœlomic fluid. The contraction of the muscles accounts for the small square elevations on the skin of the living animal. As the stomata are covered only by the corium and a very thin layer of circular muscle, it seems reasonable to suppose that the stomata are connected with respiration. The details of the dermal muscle layer are useful in classification. A careful account is

* Proc. Roy. Soc., lxxxviii. (1914) pp. 1–27 (16 figs.).
† Philippine Journ. Sci., viii. (1913) pp. 243–70 (2 pls. and 3 figs.).

also given of the minute structure of the food-canal. The author gives a key to all the species of *Thalassema*, and establishes the new genus *Ikeda* for *Ikeda tæniodes* (Ikeda), a Gephyrean of unusually large size (body 40 cm.; proboscis 150 cm.), in which the nephridia are indefinite in number (200–400), not arranged in pairs, and are provided with terminal funnels. The longitudinal muscle of the dermal muscle layer lies on the outside of the circular and oblique layers, not between them as in *Thalassema*.

## Echinoderma.

**Minute Structure of Mesothuria intestinalis.***—W. Haanen gives a full account of the structure of this Holothurian, common in northern seas and in the Mediterranean. He deals with the calcareous bodies in the skin; the cuticle, epidermis, cutis, transverse musculature, longitudinal musculature, and cœlomic epithelium; the blood-cells and non-granular plasma cells, the granular plasma cells, the free excretory cells, and the phagocytes in the gonads.

In connexion with the water-vascular system, Haanen describes the annular canal, the single polian vesicle, the tentacular and radial canals, the ampullæ, and the stone canal. A full account is given of the annular nerve, the radial nerve, the œsophageal nerve, and the innervation of tentacles, tube-feet, and skin. A radial section shows from within outwards, the longitudinal muscle, the radial water-vessel, the radial blood lacuna, the hyponeural canal, the inner and the outer nerve-strands separated by a partition, the epineural canal, connective-tissue, and the epidermis.

The minute structure of the different areas of the alimentary canal is described. There is no convincing evidence that migratory cells are formed in the wall of the respiratory trees. These trees have the same minute structure as the intestine—ciliated cœlomic epithelium, longitudinal muscles, a sparse matrix of connective-tissue, circular muscles, internal connective-tissue, and an internal epithelium of cube-shaped cells. The mesenteries, the various sinuses, and the vascular system—annular, radial, podial, intestinal, and genital—are described. There are no Cuvierian organs. The systematic position of *Mesothuria* is discussed.

**Musculature and Skin of Holothurians.**†—H. Jordan divides Metazoa into two groups according to their mode of locomotion. On the one hand there are "lever animals," such as Vertebrates and Arthropods which have lever-like appendages moved by flexors and extensors. On the other hand, there are bladder-like animals (hohlorganartige or reflexarme), without skeleton, with a wall of smooth muscle fibres (annular and longitudinal). The turgor of the internal fluid takes the place of a firm skeleton. As examples, Gastropods, Lamellibranchs, Ascidians, and Holothurians may be mentioned.

The first main conclusion of Jordan's experimental investigation is that the musculature of Holothurians does not behave as that of a

* Zeitschr. wiss. Zool., cix. (1914) pp. 185-255 (2 pls. and 2 figs.).
† Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 365-436 (9 figs.).

bladder-like animal ought to do. The muscles appear to be unable to give the animal the requisite consistence.

In the cutis of Holothurians there are annular and longitudinal fibres which have a muscular character. They may be regarded as morphologically intermediate between connective-tissue and muscular tissue. The hardening of the skin when irritated is due to a "tonic" contraction of the muscle-like fibres in the cutis. It is a protection against mechanical injury. In *Aplysia* and similar animals the hardening is a necessary secondary result of contraction; in Holothurians the contraction is a necessary but unused secondary result of the hardening. The skin has the tonus-function; the true muscles have no tonus function, but behave like skeletal muscles. In Gastropods and the like the musculature has both a motor function and a tonus function. The Holothurian skin may be compressed by the action of the muscles proper; the cutis fibres "lock": the muscles may relax without losing what they have gained. The skin and muscles proper work together, effecting the characteristic "Sperrung" without "Spannung."

**Fate of Middle Piece of Echinoid Spermatozoon.***—Fr. Meves has followed the middle piece of the spermatozoon after fertilization in the case of *Parechinus miliaris*, and has found it persisting unchanged on to the 32-cell stage. The recognition of this very minute body is rendered possible by its peculiar ring-like shape. It is suggested that the parts of the Pluteus larva which eventually come to nothing are those which have no share in the middle piece of the spermatozoon, and that the middle piece is carried on into those cells which form the primordium of the sea-urchin proper. In any case, the author contends, plastosome-substances from the male germ cell pass into the embryo and must not be excluded from the inheritance.

**Abnormal Sea-urchins.**†—James Ritchie and J. A. Todd give an account of the abnormal Echinoids in the collection of the Royal Scottish Museum. A specimen of *Amblypneustes ovum* had ambulacrum IV separated from the apical disk by about 1 cm. and showed no corresponding ocular plate. A specimen of *Echinus esculentus* showed an almost complete disappearance of ambulacrum V, and there was great derangement and consequent regulation Another test of the same species showed almost perfect hexamery. In this case we have to do with a fundamental change in symmetry, doubtless congenital in origin, and representing a duplication of parts. In the other cases the distortion is due to incomplete development caused by an interference with the processes of growth.

**Crinoid Arms in Phylogeny.**‡—Elvira Wood has studied the arms of several species of camerate Crinoids (*Cactocrinus* and *Teleiocrinus*) with reference to the phylogenetic relations of the species. From the proximal to the distal portion of the arm there may be observed a series of changes which succeed one another in a definite order. These changes

* Arch. Mikr. Anat., lxxxv. (1914) Heft 1, 2te Abt., pp. 1–8 (2 pls.).
† Proc. R. Soc. Edinburgh, xxxiv. (1914) pp. 241-52 (1 pl. and 3 figs.).
‡ Ann. New York Acad. Sci., xxiv. (1914) pp. 1–17 (5 pls.).

may be intrepreted as stages in development, each individual repeating the stages present in its immediate ancestor, and adding, in its distal portion, new characters of its own, until the number of characters becomes too great for representation in the life-history of a single organism, and certain characters, usually the earlier ones, are greatly abbreviated, or are omitted from the ontogeny of highly modified descendants. Thus interpreted, the arms of Crinoids furnish evidence from which the phylogenetic relations of different species and genera can be inferred.

## Cœlentera.

**New British Gymnoblastic Hydroid.***—J. H. Robson describes a new form, found 40 miles north-east of Shields in 45 fathoms, on an old shell of *Volsella modiolus*, and on stones in the tanks of the marine laboratory at Cullercoats. It will probably require a new genus, but the establishment of this will depend on an examination of the adult medusoid. Only very young medusoids were observed. The characteristics of the genus will probably be :—stem simple, unbranched, rooted by a reticulate stolon, invested by a thin perisarc ; zooids entirely naked, elongated, shaped much like a "ninepin," with a single verticil of filiform tentacles around the base of a conical proboscis ; gonozooid a free-swimming medusoid. There is an undeniable resemblance between this probably new Hydroid and *Campanopsis dubia* Stechow with a medusoid of an (*Octorchis*) *Eutima* type, and also with a specimen reared by Claus from an *Octorchis* medusoid. The author also gives a catalogue,† brought up to date, of the Hydrozoa of the north-east coast of England.

**Philippine Alcyonarians.‡**—S. F. Light describes a number of Philippine species of *Capnella*, including *C. philippinensis* sp. n. and several varieties, *C. parva* sp. n. and *C. ramosa*. The following diagnosis of the genus is given. The colony is upright, tree-like or bushy ; the non-retractile polyps are without a "Stützbündel," and are grouped on lobes or scattered singly on branches and twigs ; they are thickly covered with a coat, usually one spicule deep, of minute foliaceous clubs or clubs and spindles ; this covering is continued on to the stem cortex with some changes in the form of the spicules : the canal walls contain numerous spindles, clubs, or cross-shaped spicules ; the canals are numerous and small, with fairly thick walls ; their cavities are sometimes very small or lacking in the centre of the stem, resulting in the formation of an irregular central axis.

## Protozoa.

**Function of Contractile Vacuoles.§**—W. Stempell refers to Hartog's suggestion in 1888 that the contractile vacuole served as a regulator of the osmotic pressure of the cell. The water which would otherwise

* Rep. Dove Marine Lab. Cullercoats, iii. (1914) pp. 104–6 (2 pls.).
† Rep. Dove Marine Lab. Cullercoats, iii. (1914) pp. 87–103 (3 pls.).
‡ Philippine Journ. Sci., viii. (1913) pp. 435–53 (3 pls.).
§ Zool. Jahrb. Abth. Allg. Zool., xxxiv. (1914) pp. 437–78 (5 figs.).

accumulate in Protozoa living freely is passed out by the vacuoles. This view has been upheld by Degen, Burian, Zülzer, and others. Stempell has experimented with *Paramecium*, and has invented a mechanism to illustrate the function of the vacuoles. The waste-products of the metabolism accumulate in fluid form in branched canals leading to the contractile vacuole. When the vacuole empties itself to the exterior, the ends of the canals expand like clubs, the fluid accumulating in areas of least pressure. Fine valves consisting of protoplasmic lamellæ allow the fluid to pass into the vacuole until it is filled. When the pressure of the contents of the vacuole exceeds that of the external water a small opening is formed on a projecting papilla and a second valve occurs there. To the pressure of the protoplasm and the surface-tension of the vacuolar drop is due the complete emptying of the vacuole. The contractile vacuoles doubtless subserve respiration and excretion, but their chief function is the expulsion of the water which has entered by osmosis.

**Studies on Protozoa.***—Bernard Collin describes *Arcella atava* sp.n. which has a single nucleus instead of the usual two or more. Perhaps the species is in this respect primitive. The nucleus is filled with chromatin spherules of variable dimensions. There may be one large one predominating greatly over the others, or two large ones. On the surface of the plumose gill of *Pterotrachea coronata*, Collin found a new ciliated Infusorian—*Syringophora pterotracheæ* g. et sp. n. It has a terminal or sub-terminal mouth, undifferentiated holotrichous ciliation, a dorso-ventral flattening, and a flexion of the axis of symmetry to the left. There is a long tubular pharynx, but there was no hint of food-vacuoles or food-particles, and it may be that the mouth and pharynx have only a fixative function. In the liver of *Carinaria mediterranea*, the author found *Opalinopsis carinariæ* sp. n. Its nucleus may have the form of a twisted band or wreath, or it may be represented by a number of chromatin fragments, or even by chromidial dust. In the receptaculum seminis of the same Mollusc, Collin found *Cryptobia carinariæ* sp. n., with two flagella (each with a basal granule), a large blepharoplast always on the convex surface apposed to the undulatory membrane (sometimes fragmented and vacuolated), and a nucleus with a central karyosome or several granules.

**Nutritive Conditions Determining Growth of Protista.**†—H. G. Thornton and Geoffrey Smith have enquired into the nutritive conditions determining the growth of *Euglena viridis* and various soil Protista. As regards *Euglena*, it was found that in solutions containing no organic matter, it increases very slowly. By the addition of a trace of organic infusion to the solution of inorganic salts, a good growth of *Euglena* can often be obtained. The efficacy of the natural organic infusion in stimulating the growth was very variable. Minute traces of amido-acids added to the inorganic solution had a remarkable effect in stimulating the growth of *Euglena*; stronger solutions of amido-acids were less

* Arch. Zool. Expér., liv. (1914) Notes et Revue, No. 4, pp. 85–97 (5 figs.).
† Proc. Roy. Soc., Ser. B, lxxxviii. (1914) pp. 151–65 (1 pl.).

successful owing to the rapid development of bacteria in the medium. It seems that *Euglena* does not live saprophytically on the amido-acid, since it cannot be made to thrive in the absence of light.

As to soil Protozoa, such as *Prowazekia terricola*, it was found that, as compared with *Euglena*, they are able to live in cultures to which organic compounds of very varying nature have been added. This comparative impartiality is the result of the holozoic mode of nutrition, the development of Flagellates being absolutely dependent on the bacterial growth. The presence of Miquel salts in the solution is necessary for the growth of the soil Flagellates and for the proper development of the Bacteria on which they feed. The Flagellates can be fed on various kinds of Bacteria.

**Japanese Fresh-water Protozoa.***—C. H. Edmondson and R. H. Kingman report on a collection from lakes, streams, small pools, and rice fields. The list includes species of *Hyalodiscus*, *Centropyxis*, *Lecquereusia*, *Nebela*, *Campascus*, *Paulinella*, etc. among Amœbidæ; *Actinophrys sol* among Heliozoa; species of *Notosolenus*, *Anthophysa*, *Euglena*, *Trachelomonas*, etc. among Flagellata; species of *Coleps*, *Chilodon*, *Stentor*, *Gyrocoris*, *Stylonichia*, *Aspidisca*, *Vorticella*, etc. among Ciliata; and *Sphærophrya magna* Maupas among Suctoria.

**Four Species of Gregarine from one Species of Beetle.**†—S. Ishii found in the intestine of *Trebolium ferrugineum* four polycystic Gregarines—*Gregarina cuneata* F. Stein, *G. minuta* sp. n. (with a small ovoid protomerite, which, in the satellite of two individuals in syzygy, is not infrequently hidden from view, being entirely embedded in the deutomerite of the primite), *G. crassa* sp. n. (with a very small protomerite, always broader than long, usually not visible in the satellite), and *Steinina obconica* sp. n., with a half-moon-shaped protomerite and an obconical deutomerite.

* Annot. Zool. Japon. viii. (1914) pp. 531–42 (1 pl.).
† Annot. Zool. Japon. viii. (1914) pp. 435–41 (4 figs.).

# BOTANY.

## GENERAL,

### Including the Anatomy and Physiology of Seed Plants.

### Cytology,

#### Including Cell-Contents.

**Chondriosomes in Fungi.***—G. Lewitsky publishes a preliminary account of his discovery of chondriosomes in Fungi. In the plasma of the hyphæ of *Albugo Bliti* are small bodies of variable form, either round, thread or rod-like, or dumb-bell shaped. Similar bodies are also found in the conidia and in all stages of the development of the oogonium and oospore; their morphological and microchemical characters are such as prove them to be identical with the chondriosomes found in higher plants and in animals. From a study of the development of the oogonium it appears that a yellow secretion is formed in the interior of a few chondriosomes. Through the activity of the enclosing layer of mitochondrial substance the yellow secretion increases until the chondriosome is converted into a mass of yellow granules, which are eventually thrust out into the vacuoles of the plasma, but the manner of their further growth is uncertain. In addition to these bodies many smaller granules are visible, which apparently develop into full-sized chondriosomes to take the place of those previously transformed into yellow granules. In the oospore the yellow granules are replaced by yellow spheres, but at present it is impossible to explain the nature of either of these bodies.

**Chromatophores and Chondriosomes of Anthoceros.**†—A. Scherrer has studied the chondriosomes and the chromatophores of *Anthoceros*. This is the first Liverwort in which it has been possible to demonstrate the presence of chondriosomes, but the latter cannot be shown to have any connexion with the formation of chromatophores, and they are also independent of the nucleus. They do not appear to take any share in the building up of the cell-contents, but their accumulation and production in certain regions, e.g. in the spore-mother-cells, seem to indicate some function connected with the physiology of nutrition. They remain unchanged during mitosis, and there is no indication of any division during division of the nucleus. Chemical reagents give no definite result as to their chemical composition, but their amœboid changes of form point to a fluid structure.

It appears that the chromosomes preserve their morphological individuality throughout the whole development of the sporophyte and gametophyte, and that they multiply exclusively by fission. The egg-

* Ber. Deutsch. Bot. Gesell., xxxi. (1913) pp. 517–28 (1 pl.).
† Flora, vii. (1914) pp. 1–56 (3 pls.).

cell and spores have a well-developed chromosome at every stage of their development, but the male cells have no chromosomes. The chromosomes of *A. Husnoti* and *A. punctatus* contain pyrenoids of a distinctive character, consisting of a varying number of separate granules; these chromatophores may be regarded as transition-forms between those having no pyrenoids and those containing simple pyrenoids, which are characteristic of some species of *Anthoceros*.

**Mitochondrias and their Transformation into Plastids.*** — A. Guilliermond discusses the results of recent investigations concerning the nature and function of mitochondrias. The opinion that these bodies have no real existence, but are the result of experimental methods, is shown to be incorrect, for both simple mitochondrias and chondriokonts can be distinctly seen in the living epidermal cells of *Iris germanica*. The flower of the same plant also shows all stages of transition between chondriokonts and amyloplasts; it can also be proved that chromoplasts of carotin and xanthophyll owe their origin to mitochondrias. The iodin-test indicates the presence of starch in the interior of living mitochondrias, thus proving that starch is a direct product of their activity.

Mitochondrias have well-defined morphological and histochemical characters and definite physiological functions. Their simplest morphological structure is that of granules isolated or in chains; the more characteristic form is that of little rods. The chemical characters appear to indicate the presence of an albuminoid substratum saturated with lipoids. Their origin is uncertain, but there is ample evidence that they multiply by fission. The only physiological function of which there is definite proof is that of secretion of a very varied character. They appear to correspond to the mitochondrias of animal cells, where they are organs of the same rank as the nucleus, being present in all secretion-phenomena and perhaps playing a part of the highest importance in the differentiation of the cell. They are of equally wide distribution in the plant-world, and there is every indication that their secretive function is as varied as in animal cells.

**Mitochondrias of Higher Plants.†**—A. M. Löwschin has studied the mitochondrias of higher plants, and now publishes a preliminary paper dealing with results of experiments performed in order to discover the connexion between the number of mitochondrias and conditions of illumination, assimilation of $CO_2$, etc. The author finds that there can be no doubt as to the existence of mitochondrias in the leaves of higher plants. In the palisade-parenchyma they are almost always granular, but under abnormal conditions, e.g. in the dark, chondriokonts may be found. In the spongy parenchyma there are granular or rod-like mitochondrias or chondriokonts. In the conducting tissues the latter form is the most common. In the epidermis all three forms occur, but chondriokonts predominate and often reach a considerable size. In some species, e.g. *Quercus pedunculatus*, they are absent under normal conditions, but appear in the dark. In a few plants, e.g. *Selaginella Martensii*,

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 282–301 (2 figs.).
† Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 266–70 (2 pls.).

*Corylus Avellana*, they appear to be almost or entirely absent. Exposure to darkness has no effect on such plants, but in all others the change in the chlorophyll-granules is accompanied by accumulation of granular mitochondrias in the cells. The effect of darkness upon *Populus tremula* was rather remarkable. At the end of a fortnight there was a decrease in the number of mitochondrias, while the chlorophyll-granules became round and grouped themselves in balls; when restored to normal conditions both chlorophyll-granules and mitochondrias resumed their normal shape and proportion, but the latter showed a tendency to arrange themselves in pairs, although there is no proof of any increase in number as the result of division. There is no connexion between $CO_2$-assimilation and the number of mitochondrias in a leaf. Seedlings which had been kept in water for twenty-four hours had small bodies in the cells of their cotyledons which resembled chondriosomes, and similar bodies were observed again at the end of four days. In *Elodea canadensis* the chondriosomes strongly resemble bacteria. The author is unwilling at present to draw any conclusions from his experiments as to the nature of mitochondrias.

**Statolith-theory.***—E. Richter contributes a preliminary note dealing with an experiment bearing upon the Statolith-theory. The author has modified Buder's experiment in two ways, viz. (1) by arranging that the first period of attraction was shorter than the time of presentation, the antagonistic attraction at the beginning of the experiment was avoided; (2) the roots were rotated on the klinostat in two different positions, so that in one position they were subjected to an intermittent attraction on one side, while in the other position the attraction was still one-sided but continuous. It is also shown that the method of rotation of the klinostat must be taken into account when the time of presentation is modified. The results of the present experiment agree with those obtained by Buder, and the author finds himself unable to explain them except by the Statolith-theory.

**Tannin-idioblasts in Mesembrianthemum.*** — O. Oberstein finds that the leaves of certain species of *Mesembrianthemum* contain a large number of tannin-idioblasts. Such formations have hitherto been wrongly described as mucilage-cells, etc., but chemical reactions leave no doubt as to their true nature. Observations made by the author upon cultivated species induce him to agree to some extent with those authors who regard the presence of tannin as a protective device against the attacks of certain animals to which the plant would otherwise fall an easy prey; it is found that slugs and snails do not attack those species of *Mesembrianthemum* where tannin-idioblasts are present in the leaves. The author confirms Volken's theory as to the intimate connexion between the conducting tissues and the tannin idioblasts; he also draws attention to the regularity in the arrangement of the latter, which occur in greatest numbers in the sub-epidermal layer, being more or less per-

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 302–8.
† Beih. Bot. Centralbl., xxxi. (1914) pp. 388–93 (2 pls.).

pendicular to the leaf-surface, between the secondary bundles and the assimilatory zone. The regular arrangement allows free access of light to the aqueous tissues, and is only found where tannin is present; if the cells contain simple mucilage, they are much more irregular. This fact appears to support the popular view that the chief function of aqueous tissue is the improved illumination of the interior of the leaf.

## Structure and Development.

### Vegetative and Reproductive.

**Cell-arrangement.***—F. Neeff has studied the changes in the arrangement of the cells resulting from decapitation of the main shoot. The following species were studied—*Tilia americana*, *T. platyphyllos*, *Æsculus Hippocastanum*, *Acer platanoides*, *Salix babylonica*, *Picea excelsa*, *Populus pyramidalis*, *Ricinus communis*, and *Phytolacca icosandra*. Investigations show that a series of changes takes place in the cambium of the nearest lateral branch, in the zone adjoining its attachment. The cambium-cells divide by short cross-walls to form wood and bast parenchyma, but the new growth is in the direction of the lateral branch. The short cambial elements give rise to large bundles, which run more or less transversely; fusion then takes place, usually by the absorption of longitudinal walls, and thus it is possible for the wood of the main stem to supply water to the lateral branch. Analogous changes take place in the sieve-tubes. Subsequent cambial growth results in the formation of wood and bast, which from the first is in the new direction, and in which the normal fusion by the absorption of transverse walls is again resumed. Similar changes result from wounding of the main axis; while if both decapitation and wounding occur in close proximity, the formation of new tissues is accelerated. In the case of wounded tissues, new vascular strands are formed transversely, so as to unite the normal strands which run longitudinally on each side of the wound. In the case of completely inverted plants the polarity of the tissues is likewise inverted, so that the cambium gives rise to root-structure in the former apical region, and vice-versâ. This change in the direction of the tissue formation is accompanied by a sliding growth of the individual cells, during which the protoplasmic connexions are severed, and each cell has a relative independence of movement; as new tissues are formed, however, this independence disappears, and new protoplasmic connexions are formed with adjacent cells. The author agrees with Vöchting as to the less definite polarity of young parenchyma-cells, and upon this fact bases a new theory, according to which the cambium in the neighbourhood of a wound functions as a growing-point, which gives off new cells in all directions, capable of responding to a new polarity; in this way the changes described above are perfectly comprehensible. In conclusion, it is shown that, since neither interruption of the flow of water nor of food-materials can alone bring about change of direction in the formation of new tissues, this change must be due to some property inherent to the contents of the cambium-cells.

* Zeitschr. Bot., xvi. (1914) pp. 465–547 (2 pls. and 32 figs).

**Growth of Root-tip.***—H. Lundegärdh finds that there is a certain definite relation between the condition of nuclear division and the rapidity of growth of the cell. The increase in volume of the nucleus which takes place during spireme-formation is accompanied by a definite, although relatively smaller increase in size of the cell. Thus, activity of growth may be expressed by the ratio between the number of spireme and metaphase stages and the number of nuclei in a given group of cells. By means of this ratio it has been proved that the growth-activity of the periblem is less than that of the plerome, but greater than that of the dermatogen; also that growth-activity in the central zone is greater than in the periphery, being especially great in the region of the calyptrogen. It is also shown that cell-division is rhythmic, adjacent cells exhibiting successive stages of division. In order to reconcile the unequal growth of the periblem and plerome it is supposed that a sort of sliding growth takes place, whereby some of the outer daughter-cells of the plerome become part of the periblem. Adjustment of the tissues is also facilitated by the plasticity of the cell-walls, which enables them to alter their shape in accordance with varying pressures and tensions, while the closely packed cells of the hypodermis and epidermis act as an external support to the cell-displacement. This theory as to the sliding-growth of meristematic tissues is in accordance with the periclinal growth of Sachs' theory.

**Lactiferous Vessels and Cells.**†—R. Kōketsu has studied the functions of lactiferous vessels and cells in various Japanese species belonging to the Compositæ, Campanulaceæ, Convolvulaceæ, Asclepiadaceæ, Apocynaceæ, Euphorbiaceæ, and Papaveraceæ. The chief results obtained are as follows: Earlier descriptions of the structure, course and localization of lactiferous vessels and cells are found to be correct. No true anastomosis of unjointed lactiferous vessels is ever found, but the latter traverse the mesophyll without any distinct connexion with neighbouring cells, and often end blindly. The sieve-tubes of fleshy organs sometimes exhibit a reduction in the number of sieve-plates, although frequently both the conducting parenchyma and the sheath of the vascular bundle is quite normal, while the lactiferous system is most highly developed. The chief lactiferous vessels usually occur in storage-tissue and are often surrounded by epithelial cells, so that it is probable that the lactic fluid is formed at the expense of the organic compounds contained in the storage-tissue. Flowers and their bracts and peduncles have a specialized lactiferous system.

The lactic fluid is of a viscous nature, especially when highly emulsified; the taste is unpleasant. It is more or less acid and contains a variable amount of sugar and albumen, but the chief constituents appear to be caoutchouc, resin, or similar substances; the most abundant inorganic constituents are magnesium and potassium, and peroxidases are common. In addition to the lactic fluid the vessels and cells also contain protoplasm and nuclei, while leucoplasts are not uncommon.

The author is unable to find any reason for regarding the lactic fluid

* Ber. Deutsch. Bot. Geseli., xxxii. (1914) pp. 77–83 (3 figs.).

† Journ. Coll. Sci. Tokio, xxxv. (1913) pp. 1–57 (3 pls. and 2 figs.).

as a food-material, especially in view of the fact that useless substances such as resin, alkaloids, etc. are far in excess of sugar, starch, albumen, etc. There is no direct evidence as to the true function of the lactic fluid, although in one case at least, it appears to have the power of closing up wounds, but the frequency of poisonous and unpleasant substances, together with the distribution of the vessels in flowers and fruits, induce the author to agree with Kniep in believing that the primary function rests not upon physiological but upon ecological grounds.

**Anatomy of Mesozoic Conifers.***—R. Holden publishes a second paper dealing with the cretaceous lignites of New Jersey. The author has studied the anatomic structure of *Araucarioxylon*, *Brachyoxylon*, and *Cupressinoxylon* with special reference to the phylogeny of the Coniferales, and her chief results are as follows: an *Araucarioxylon* from the Raritan cretaceous beds has bars of Sanio near the pith of the stem, resembling those of the cone-axis of living Araucarineæ. The *Cupressinoxyla* lack cellulose bars of Sanio and may therefore be regarded as a new genus—*Paracupressinoxylon*. Three typical *Pityoxyla* but not one typical *Araucarioxylon* were found among these lignites, a fact which seems to indicate that living Abietineæ resemble their ancestors in all respects, while the Araucarineæ have become less like those of past times. All the Araucarineæ have exactly the same wood-structure as the Abietineæ down to the smallest and most unimportant details; the anatomy of the strobilus exhibits a reduction of the female cone precisely similar to that of various cupressineous and taxodineous genera, and one Mesozoic Araucarian (*Voltzia*) had a double cone-scale resembling that of *Cryptomeria*. Thus it would appear that Conifers, as a whole, are derived from the same ancestral stock, and that the Abietineæ are more like that stock than the Araucarineæ.

**Morphology of the Leguminosæ.**†—J. N. Martin has made a comparative investigation of the development of the embryo-sac, embryo, and endosperm of *Trifolium pratense*, *T. hybridum*, *T. repens*, *Medicago sativa*, and *Vicia americana*. All five species resemble one another in the following features: (1) the ovules are campylotropus; (2) two integuments are present, the outer of which develops first; (3) the archesporium is multicellular; (4) there is one parietal cell which divides to form more or less parietal tissue; (5) the megaspores are produced in a row of four; (6) the nucellar tissue rapidly breaks down, thus bringing the embryo-sac into contact with the inner integument; (7) the antipodal cells are transitory. They differ in the following respects: (1) in *T. pratense* there are always two ovules, but more in the other species; (2) in *T. repens* the third megaspore is sometimes functional; (3) in *Trifolium* the antipodal end of the nucellus breaks down to form a tubular sac; (4) in *Trifolium* the embryo-sac is always vacuolate, but in *Vicia* and *Medicago* it is filled with cytoplasm; (5) the place of meeting of the polar nuclei and their distance from the egg-

* Bot. Gaz., lviii. (1914) pp. 168–77 (4 pls.).
† Bot. Gaz., lviii. (1914) pp. 154–67 (4 pls.).

apparatus differ in the three genera but are fixed for each species: (6) starch fills the sac in *Medicago* but is confined to the micropylar end of the nucellus and the inner integument in the other genera: (7) in *Trifolium* the pro-embryo is short and massive and more or less ill-defined; (8) in *Medicago* and *Vicia* the suspensors are well-defined with multinucleate cells; in the former it is filamentous, in the latter it is composed of two superimposed pairs of cells: (9) sterilization is most pronounced in *T. pratense*.

**Embryo-sac of the Convallariaceæ.***—F. McAllister has studied the development of the embryo-sac in the Convallariacæ, and finds that in *Polygonatum* it is formed from one reduction-nucleus, in *Smilacina racemosa*, *S. amplexicaulis*, and *Streptopus roseus* from two such nuclei, and from four in *Smilacina stellata*, *S. sessifolia*, *Maianthemum canadense*, and *Medeola virginica*. Wherever more than one nucleus takes part in the formation of the embryo-sac, the nuclei are at first separated by cell-walls, varying from split cell-plates in *Smilacina stellata* to temporary cell-plates in *Medeola virginica*. This separation does not affect the morphology of the cells, which are all megaspores. Thus it appears that all reduction-nuclei formed from the nucleus of the megaspore-mother-cell, whether separated for a time or not at all, are to be regarded as megaspore-nuclei. In six of the eight species studied two megaspore-mother-cells were sometimes found.

**Sexuality of Humulus.**†—J. Tournois has studied the problems connected with sexual reproduction in *H. Lupulus* and *H. japonicus*. The time of the appearance of the flowers is closely connected with external factors, e.g. variations in illumination induce corresponding variations in the duration of the purely vegetative period, and in *H. japonicus* flower-formation has been considerably hastened by reduction of the daily time of exposure to sunlight. Both species of *Humulus* are normally diœcious, the sexes being confined to different plants, but it is not unusual to find both sexes on the same plant; when this is the case, however, with *H. Lupulus*, the male and female flowers are rarely fertile at the same time. In *H. japonicus*, monœcious forms of two kinds have been observed, viz. some of spontaneous origin and others induced by well-defined experimental conditions. The most remarkable results were obtained with plants grown in winter, in which progenetic inflorescences were produced; in this case the male branches were sometimes transformed in such a manner as to function as monœcious, or even as almost exclusively female plants. All the monœcious inflorescences of both species of *Humulus* were of the same morphological type, viz. a biparous cyme of male flowers, the branches of which terminated in clusters of female flowers. The same conditions which in *H. japonicus* induce the transformation of male into monœcious plants, can also cause the production of stigmata or sterile carpels in male flowers, either by substitution for or superposition to the male organs. Diminution of transpiration is a most important factor in producing such transforma-

* Bot. Gaz., lviii. (1914) pp. 137–53 (2 pls.).
† Ann. Sci. Nat., xix. (1914) pp. 49–191 (5 pls. and 23 figs.).

tions, but any condition which tends to decrease osmotic pressure, may cause male plants to produce female organs; conversely, but far more rarely, increase of osmotic pressure will bring about the formation of female organs.

There is no proof that seeds are ever formed in *H. Lupulus* in the absence of fertilization, for in spite of the absence of a micropyle, the pollen-tube can penetrate the ovular tissues as far as the embryo-sac. It is possible, however, for seeds to form under the influence of foreign pollen, such as that as of *H. japonicus* and of the Hemp, but such seeds have only abnormal and abortive embryos. In the former case true fertilization occurs, but in the latter case development is the result of simple contact between the pollen-tube and the oosphere, there being no true fusion. Fertilization is not necessary for the development of the fruit of *H. Lupulus*, but it causes greater activity in growth. In conclusion, the author points out that these experiments with *Humulus* show that it is possible to modify the sex of diœcious plants, but that changes of sex thus produced are limited to a small proportion of individuals, while in the greater number the changes are neither complete nor definite. Also, that it is possible to bring about abortive developments of the female gametes of plants comparable to those obtained in such animals as sea-urchins, and it is probable in both cases that arrested growth is due either to deficiency of male chromatic substance or to an excessively heterogeneous chromatic association.

**Projection of Seeds of Oxalis.***—V. Royale has studied the mechanism by means of which the seeds of *Oxalis* are projected from the fruit. The author finds two reasons for disagreeing with those writers who maintain that projection is due to the structure of the outer integument of the seed. In the first place, the structure of this integument is identical with that of the seed of *Biophytum*, where no such projection occurs; secondly, in almost every instance the seed retains its integument after projection. The present investigations prove that the seed is first detached from the fruit by the breaking down of the suberized tissue at the point of attachment of the seed to the fruit-wall. The seed then becomes enveloped in a thick layer of mucilage, which, by its turgescence, projects the seed through the suture of the carpels. Thus the external integument plays no part in the projection which depends directly upon the periseminal mucilage and indirectly upon the structure of the carpels.

## Physiology.

### Nutrition and Growth.

**Influence of Water on Roots of Trees.***—G. Boudois has studied the modifications in the morphology and anatomy of roots of trees growing by the water-side, where the roots are actually growing in water. The author finds that under these conditions the rapidity and extent of growth of the primary roots is greatly increased, while the

* Ann. Sci. Nat., xviii. (1913) pp. 25–33 (8 figs.).
† Ann. Sci. Nat., xviii. (1913) pp. 1–24 (9 figs.).

rootlets also increase in size and number; the absorbent root-hairs disappear, but the root-cap is well developed; no mycorhizal swellings are ever present. Such roots are frequently coloured owing to the presence of chlorophyll and other pigments. The anatomy also undergoes considerable modification; the thickness of the bark is relatively much increased and the piliferous layer disappears; lacunæ are formed in the cortex, while the latter, together with the medullary rays, undergoes lignification; the number of vascular bundles is greatly reduced. The secondary roots are characterized by the relative abundance of the lenticels and the diminution in the number of vascular bundles and amount of sclerenchyma and other supporting tissues.

The action of water rests upon two factors, viz. its physical and its chemical properties. Thus, its homogeneity produces equality and symmetry of growth, and the support afforded to the roots causes, on one hand, a reduction in supporting tissues, and, on the other, a formation of lacunæ, whereby the root is enabled to float more freely. The solvent property of water facilitates the absorption of food-materials, and consequently causes a reduction in the absorbing and conducting tissues; also, since absorption can take place at any part of the root-surface, lenticels are abundant.

## CRYPTOGAMS.

### Pteridophyta

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

**Macroglossum.***—D. H. Campbell publishes notes on the structure of *Macroglossum*, a new Marattiaceous genus described by E. B. Copeland in 1909, and containing one species, *M. Alidæ*. Campbell finds a second species in the type plant of *Angiopteris Smithii* Racib., cultivated in the Buitenzorg botanic garden, but of unknown origin. The latter is a somewhat smaller species. The fronds of *Macroglossum* are upright and simply pinnate; those of *Angiopteris* are broad-spreading and bipinnate. In habit *Macroglossum* much resembles the larger species of *Danæa*. Campbell describes and figures the structure of the lamina, indusium, sorus, sporangium, and annulus of *Macroglossum*, and contrasts them with those of *Angiopteris* and other genera.

**Vittaria.**†—R. C. Benedict publishes a revision of the genus *Vittaria*. Having in a previous paper (in 1911) discussed the morphological features of the tribe Vittarieæ, and indicated the probable relationships of the genera, he now treats of seven species comprised in his subgenus *Radiovittaria*, which is characterized by its radial stem structure and leaf arrangement, as well as the specialized collenchyma. He has found it necessary to study the plants microscopically and make sections of the stems and leaves. It is then seen that there are very considerable differences in the outline of the transverse sections of the leaf,

* Philippine Journ. Sci. (Bot.) ix. (1913) pp. 219–25 (1 pl. and figs.).
† Bull. Torrey Bot. Club, xli. (1914) pp. 391–410 (6 pls. and figs.).

petioles, and laminæ, in the arrangement of the vascular tissues in the stem and petioles, and in the kind of cortical tissue developed. The scales which cover the stems and leaf-bases often show well-marked differences in cell structure; and important differences may be found in the shape of the spores and paraphyses. He supplies a key to the species of *Radiovittaria*, followed by revised specific descriptions. *Vittaria latifolia* and *V. Williamsii* are novelties from Bolivia.

**Sumatra Ferns.***—E. B. Copeland publishes descriptions of the characteristic structure of fourteen new species of ferns collected by C. J. Brooks at Lebong Tandai, Benkoelan, Sumatra. He is of opinion that the floras of Borneo and Sumatra are more closely related than has hitherto been supposed.

## Bryophyta.

(By A. Gepp.)

**Morphology of Pallavicinia.**†—D. H. Campbell and F. Williams publish a morphological study of three species of *Pallavicinia* collected in Java—namely *P.* (*Mittenia*) *Zollingeri*, *P. radiculosa*, and *P. Levieri*. In summing up their results they say: 1. The thallus in the two sections of the genus differs in two respects. In section *Eupallavicinia* or Procumbentes the wings are one-cell thick throughout; in section *Mittenia* or Dendroideæ the midrib merges gradually into the wings, as is also the case in *Mörkia* and *Calycularia*. In *Mittenia* also there is a marked difference between the prostrate, rhizome-like portion of the thallus and the upright fan-shaped green branches; and the formation of adventitious branches from the rhizome is more common than in *Eupallavicinia*. 2. The apical cell of the three Javan species is two-sided, as in *Aneura* or *Metzgeria*. *P. decipiens*, a Ceylon species, has a three-sided prismatic apical cell. In *P. cylindrica* the apical cell may be two-sided; and in *P. Lyellii* it is two-sided according to Leitgeb. 3. The hooked marginal teeth of *Mittenia* are probably comparable to the leaf-like lobes of certain species of *Symphyogyna*, and, like them, bear a definite relation to the segments of the apical cell. 4. The position of the antheridia in the three Javan species studied differs somewhat from the descriptions given by Schiffner. In *P.* (*Mittenia*) *Zollingeri* they cover the whole surface of the midrib, as they do in *Mörkia*. In the Ceylonese *P. decipiens* they are said by Farmer to form a row on each side of the midrib. In *P. Levieri* they occur in a row on each side of the midrib, and not on its upper side. In *P. radiculosa* the groups of antheridia are separated by sterile areas. 5. The development of the antheridium is much the same in all the species—the usual type found in Jungermanniales. 6. The spermatogenesis corresponds to that of other Hepaticæ. A delicate membrane separates the pairs of spermatocytes as in *Fossombronia* and *Calycularia*. A "Nebenkörper" may perhaps be present, as in *Marchantia* and *Fossombronia*. Woodburn

* Philippine Journ. Sci. (Bot.) ix. (1913) pp. 227–233.

† Leland Stanford Junior Univ. Publications (California, 1914) 44 pp. (23 figs.).

believes that it is not present in the spermatozoid. The number of chromosomes is probably eight. 7. The archegonial receptacle is smallest in *P. Zollingeri*, largest in *P. radiculosa*. In the latter species the archegonium shows a limited apical growth due to the activity of the cover-cells. 8. The embryo of *Pallavicinia* is much like that of other Anacrogynæ, and is perhaps most like that of *Aneura* in the development of a very large haustorial organ, or suspensor. In this respect the three Javan species seem to differ a good deal from *P. decipiens* and from *Mörkia*. *P. Zollingeri* is nearest to *Mörkia* in the form of the capsule and the larger foot. 9. In the structure of the capsule the three species are alike. The capsule has a more or less conspicuous terminal beak or pad, which remains intact, so that the four valves of the open sporogonium remain attached to each other at the apex, dehiscence taking place by four longitudinal slits. The beak is best developed in *P. radiculosa*, in which the capsule is more elongated. The much shorter and relatively broader capsule of *P. Zollingeri* recalls *Mörkia* or *Calycularia*. *P. Zollingeri* also resembles the latter in the tuberculate spores. In *P. radiculosa* and *P. Levieri* the spores are reticulately marked.

In conclusion, the authors regard *P. Zollingeri* as approaching *Mörkia* in respect of structure, and are on the whole inclined to retain the generic name *Mittenia* for the dendroid species of *Pallavicinia*, leaving the section *Eupallavicinia* to be transferred to *Blyttia*. They are also of opinion that the production of reproductive organs upon special branches, which appears to be the only constant difference between the Aneuraceæ and Blyttiaceæ, seems hardly of sufficient importance to warrant the establishment of two separate families.

**Fegatella without Air-chambers.***—Annie C. Maybrook publishes a note on a colony of *Fegatella* found in a moist little cavern in a high hedge-bank, which showed air-chambers dwindling to nothing. The absence of air-chambers is presumed to be due to the combined effect of darkness and moisture. Thalli growing in decreasing intensities of light revealed a gradual decrease in the number of air-chambers per unit of surface area, and in the size of those air-chambers. The final disappearance, however, seems to be dependent on the factor of moisture, for only in those forms showing marked adaptations to a moist habitat were the air-chambers totally lacking. Figures of the thalline structure and the reduced chambers are given. Suppression of the air-chambers in *Fegatella* does not appear to have been noticed previously.

**Xerophytic Adaptations of Bryophytes.**†—W. Watson has for several years studied the xerophytic adaptations of bryophytes in relation to habitat, and publishes the results of his observations. He classifies the structures concerned under the following headings:—I. Protective arrangements in the sporogonium: (1) Immersion of capsule; (2) length of seta; (3) curvature of seta; (4) papillosity; (5) bell-shaped calyptra; (6) hairy calyptra, etc.; (7) position of stomata; (8) plication of capsule; (9) fleshy or bulbous involucre.

* New Phytologist, xiii. (1914) pp. 243–9 (figs.).
† New Phytologist, xiii. (1914) pp. 149–69, 181–9 (figs.).

II. Protective arrangements in the gametophyte: A. Reduction of water output: (1) Cushion-forming habit; (2) investments of dead or non-chlorophyllous cells; (3) shape of leaf or thallus; (4) size of leaf-cells; (5) thickenings of leaf-cells; (6) stem structure; (7) arrangement of leaves on stem; (8) capillary structures; (9) vegetative methods of reproduction. B. Water-storage methods: (1) Water-sacs; (2) water-storing cells; (3) mucilaginous cells; (4) hypogæal tubers, etc.; (5) succulent tissue. In conclusion, he says that some xerophytic adaptations found in bryophytes occur also in vascular plants, but many are peculiar to the group. Many plants mentioned as exhibiting "xerophytic" devices are not really xerophytes, but by means of the devices are enabled to live under less moist conditions than would be possible otherwise.

**Aitchisoniella, a New Himalayan Hepatic.***—S. R. Kashyap publishes morphological and biological notes on new and little known West Himalayan liverworts. Some thirty liverworts were gathered at Mussoorie in the summers of 1912, 1913, and among them three new genera and eleven new species. In the present paper the following are described and discussed, figures of the structure being given in illustration of the text:—*Cyathodium tuberosum*, new species; *Targionia hypophylla* L. var. *integerrima*, new variety; *Aitchisoniella himalayensis*, a new genus and species related to *Targionia*.

**New Indian Mosses.**†—H. N. Dixon reports on the mosses collected by I. H. Burkill during the Abor punitive expedition (1911–12) in the Himalayas north of Assam. Forty-two species are recorded; and among them are six novelties (five species and one variety), the characteristic structure of which is described and figured. Some of the other species are of considerable interest from the distributional point of view.

The same author ‡ gives an account of fifty-eight mosses collected in the south of India and in Ceylon by C. E. C. Fischer and others. Among them are five new species and three new varieties, the structure of which is described and figured.

## Thallophyta.

### Algæ.

(By Mrs. E. S. Gepp.)

**Plankton of Richmond River, N.S.W.**§—G. I. Playfair gives an account of the plankton of the Richmond River and tributary creeks, principally in the neighbourhood of Lismore. The outstanding feature of the flora is its richness in Diatoms. The Desmid flora is also extraordinarily rich and there is a considerable number of Myxophyceæ. Phytelieæ and Peridinieæ are absent. Though the Chlorophyceæ total

* New Phytologist, xiii. (1914) pp. 206–25 (figs.).
† Records Bot. Survey India, vi. (1914) pp. 57–73 (2 pls.).
‡ Records Bot. Survey India, vi. (1914) pp. 75–89 (2 pls.).
§ Proc. Linn. Soc. N.S.W., xxxix. (1914) pp. 93–151 (8 pls.).

up well, in the fresh gatherings they were very poorly represented indeed, both in species and numbers. The total number of organisms in the flora amounts to 305, of which 81 are here described as, to a greater or less extent, new forms. Critical notes are appended to most of the records.

**Chlamydomonas.***—M. W. Spargo writes on the genus *Chlamydomonas*, her purpose being to bring together comparatively a number of the American species and to correlate them so far as possible with the better known European species. After a histological discussion of the genus, she describes her technique, which proves satisfactory. A new marine species is then described, *C. Moorei*, from Woods Hole, Mass. As regards the cilia on a cell of *Chlamydomonas*, the author finds that their number is not a definite specific character, but depends on circumstances which have not yet been determined. Also she holds that *Carteria* Diesing should no longer be considered a genus, since its single hitherto differentiating character has been shown to vary in the same species. She believes that the stigma of *Chlamydomonas* is a disk-shaped body, the various shapes ascribed to it by authors depending on the various positions of the cell when being examined. The use of the position of the pyrenoid in relation to the longitudinal axis of the cell as a systematic character is an error, as the pyrenoid is in the chromatophore, which does not fill the centre of the cell, but extends around the cell, within the membrane. Remarks are made on physiological experiments. Eleven species are described, of which three are new.

**British Diatoms.**†—N. E. Brown describes some diatoms found during a holiday at Tenby. Two species among them were *Toxonidea Gregoriana* and *T. madagascarensis*, the latter a new record for Britain. This is figured. Other species found were *Pleurosigma lanceolatum*, *Donkinia recta*, *Amphora obtusa*, and *Nitzschia virgata*. The author discusses the diamond-dotting of these species, which has been incorrectly described. His own careful and exact measurements show the number of striæ on his specimens to be about as follows:—*Toxonidea Gregoriana* 48,000–52,000; *T. madagascarensis* 56,000; *Pleurosigma lanceolatum* 56,000–60,000; *Donkinia recta* 60,000–64,000; *Amphora obtusa* 64,000. He points out that the striæ on *A. obtusa* are very difficult to resolve with a dry lens.

**Polymorphism of certain Antarctic Diatoms.**‡—L. Mangin writes on the polymorphism of certain Antarctic diatoms collected during the second French expedition in the 'Pourquoi-pas?' The first instance he gives is that of his new species *Biddulphia polymorpha* observed by Van Heurck in material collected by the 'Belgica.' Van Heurck described several species and varieties, which according to Mangin are but forms of one and the same species, *B. polymorpha*. This is amply proved by the presence of several of the so-called species in the same chain. The

* Washington Univ. Studies, pt. 1, i. (1913) pp. 65–88 (1 pl.).
† English Mechanic, c. No. 2584 (1914) p. 213 (1 fig.).
‡ Comptes Rendus, clix. (1914) pp. 476–84 (figs.).

different forms have been known as: *B. Ottomülleri* with var. *rotundata*, *B. anthropomorpha*, covered with spines or horns projecting more or less; *B. punctata*, with vars. *subtriundulata* and *subaurita*, covered with punctuations; *B. translucida* with neither spines nor punctuations. *B. polymorpha* is rare or absent in surface collections, and is principally found at a depth of 20–120 m. and between latitudes 65–70°. The various forms this species may assume are described and figured. The author does not consider that season is the cause of the polymorphism. Another instance given is *Eucampia antarctica*, which includes as its forms *E. balaustium* and *Mölleria antarctica*. These are discussed and figures of various forms are given. Other species which show polymorphism are: *Rhizosolenia polydactyla*, *Biddulphia striata*, and certain species of *Chætoceros*. The author maintains that the structure of the endochrome is a more fixed character than the form and variety of the sculpture of the valves, since it remains constant throughout a species, notwithstanding variety of outward form. And he complains that diatomists do not easily shake off the old method of diatom nomenclature, founded on the form and structure of the shell. Petit's lines of study, founded on characters of the endochrome, have not been followed except for plankton diatom.

**Microspora amœna.***—K. Meyer describes the development and life-history of *Microspora amœna* Rab., and compares it with *M. Willeana*, which was studied by Lagerheim. The differences in the chromatophores of the two species, and indeed in their life-history, are so marked, that the author considers each to represent a distinct group, possibly a distinct genus. Thus *Microspora* Thur. and *Microspora* (Thur.) Lagerheim are not in the least synonymous. The nuclei, formation of zoospores, and the akinetes of *M. amœna* are described in detail.

**Oogenesis in Hormosira.**†—M. R. Getman writes on the oogenesis in *Hormosira*. He first describes its morphology and then briefly summarizes the oogenesis of Fucaceæ in general. A short account is given of what happens in *Hormosira*, in which genus eight nuclei are formed and eight eggs begin to develop. The final 4-nucleate condition is reached by the breaking down of four immature eggs, rather than of four free nuclei. Such a condition is safely interpreted as less removed from the *Fucus* condition than forms in which the 4-nucleate stage is reached by the breaking down of free nuclei. The author shows a series of oogenesis in Fucaceæ, beginning with eight eggs in *Fucus* and ending with a parthenogenetically developed egg in *Sargassum*.

**Marine Algæ of the Danish West Indies.**‡—F. Börgesen publishes an account of the Phæophyceæ of the Danish West Indies. This forms the second part of his monograph of the marine algæ of that region. In the Phæosporales he treats of the Ectocarpaceæ and seven more families. In Encoeliaceæ he places a new genus, *Rosenvingia*, which is allied to

* Ber. Deutsch. Bot. Gesell., xxxi. (1913) pp. 441–8 (1 pl.).
† Bot. Gaz., lviii. (1914) pp. 264–71 (1 pl. and figs.).
‡ Dansk. Bot. Arkiv, ii. (1914) pp. 157–224 (44 figs.).

*Chroospora*. The type of it is a new species, *R. sanctæ-crucis*; and three species are transferred to it from *Asperococcus*. In the Cyclosporales he treats of two familes. The structure of nearly all the 40 species is figured and described, or discussed. In all there are five new species described. Critical notes of much interest are appended.

**Officinal Algæ.***—A Segers-Laureys writes on the composition and the structure of certain officinal algæ, species of *Fucus* and *Laminaria*, *Chondrus crispus* and *Corallina officinalis*. The structure of each is described, its chemical composition, etc., and the uses to which it is applied.

**Marine Algæ of Peru.**†—M. A. Howe publishes a work on the marine algæ of Peru, a region hitherto but little explored for these plants. The principal collections described were made by R. E. Coker, a fishery expert to the Government of Peru, in 1906, 1907, and 1908. The collecting of algæ was merely incidental to his fishery studies; but the result was one of the most comprehensive and instructive collections of algæ ever made in S. America. In the Introduction the author gives interesting information regarding nature of climate, economic possibilities, and history and bibliography of Peru algæ. In Coker's collections are 96 species, representing 67 genera. Twenty-nine species are described as new. The total known flora is now 123 species. Critical notes are appended to each record. The book is well illustrated with text-figures and plates.

## Fungi.

(By J. Ramsbottom, M.A., F.L.S.)

**Fungus Parasites of Living Insects.**‡—R. Thaxter, well-known for his studies on the Laboulbeniales, gives an account of some new and peculiar fungi parasitic on living insects, belonging to other groups. Although few in numbers, these parasites belong to several quite unrelated groups, and seem to have adjusted themselves successfully to the uncertain conditions of life and propagation on rapidly moving living hosts. "The apparent rarity of most of them seems quite remarkable, however, in view of the fact that any such exist; since, if a certain small number of insects furnish favourable conditions for such development, it is difficult to understand why hosts of other similar insects have not also been similarly parasitized, and why an extensive flora of this nature, or at least one comparable in numerical importance to that of the Laboulbeniales, has not been developed." In comparing the miscellaneous assemblage of forms which are now known to live as external parasites on living insects, it is of interest to note that a great majority, at least, possess a more or less clearly defined blackened foot-like structure, which serves both as an organ of

* Recueil Inst. Bot. Léo Errera, Bruxelles, ix. (1913) pp. 81–110.
† Mem. Torrey Bot. Club, xv. (1914) 185 pp. (66 pls. and figs. in text).
‡ Bot. Gaz., lviii. (1914) pp. 235–52 (4 pls.).

attachment to the host and a means of absorbing such materials as are necessary for growth. Thaxter holds that the food-material is obtained directly from the circulatory system of the insect. The new fungi described are—*Hormiscium myrmecophilum* ; *Muiogone* (new genus near to *Sporidesmium*), with one species : *Muiaria* (new genus closely resembling certain types of *Macrosporium*), with four species ; *Chantransiopsis* (a Hyphomycete), with three species ; and *Amphoromorpha*, of uncertain position but apparently corresponding most closely to some of the Mycochytridineæ : one species is described.

**Sexuality of Tilletia Tritici.***—F. Rawitscher has continued his researches on the Ustilagineæ. Previous observers have noted that there is a fusion of nuclei in the brand-spore. Rawitscher germinated the spores of *Tilletia Tritici* and *T. lævis* in water and infected young wheat-plants with them. The germ-tube produced by the spores is long ; the contents of the spore pass into it immediately. In all cases the germ-tube contains eight nuclei. It is assumed that a reduction-division occurs when the original spore nucleus divides, but the eight-nucleate stage was the earliest observed. Usually eight sporidia are produced on the end of the germ-tube, though frequently ten, twelve, or sixteen are formed. Each receives a single nucleus from the tube. The sporidia then build the well-known copulation tubes. The nucleus of the one sporidium passes over through the tube, and from the resulting binucleate sporidium long hyphæ grow out, which are also binucleate, and can produce binucleate secondary sporidia. The infection of young wheat-plants takes place by means of such a binucleate hypha. The production of brand-spores was not followed owing to the failure of the author's wheat-cultures. The course of events is apparently similar to that recorded by Rawitscher for *Ustilago carbo*. Some interesting remarks are made concerning the constant appearance of an eight-nucleate stage in the germ-tube, the number recalling the formation of asci, and the method of spore-production recalling that of basidia.

**Sori and Mycelium of Rusts in the Caryopses of Cereals.**†—J. Eriksson points out, in reference to Beauverie's observations on the presence of the sori and mycelium of rusts in the caryopses of cereals and other Gramineæ, that he had already described and figured this in 1896. In 1901 he expressed the opinion that such are to be regarded as an abnormal and excessive growth, having no practical importance in the life of the fungus. In 1912 he gave his results on the wintering of cereal rusts, and recent observations have confirmed the opinion that the presence of mycelium and clusters of spores on the surface of the caryopses is without importance ; similar observations have been published by Pritchard in the United States.

**Mycena.**‡—J. E. Lange begins his Studies in the Agarics of Denmark by a consideration of the genus *Mycena*. There is a general introduction to Agarics in general. It is pointed out how it is universally

* Ber. Deutsch. Bot. Gesell., xxxii. (1914) pp. 310–14.
† Comptes Rendus, clviii. (1914) pp. 1194–6.
‡ Dansk Bot. Ark., i. (1914) pp. 1–40 (2 pls.).

felt that herbarium specimens of Agarics fail to be of much value. Good illustrations and careful study of the microscopic structure are what the author has attempted. The microscopic characters are very useful in the study of the genus *Mycena*, a number of unusually distinct and varied characters being present. The shape of the spores is extremely variable, the size, outline, and surface varying with different species. Quite a number of species have bi-spored basidia. Two types of cystidia can also be distinguished. 1. The cystidia are smooth, their free portion hair-shaped, cylindrical, or conical, rarely somewhat branched or forked: the inserted part often more or less ventricose. 2. The free portion of the cystidia is set with warts or setiform hairs; its outline obtuse or almost hemispherical; the entire cell pyriform or obovate. The microscopic characters are given the chief importance, and used as the basis for the systematic arrangement of the species. A key is given to fifty-five species of the genus. The microscopic characters of each species are given, with notes in most cases on their macroscopic characters, habitats, and distinguishing features. Five new species are described, and several new varieties. Eleven coloured drawings of interesting species are given, and figures of the spores, cystidia, etc., of all the species considered.

**Fungi of Sand-dunes.***—H. J. Wheldon has studied the fungi which occur in the various plant associations of the extensive sand-dune formation on the Lancashire coast. The associations are first described and the characteristic plants, phanerogams and cryptogams, indicated. The fungi are then listed under the different associations.

**New Species of Fungi.**†—Eight new species of fungi are described by E. M. Wakefield and G. Massee. Two new species of *Polyporus*; a new species of *Cyphella*, *C. Heveæ*, said to be undoubtedly parasitic on *Hevea brasiliensis*; two new species of *Aspergillus*, which with two other known species were taken from the soil at Khartoum; *Scirrhia Cyperi*; *Sphærella vexans*; *Botrytis necans*, parasitic on the moth *Brachartona catoxantha*; and *Cercospora Musæ*, causing a serious banana disease in Fiji.

**Nigerian Fungi.**‡—E. M. Wakefield describes a small collection of fungi from Southern Nigeria. Notes on the habitats are given. Points of interest in structure are remarked. *Hymenochæte castanea* is figured and described as new.

**Philippine Basidiomycetes.**§—P. W. Graff continues his account of the larger fungi of the Philippines. The synonymy, distribution, etc., of the species are given. Seven new species of Agaricaceæ are diagnosed, one of which, *Lentinus Macgregorii*, is figured.

* Lancashire Naturalist, April–September 1914.
† Kew Bull., No. 4 (1914) pp. 156–9.
‡ Kew Bull., No. 7 (1914) pp. 253–61.
§ Philippine Journ. Sci., ix. (1914) pp. 235–55 (1 pl.).

**Hibernating Mycelium in Tomato Seed.***—I. Massee has examined seed produced by tomato plants suffering from "black-rot" (*Macrosporium Solani*). Such seeds often show black spots on the surface. Microtome sections of such spotted seed proved the presence of mycelium in varying quantities. In a healthy tomato seed the testa is in close contact with the endosperm, but in an infected seed a thick weft of closely compacted hyphæ is present between the testa and the endosperm. From this peripheral weft of mycelium hyphæ pass into the endosperm and also into the embryo. These hyphæ are inter- and intra-cellular. On the germination of infected seed either the embryo is killed almost at once by the mycelium, when present in considerable quantity, or the mycelium grows along with the seedling.

**Saprophytic Fungus becoming Parasitic.**†—G. Massee records the fact that a batch of *Clerodendron fallax* became studded on the lower surface of the leaves with peltate glands which exuded a liquid drop with a sweet taste. The ubiquitous floating species *Cladosporium epiphyllum* found these sugary drops a congenial pabulum, and each gland was soon tipped with a fruiting tuft of *Cladosporium*. At first the *Cladosporium* was strictly confined to the glands and depended on the secretion for its support, but it gradually passed from the saprophytic condition and entered that of a facultative parasite, passing beyond the range of the gland and attacking the surrounding living tissue of the leaf, forming conspicuous brown, dead patches on the upper surface. Three weeks after the disease first appeared, the spores of the fungus were capable of infecting any portion of the leaf, quite apart from receiving an initial start on the sugary excretion from a gland. It is also pointed out how mechanical injuries, which are often self-inflicted, may form the centre of an attack by microfungi.

**Plant Diseases.**‡—G. H. Pethybridge gives an account of his investigations on potato diseases. Experiments were conducted on *Phytophthora infestans* in continuation of those of 1913, to ascertain which is the best time to spray, the best method of application of the spray, the strength of the mixture, and the efficiency of certain proprietary spraying materials. In the case of *Sclerotinia sclerotiorum*, which, next to the blight, is apparently the most serious potato disease in the west of Ireland, since all experiments in spraying have resulted in failure to control it, attention is being devoted chiefly to investigating the relation between the virulence of the attack and the date of planting. It has been clearly established that the later the potatoes are planted the less is the number of plants which become attacked. Notes are also given on *Bacillus melanogenes*, *Spongospora subterranea*, and *Phytophthora erythroseptica*.

The same writer§ has also investigated the possibility of the spread of celery leaf-spot disease (*Septoria Petroselini* var. *Apii*) by the use of

* Kew Bull., No 4 (1914) pp. 145–6 (1 pl.).
† Kew Bull., No. 5 (1914) pp. 190–1.
‡ Dept. Agric. and Tech. Instr. Ireland Journ., xiv. (1914) 24 pp. (3 pls.).
§ Dept. Agric. and Tech. Instr. Ireland Journ., xiv. (1914) 9 pp. (1 pl.).

affected seed. Of 109 samples of celery seed, 100 were found to have pycnidia of the fungus upon them. It was proved definitely and clearly that the disease can be contracted and propagated by the use of affected seed bearing the fungus in a living state on it. By treating such seeds with formaldehyde, hydrogen-peroxide, or copper sulphate solution the fungus can be rendered innocuous. Studying the effects of these solutions on germination it was found that the treatment with copper sulphate caused a serious decline in the percentage of germination, but in the case of the other liquids the effect was practically nil.

H. A. Allard* gives a detailed review of the investigations on the mosaic disease of tobacco, together with a bibliography comprising sixty-four of the more important contributions on the subject.

## Schizophyta.

### Schizomycetes.

**Behaviour of the Hansen Bacillus in vitro.**†—C. W. Duval, working with leprous tissues, finds that multiplication of the acid-fast rods of *Bacillus lepræ* takes place in removed leprous tissue under aerobic conditions and within a temperature range of 25–37° C. The growth in the tissue is moist and translucent, and, on removal, readily forms a homogeneous turbidity when suspended in liquid. Growth in sub-culture is difficult to obtain, and, according to the author's experience, only occurs when the artificial medium contains the split products of animal protein.

He does not regard the diphtheroids, so often described in connexion with leprosy, as having anything more than an accidental relation to the disease.

**Boas-Oppler Bacillus.**‡—H. M. Galt and C. C. Iles are of opinion that the large Gram-positive bacillus isolated by Boas and Oppler from the gastric contents in carcinoma of the stomach is identical with *Bacillus bulgaricus* and is not an organism *sui generis*, and that the *B. bifidus* of Tissier is also probably identical with these organisms. The inference is drawn that in cases of cancer of the stomach it is the absence of hydrochloric acid that allows of the growth of the bacillus, and that the lactic acid is formed as a result of the activity of this organism.

**Bacillus abortivus equinus in Infectious Arthritis of Colts.**§ E. S. Good and W. V. Smith have isolated an organism in pure culture from the synovial fluid of a colt dead of "septic arthritis," which is apparently one and the same germ as that causing infectious abortion in mares (*Bacillus abortivus*). Not only are the organisms culturally and morphologically indistinguishable, but the joint organism gives positive

* Bull. Torrey Bot. Club, xli. (1914) pp. 435–58.
† Amer. Journ. Trop. Diseases and Prev. Med., ii. (1914) pp. 185–90.
‡ Journ. Path. and Bact,, xix. (1914) pp. 239–44.
§ Journ. Infect. Diseases, xv. (1914) pp. 347–9.

agglutination and complement fixation when tested against abortivus-immune sheep-serum. The infection was most probably conveyed to the colt by means of the umbilicus.

**Diphtheroid Organisms isolated from Lymphadenomatous Structures.***—J. A. Lanford has succeeded in cultivating seven strains of diphtheroids, which resemble each other in their morphology and staining reactions, from the spleen and lymph nodules in various pathological conditions. They were found to agglutinate the homologous sera, but also, for example, the serum from a case of splenic anæmia agglutinated strains from cases of Hodgkin's disease. No opinion is offered as to the possible role that these organisms may play in the production of the diseases with which they were asociated.

**Infection of Man with Bacterium tularense.**†—W. B. Wherry and B. H. Lamb report a case of human infection (multiple ulcerative conjunctivitis and lymphadenitis) with *Bacillus tularense*, which organism is, according to McCoy and Chapin, associated with a plague like-disease of the Californian ground-squirrel (*Citellus beechyi* Richardson). The bacterium is a very minute organism requiring special methods of cultivation and staining for its identification. The best media for its cultivation are coagulated hen's egg-yolk, and hen's ovo-mucoid with a trace of yolk. For slide demonstration, anilin-water-Hoffman's violet is particularly recommended. On the appropriate media minute viscous colonies appear after two or three days under anaerobic conditions at 37° C. The organisms, which appear as minute coccoid bodies, are non-motile. The disease is wide-spread among rodents, and it has been found by experimental inoculation that small quantities of the virus of the infection kill white mice and guinea-pigs in a few days, with characteristic lesions. The Norway rat (*Mus norvegicus*) is relatively immune, but the grey mouse (*M. musculus*) is susceptible. The suggestion is thrown out that possibly this organism may some day take its place along with *Bacillus pestis* as a menace to the human race.

**Bactericidal and Antitoxic Action of Lanthanum and Thorium Salts on the Cholera Vibrio.**‡—Albert Frouin and D. Roudsky state that, after mixing the microbic emulsion with an equal volume of lanthanum sulphate or thorium sulphate solution, centrifuging the mixture after thirty minutes, and suspending the microbic deposit in a volume of saline solution equal to that of the original emulsion, a guinea-pig was able to survive a peritoneal injection of an amount equal to twice that which proved fatal in eight hours without previous treatment. An injection of three and a half times the fatal dose killed the guinea-pigs at the end of twenty-four to thirty-six hours when using lanthanum sulphate, but they survived this amount after its treatment with thorium sulphate. Phagocytosis and dissolution of the vibrio in the peritoneum of the guinea-pig is much more rapid in the case of the cultures treated

* Amer. Journ. Trop. Diseases and Prev. Med., ii. (1914) pp. 194–8.
† Journ. Infect. Diseases, xv. (1914) pp. 331–40 (1 pl.).
‡ Comptes Rendus, clix. (1914) pp. 410–13.

with the above salts. In the case of monkeys, the culture was administered by the mouth after the purgative effect due to an ingestion of sodium sulphate had been produced, and then either six or twelve hours later 40 c.cm. of a 2 p.c. solution of thorium or lanthanum sulphate was given by the mouth. In the case of the six hours' intervals, the monkeys survived after treatment with either of the salts, but with the twelve hours, the animals died when lanthanum sulphate was administered, but survived when thorium sulphate was used.

**Nitrogen Fixation by Azotobacter in Substrata Poor and Rich in Nitrogen.***—J. Hanzawa states that mixed cultures of different strains of *Azotobacter* were found to be more efficient than the same bacteria in pure cultures, especially in aqueous solutions of mannitol. The nitrogen of humus and small amounts of nitrates were almost without effect on the fixation of nitrogen by pure cultures of *Azotobacter*. In presence of nitrogen amounting to 2·5 p.c. of the amount of carbon, nitrogen fixation is retarded, and with large proportions of nitrogen, inhibited. Under natural conditions it seems probable that soil nitrogen can only seldom, if at all, have an unfavourable action on nitrogen fixation. Some humus substances seem capable of being utilized as source of energy in the fixation of nitrogen. The humus of farmyard manure gave positive results, whilst that of green manure gave negative results.

**Metabiotic Action of Ultra-violet Rays. Theory of the Production of New Microbic Forms by the Action on the Different Nutritive Functions.**†—Victor Henri and Mme. Victor Henri made a comparative study of the development of normal anthrax bacillus and two new forms: (1) cocciform-$S_1$, taking Gram's reagent; (2) slender filaments, not taking Gram's reagent, yellow in colour, which they call anthrax-$\gamma$.‡ The culture media consisted of mineral salts, together with (*a*) one of the carbohydrates, dextrose, sucrose, maltose, lactose, or starch; (*b*) one of the nitrogenous substances, ammonium lactate, ammonium citrate, glycin, $\alpha$-alanin, asparagin, or Chapoteaut's pepton; (*c*) hydrochloric acid or sodium hydroxide at a concentration of $N/200$.

Normal anthrax does not develop on media containing ammonium salts or amino-acids as the nitrogenous nutrient, but only in media containing pepton. The form $S_1$ behaves exactly like normal anthrax. Anthrax-$\gamma$ develops in the presence of both ammonium salts and amino-acids. None of the three forms develops in an acid medium, but all prefer an alkaline to a neutral medium. Normal anthrax develops better on a medium devoid of carbohydrates than in the same medium with carbohydrates present, and if grown under the latter conditions a whole series of modified forms is obtained. For the form $S_1$ there is no appreciable difference. Anthrax-$\gamma$ develops best in the presence of carbohydrates, and often it will not grow in a medium containing pepton

* Centralbl. Bakt., 2te Abt., xli. (1914) pp. 573–6. See Journ. Chem. Soc., cv. and cvi. (1914) pt. 1, p. 1113.
† Comptes Rendus, clix. (1914) pp. 413–15. See Journ. Chem. Soc., cv. and cvi. (1914) pt. 1, pp. 1112–13
‡ See this Journal, *ante* p. 292.

unless sucrose or maltose are present. Cultures of anthrax-$\gamma$ are very abundant on potato.

After short periods of irradiation, cultures inoculated on media devoid of carbohydrates develop but little, whereas the culture is abundant in the presence of carbohydrates. For longer periods of irradiation the reverse is true. Apparently, under the influence of the irradiation, the anthrax bacillus loses its capacity for secreting proteolytic enzymes whilst retaining the power of producing amylolytic enzymes. Such a bacillus placed on a nutritive medium would require carbohydrates for its development, and would thus change its mode of feeding, and as a result its form and all its biochemical and biological properties would be modified. A new form would thus be obtained which would retain its acquired characteristics through thousands of generations.

**Bursati.***—Bursati is a disease affecting horses in India, though similar phenomena have been described by writers in the United States, Australia, Europe, and North Africa. Swellings in the cutaneous and subcutaneous tissue which break down and ulcerate are the principal features The cause of this disease has been ascribed by some to the presence of Nematode worms, but the author, J. D. E. Holmes, has proved the presence of a fungoid growth in all the cases he examined. Micro-sections show that the tumours consist of an inflammatory fibrosis in which were found, after treatment with caustic potash, spores and mycelium. In character the mycelium is much like that of a *Streptothrix*. Successful cultures were obtained on Sabouraud's agar. About the fifth day after inoculation growth appeared ; this gradually spread till the surface of the agar was covered with a white chalk-like substance, which is easily removed and shows underneath a dry opaque skin which adheres firmly to the agar. Preparations from this culture showed fine branching mycelia and numerous spores which appeared to be formed inside the mycelium and often ran in chains resembling cocci. Hence it would seem that this fungus ought to be classed with *Sporothrix* rather than *Streptothrix*. Inoculation experiments on horses, guinea-pigs, and rabbits were negative.

**Variability among Bacteria.†**—M. C. W. Young, in a paper read before the British Medical Association, gave a general account of the hypothesis from which the work had started and the methods which had been employed in the transformation of the bacteria. This hypothesis was that all bacteria formed merely stages in the history of a group of organisms with an extremely complicated life-cycle, part of which was protozoal in character, and often (possibly always) parasitic.

The connexion between the bacterial and protozoal aspects could frequently be demonstrated by examining with the dark-ground illuminator perfectly clear and apparently sterile serum which had incubated for some time. The serum chiefly used for study was taken from subjects with rheumatic affections or arterial disease. In it there might

* Mem. Dept. Agric. India, ii. (1914) pp. 119–52 (5 pls.).
† Brit. Med. Journ. (1914) ii. pp. 710–11 (2 figs.).

only be seen a few dancing granules, but more frequent and characteristic was a further stage of bright flocculent masses apparently made up of tiny amœbulæ. In these masses nucleated bodies about the size of red corpuscles made their appearance later—the sporoblasts. These could develop microbes of various kinds. The one almost invariably met with—the sporozoite, in fact—was a bacillus of the *subtilis* type. This bacillus, in young growths, usually passed on in a few hours to the protist stage without giving any indication of its presence to the naked eye, and the serum again became apparently sterile to subculture. This cycle, with appearance and disappearance of the bacillus, might take place several times, but eventually, with the exhaustion of the medium for the protozoal phases, the bacillus came to stay. It, however, might be present for some days only in small numbers if any of the other stages were present which had not completed their evolution. It then grew, usually as a wrinkled film on the surface, and formed spores. A single cycle appeared in many cases to take about a fortnight, but several overlapping cycles were usually present.

Other bacteria which had been seen to develop from these sporoblasts were a drumstick bacillus in symbiosis with a coccus. These were seen to emerge from the sporoblasts of a moribund patient after a fortnight's incubation. These latter sporoblasts, subcultured from the serum of a rheumatic case, appeared as a solitary hard colony on agar on the eighth day, the streptococcus developing from them two days later. A staphylococcus had also been seen to develop from similar sporoblasts on an agar slope.

The spores of this *subtilis* bacillus had been transformed into the protozoal stages by growing them on agar at 60° and then in 10 p.c. unfiltered pepton solution acidulated with metaphosphoric acid at 37° C. The transition to the protist was complete in about twelve hours, when the subcultures were negative. A couple of days later there appeared the nucleated sporoblasts. Unfortunately, the medium had apparently not been suitable for the repetition of the cycle, and the bacterium which developed from them did not disappear, but grew on and formed spores.

Every type of bacterium which had been tried—and the attempt had been made with a considerable number of non-pathogenic ones—had been transformed into this *subtilis* type with more or less ease, usually by growth in broths of varying alkalinity, $\frac{1}{2}$ c.cm., 1 c.cm., or more of a 5 p.c. solution of sodium hydrate being added and the cultures kept at the required temperature, the optimum for many being about 42°. The cultures passed through the protist stage to the sporoblast, from which the usual sporing bacillus developed. The longest time taken was about four days. Some bacteria changed much more rapidly.

The bacteria resulting from this transformation resembled each other very closely, both microscopically and in culture, while, on the other hand, a large variety of types of growth could be obtained from each bacterium, by, for example, heating the spores to temperatures not sufficient to kill them. Each bacillus might occur also in a motile and non-motile form. There was shown a motile bacillus turned into a non-motile by growth at 60° in glycerin broth. Non-motile forms, on the other hand, tended to pass spontaneously into the motile, especially on media containing lactose.

It had been necessary, therefore, for identification, to try to obtain as many other stages of each life-history as was possible. The preferable method would have been to have obtained the sporoblast as described above, and then to have brought about the development from it of the other phases. This method had to be given up for the time, owing to the difficulty of getting the bacteria to grow at the required temperature. It had been found, however, in the course of the experiments on the modification of the macroscopic appearance of the cultures, that on heating the spores for longer than the time which had apparently sufficed to kill them, the bacillus sometimes reappeared. The spores were therefore heated for still longer times and in various solutions, and other types of microbe were occasionally obtained. Many of the sporing bacteria from the blood and saprophytic bacteria were used as well as those from the anthrax and tubercle bacilli.

The *subtilis* spores from anthrax were got by heating a two-and-a half-months old culture and from the subculture in lactose broth of a five-months old culture, which grew a wrinkled film, the broth below being clear and alkaline, while the other test broths gave typical cultures of the anthrax bacillus. The temperature for transforming the spores was, as a rule, 110°, the heating medium salt solution with or without alkali, and the time, for anthrax, at most five minutes. Slight variations in the process and even in the age of the spores used often affected the result materially. At best, 10 p.c. of the subcultures on one medium or another gave positive results (agar with various sugars was used). The microbes obtained included four apparently different staphylococci. A pink coccus, shown under the Microscope, could be seen to transform itself directly into a bacillus on certain media, especially glucose-agar, reverting to the coccal form when put back on plain agar. It was possible that such direct transformations were comparatively frequent. A diphtheroid and various coccobacilli and diplobacilli were also got. Of the tubercle bacillus both human and bovine types, and the Arloing-Courment bacillus were used. It required a good deal of care to get positive results. The temperature was $41\frac{1}{2}°$. The human bacillus turned five times out of six in $\frac{1}{2}$ c.cm. alkaline broth and the six thtime in 1 c.cm. The bovine turned in the 1 c.cm., and the Arloing-Courment in the 1 c.cm. and 3 c.cm. broths. Often a bacillus which gave negative results would give positive if tried a week or so later. Parallel cultures from different media such as egg and glycerin agar would also give different results.

The sporing bacteria corresponding to the tubercle bacilli differed from all those hitherto worked with in being more readily killed by heat. Five minutes boiling sufficed when first obtained, whereas most resisted for one and a half hours, the anthrax ones for over an hour, and one from a rheumatic blood for about six hours. Their upper limit of growth and spore formation were, when first got, about 10° higher than those of the *subtilis* type from anthrax.

The microbes got from overheating these tubercle spores were chiefly cocci. The temperature used was not higher than 105° for two to five minutes. With more or less similar conditions the same coccus, if any, appeared. Two sets of cocci from the bovine bacillus were shown. Those from the spores heated to 105° (ten in number) were white and grew at 37° ; those from the steamed spores were orange, and did not grow at 37°, but scarcely about 20°. The cocci from the tubercle bacilli, appeared on the agar in from two to four days, while those from the anthrax took from seven to ten days, and the pink coccus mentioned above five weeks (one week being at 37°, and the heating solution 5 p.c. metaphosphoric acid). Coccobacilli, diplobacilli, and anthracoids were also got from this tubercle, as from most of the other spores, and a yeast and torula apiece from the human and bovine bacilli. The anthracoid from the human bacillus was remarkable for the extremely waved almost spirochætal appearance of its filaments by the third day, spore-formation having been arrested.

# MICROSCOPY.

## A. Instruments, Accessories, etc.*

### (1) Stands.

**Watson-Conrady "Bicor" Binocular Attachment.†**—W. Watson and Sons intend this auxiliary to afford the student the advantage of

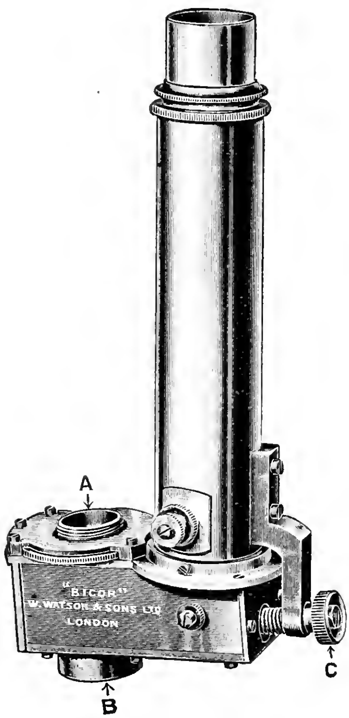


Fig. 56.

using two eyes instead of one in his observations. It also affords the means of readily converting a monocular into a binocular Microscope,

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

† Catalogue, "Microscopes and their Accessories," W. Watson & Sons, London (1914–15).

or vice-versa. It is supplied in two forms: (1) attachable; (2) built-in. The attachable form is shown separately in fig. 56, and in position in fig. 57, and is screwed to the objective-glass end of a monocular body in precisely the same way as an ordinary revolving nose-piece is fitted. It can, therefore, be placed on the instrument required, and thus convert a monocular into a binocular. The built-in form is a complete binocular body, and is provided with a sliding carrier for the prism, whereby the prism can be withdrawn from the field and the light, therefore, enabled

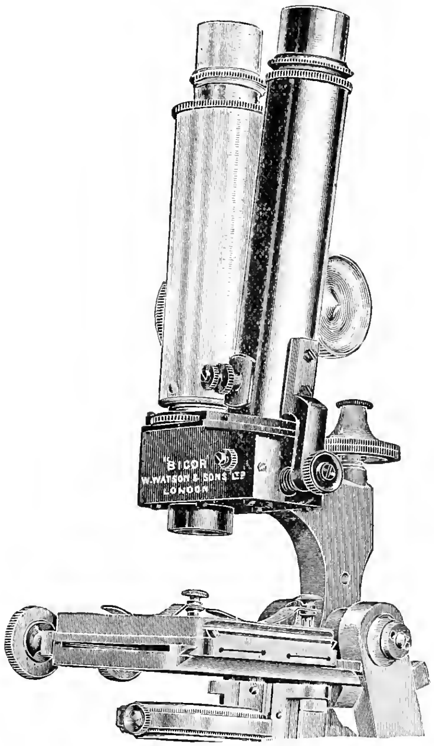


FIG. 57.

to pass directly up the monocular body only, without obstruction, when so desired. The binocular thus becomes a monocular. Both forms depend upon an optical system, first employed by Abbe, for dividing the light coming from the objective, the dividing prism being placed close to the objective, and the lateral prism being provided with a glass extension of such length as to cause the two separated beams to focus at the same distance from the objective. The instrument also includes an ingenious arrangement for adjustment of width of eyes without alteration of tube length. The lateral prism and the tube carrying


Fig. 58.

the lateral eye-piece are mounted together on hinged bearings set in such a position that the beam of doubly reflected light always occupies the same position with reference to the axis of the lateral tube. By turning the screw C (fig. 56) the binocular tube is gently altered in its angular position until the user's width of eyes is suited. If, then, it is necessary to change the tube length, the inter-ocular distance can be at once reset. In addition to the advantages already referred to, the makers state the following :—1. Suitability for all objectives from 1 in. to $\frac{1}{12}$ in. oil immersion, the full resolving power of every objective being retained. 2. Equal brilliance of image in both tubes. 3. Maintenance of definition so perfect that the interposition of the prism is unobservable. 4. Good range of tube length. 5. Production of stereoscopic or pseudoscopic effect at will by setting the interocular distance slightly narrower or wider than the interpupillary distance of the observer.

**W. Watson and Sons' Agricultural Microscope.***—This Microscope (fig. 58), has been designed specially for use in botanical and agricultural work in which very low magnifications are frequently necessary for the general examination of large specimens without loss of the usual precision for medium and high-power observations. The coarse adjustment, is W. Watson and Sons' regular spiral rack-and-pinion pattern ; the fine adjustment being their standard lever form. The important feature of the instrument is its very long range of coarse adjustment which enables the highest and lowest power objectives to be used with ample margin. This will be understood from the fact that with an object $1\frac{1}{2}$ in. thick laid on the stage, with a triple nose-piece in position, a 3-in. objective of the parachromatic or Argus series will focus with rackwork to span. The stage is of extra large size, $4\frac{5}{8}$ in. square. When the tube is racked down high powers such as $\frac{1}{6}$ in. or $\frac{1}{12}$ in. can be employed.

**W. Watson and Sons' Grand Model Van Heurck Microscope (1914 Model).†**—The new model of this well-known instrument is shown in fig. 59. It has been revised in several respects in order to meet the demand for a long range of mechanical stage movement with complete rotation at any position. The stage now has 2 in. of horizontal traverse, and is fitted with movable object clips and removable spring bar clips. The range in the vertical direction is about $1\frac{1}{4}$ in. The milled heads work on one centre, and, if desired, can both be rotated simultaneously, thereby affording a diagonal movement. The stage now has a diameter of 5 in., and has complete concentric rotation. The object is gripped by double sliding bars. It will be readily seen that the altered shape of the limb gives great freedom to the surface and, incidentally, acts as a convenient handle.

* Catalogue, "Microscopes and their Accessories," W. Watson & Sons, London (1914–15) pp. 34–5.
† Catalogue, "Microscopes and their Accessories," W. Watson & Sons, London (1914–15) pp. 74–5.

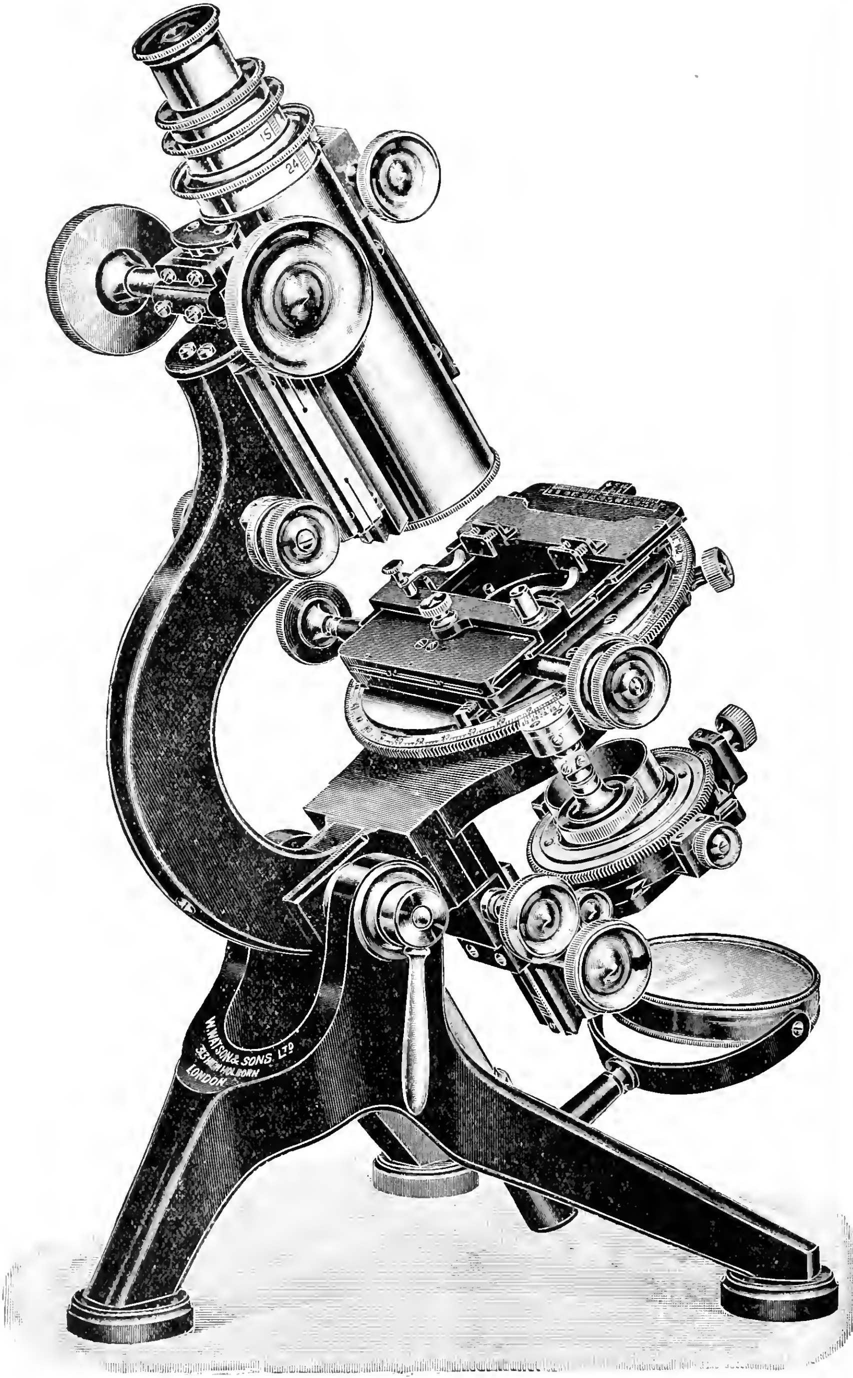


Fig. 59.

### (6) Miscellaneous.

**Glass for Optical Purposes.***—S. D. Chalmers calls attention to this important subject, and incorporates in his paper a series of historical notes likely to act as useful hints to any manufacturers contemplating improvements in British methods. In view of the importance to our industries and to the army and navy of an adequate supply of optical glass of various types, it is most desirable that our optical glass should be made in this country, and the author thinks that the manufacturers should be encouraged to meet this demand. Success in this direction is, however, most likely to be achieved by scientific experimental work carried out in conjunction with those manufacturers who have already acquired valuable and essential experience in the manufacture of optical glass. The manufacture of the optical glass is not, indeed, to be lightly undertaken. Great difficulties are associated with the purity of the materials and their proper mixing; the pots must be of clay, free from impurities which might colour the glass. The preparation of these pots requires skilled workmen of long experience, and the same may be said of the melting temperatures, the proper period of stirring, the rate of cooling, and the whole annealing process. At the same time small variations of composition or treatment will affect the optical properties quite considerably. The experimental work associated with the production of special types of glass is expensive and troublesome, since the principal difficulties arise when we endeavour to change from the laboratory to the works scale.

The history of optical glass-making is to a large extent the history of optical progress. Dollond's discovery of the achromatic combination (1757) created a demand for flint glass suitable for optical purposes. The demand for large disks of flint glass led Guinand (1748–1824) to work out new methods of melting flint glass. Guinand in conjunction first with Utschneider and later with Fraunhofer improved his process so as to make good flint disks up to 10 in. in diameter. He afterwards made them up to 14 in., and on his death in 1824 the secret passed to his sons and through them to Bontemps in France. Bontemps' work was carried on by the French house of Feil, now Paira-Mantois, while Bontemps himself brought the secret process, in 1848, to the glass-works of Messrs. Chance. The calculation of the Petzval portrait lens and its successors led to a large demand for a glass intermediate in type between the ordinary flint and the crown, and by 1880 it was possible to make a complete series of glasses with their refractive indices ranging from 1·515 to 1·72. But these glasses had two special characteristics: as the refractive index increased the dispersion increased more rapidly; also the dispersions of two glasses of different refractive index were not proportional throughout the spectrum. The consequence was that all images appeared coloured. The experiments of the Rev. W. V. Harcourt (1789–1871) which extended from 1834–1871 showed that this problem could be solved; he proved that the effect of substituting boric acid for

* Nature, 2344, Oct. 1, 1914, pp. 171–2.

part of the silica in the glass was to reduce the dispersion of the blue end of the spectrum and so to make a flint glass which more nearly matched the ordinary crown glass. He was also able to modify the crown glass by using phosphoric acid, but wrongly attributed the result to the presence of titanic acid. Unfortunately these experiments did not lead to practical results, probably because of the expense attaching to experimental meltings on a practical scale. Schott and Abbe (1881–1886) confirmed Harcourt's results as to the action of boric acid, and correctly attributed the effects observed by him to phosphoric acid. In addition they were able to determine the effects of barium both with and without boric acid. Now the use of boric acid in the ordinary lead glasses always leads to a glass which is more or less liable to spot, but by the use of barium instead of some of the lead this effect is reduced. The boric acid barium glass is, however, of special value, because in this case a high refractive index is associated with a low dispersion. It behaves as a crown glass as regards its dispersion, but as a flint glass in respect of its refractive index. This property is of special value in the construction of modern anastigmat photographic lenses. These researches of Schott and Abbe were followed by the establishment of the Jena glass-works. The immediate results were :—

1. The manufacture of flint glasses containing boric acid ; by the aid of these glasses it was possible to make three lens objectives free from secondary spectrum, but these glasses are not so permanent as the older types. 2. The series of phosphate glasses which proved chemically unstable and deteriorated in use. 3. The boro-silicate crown glasses, which are of somewhat lower refractive index and dispersion than the ordinary crown glass. These are good glasses, and are now extensively used for small objectives and for prisms in prism-binoculars. 4. The dense barium crown glasses containing barium and boric acid. These glasses are used in nearly all anastigmat photographic lenses, but they are difficult to make because such abnormal optical qualities are closely associated with chemical instability. 5. The most important result was, however, the possibility of obtaining a large range of refractive index and dispersion, so that the designer was able to regard the dispersion and refractive index as more or less independent of each other.

These great successes led at first to a concentration of the optical glass industry in Jena, but the success of Chance in improving the quality of the older types of glass, and of Mantois in making the newer types, have somewhat modified this situation, though we are still dependent on Jena for some of the special glasses.

## B. Technique.*

### (1) Collecting Objects, including Culture Processes.

**Purification of Crude Silk Peptones.**†—I. Walker Hall has devised a method for the removal of the pigment of crude silk peptone (a mixture of the hydrolytic products of the original silk fibre) by filtration through argilla-alba. After three filtrations the residue is washed with distilled water, and the total filtrates are evaporated almost to dryness. The viscid mass is extracted several times with hot methyl-alcohol, the residue powdered, dissolved in water, and the process repeated. The extracts are poured into ethyl-alcohol, filtered off and placed in a vacuum. The filtrates are allowed to stand for 24 hours, and the flocculent precipitate removed as a second peptone. The products are tested for their peptone contents. Purified silk peptone provides a valuable medium for bacteriological purposes.

**Cultivation of Pathogenic Spirochætes.**‡—J. W. McLeod and A. R. B. Soga have devised a simple method for the obtaining of anaerobic conditions with the valuable though complex fluid media introduced by Noguchi. A test-tube is fitted with a perforated rubber bung, and a bent glass tubule with a capillary end is introduced to within a short distance of the lower end of the bung. The test-tube is now half filled with pepton bouillon, which is then boiled. On cooling, a portion of sterile rabbit's kidney is introduced, and a piece of cotton-wool, which has been threaded through a glass bead, is soaked in the inoculating material and dropped into the test-tube. Ascitic fluid is then run in to near the mouth of the test-tube, and the bung introduced. As the bung is pushed downwards, so the fluid rises in the narrow tube until it reaches the bent portion. The capillary end is then sealed off. Fluid can be easily drawn off at any stage of culture and subculture prepared. This method is capable of general application to the cultivation of anaerobic bacteria, with the exception of such as cause active gas formation.

**Culture of the Plankton Diatom Thalassiosira gravida.**§—E. J. Allen gives the following summary of his investigations as to the artificial cultivation of diatoms. Attempts to obtain good cultures of *Thalassiosira gravida* in a purely artificial medium, made by dissolving in doubly distilled water Kahlbaum's pure chemicals in the proportions in which the salts occur in sea-water, adding nitrates, phosphates, and iron according to Miquel's method and sterilizing the medium, have not succeeded. If, however, a small percentage of natural sea-water (less than 1 p.c.

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

† Journ. Path. and Bact. (1914) xix. pp. 286–304.

‡ Journ. Path. and Bact. (1914) xix. pp. 210–13 (1 fig.).

§ Journ. Marine Biol. Assoc., x. (1914) pp. 417–39.

will produce a result) be added to the artificial medium and the whole sterilized, excellent cultures are obtained which are often better than any which have been got when natural sea-water forms the foundation of the culture medium.

The result appears to be due to some specific substance present in minute quantity in the natural sea-water, which is essential to the vigorous growth of the diatoms. The nature of this substance it has not been possible to determine, but some evidence seems to suggest that it is a somewhat stable organic compound. Provided that 1 p.c. of natural sea-water is added, the various constituents of the artificial sea-water forming the basis of the culture medium can be varied in amount within wide limits. The salinity of the medium can also be considerably altered without serious detriment to the cultures.

The experiments recorded are of interest as furnishing another instance of the importance in food substances of minute traces of particular chemical compounds. They may also eventually throw light upon the nature of the conditions in the sea, which are specially favourable to the production of plant life, and therefore also of the animal life which that plant life sustains. In connexion with the foregoing, allusion is made to W. B. Bottomley's paper on Accessory Factors in Plant Growth and Nutrition.* The experiments of Gowland Hopkins on the feeding of rats also bear on the same point.

**Growth of certain Fresh-water and Soil Protista.†**—H. G. Thornton and G. Smith record most interesting experiments with the object of indicating certain lines upon which it may be possible to attack the problem of cyclical development in ponds and lakes. The general results they arrive at are that, as compared with *Euglena*, soil flagellates are able to live in cultures to which organic compounds of very varying nature have been added. This comparative impartiality is the result of the holozoic mode of nutrition, the development of the flagellates being absolutely dependent on the bacterial growth. The presence of the Miquel salts in the solution is necessary for the growth of the soil flagellates and for the proper development of the bacteria upon which they feed. The flagellates can feed upon a variety of different types of bacteria.

**Method of Making Cultivation Media without Prepared Peptones.‡**—S. R. Douglas describes a method of media making which gives constantly an efficient medium, and has proved more simple and easier than Haffkine's method. Fresh bullocks' hearts having been obtained, the fat and large vessels are removed. The meat is then finely minced, and to the mince thus obtained from an average-size heart four litres of water are added. This mixture, after being thoroughly stirred and rendered faintly alkaline to litmus, is heated to between 70° and 80° C. After cooling to 45° C. 1 p.c. of trypsin solution (40 c.cm. to the 4 litres) is added, the preparation of trypsin used being Allen and Hanbury's liquor trypsin co. This, in view of the fact that

* Proc. Roy. Soc., lxxxviii. (1914) p. 237.
† Proc. Roy. Soc., lxxxviii. Ser. B (1914) pp. 151–65 (1 pl.)
‡ Lancet, 1914, ii. pp. 891–2.

the preliminary heating has destroyed the anti-tryptic power of the meat juices, rapidly breaks down some of the albumins present. The trypsin is allowed to act for from two to three hours, the temperature being kept raised by placing the vessel containing the mixture in an incubator at 37° C. The next process is to precipitate the unaltered albumins and to render the broth easily filtrable, and with this in view the mixture is rendered slightly acid with acetic acid and brought to the boil. The coagulated proteids and other solid matters can now be almost entirely separated by straining through a bag of close-meshed muslin.

After rendering the fluid thus obtained alkaline to litmus, a small quantity of calcium chloride (about 0·5 grm. to the 4 litres) and 0·25 p.c. of sodium chloride are added, and the resulting broth is then autoclaved for an hour at 115 C.° so as to precipitate thoroughly any phosphates that may be in solution, filtered through filter paper, and then tubed and sterilized as in the case of ordinary peptone broth. In making agar the agar powder is best added before the phosphates are precipitated, as the prolonged heating brings the agar thoroughly into solution.

This medium has the following advantages over that made from beef extracts and prepared peptones:—1. The cost is very much less. 2. The growth of the bacteria both on the solid and liquid forms has proved to be very much more abundant than that obtained on the media usually employed; for instance, it has been found that four times more typhoid bacilli were obtained from agar bottles in a given time containing medium thus made than in the case of medium made from beef extract and Witte's peptone.

**Peptone-free Medium for the Cultivation of the Tubercle Bacillus.***—The medium, the preparation of which is described by S. R. Douglas, was the outcome of the following observations. In the first place, it was noticed in cultivating tubercle bacilli on glycerin potato, that frequently an abundant growth of the tubercle bacillus occurred on the surface of the glycerinated salt solution which was contained in the lower part of the tube. Attempts were therefore made to make a broth from potatoes which would give a good growth of such bacilli. On such a broth good growths were frequently obtained, but from time to time an individual brew gave but unsatisfactory results. These unsatisfactory results seemed to rest with some quality of the potatoes rather than with any variation of alkalinity, etc. Noting, however, that the tubercle bacillus seemed readily to assimilate even coagulated albumin, it was determined to try the effect of adding some form of soluble albumin, unaffected by the temperature necessary for the sterilization of the broth, and with this in view various casein preparations on the market, sold under patent names, were tried in order to ascertain if these, when added to the extract of potatoes, would ensure a medium giving constant and abundant growth of the tubercle bacilli. The preparation giving the most satisfactory results was that sold under the name of "Plasmon."

The medium is made in the following manner. Potatoes are skinned, then passed through a mincing machine, and the resulting pulp

* Lancet, 1914, ii. p. 892.

is weighed. To each pound one litre of water is added and allowed to extract over night at room temperature. The solid matter is now removed by straining through muslin, and the resulting fluid is heated in the autoclave to 115° C. A sufficient quantity of acetic acid to render the hot fluid faintly acid is next added, which causes the suspended matter, starches, albumins, etc., to agglutinate into large masses, rendering the passage of the fluid through filter paper rapid and easy. The fluid thus obtained is rendered faintly alkaline to litmus, and 0·25 p.c. of glucose, 5 p.c. of glycerin, and 200 c.cm. per litre of a 2 p.c. slightly alkaline solution of plasmon are added. On the addition of a white of an egg to each litre a further heating to 100° C. clears the fluid, and on filtration gives a clear brown-coloured broth, which is then distributed in flasks and sterilized by steaming for 30 minutes on three successive days. Agar medium can also be made from this broth, which gives an abundant growth of human tubercle bacilli having but very slight adherence to the agar surface, and in consequence easily lifted off with a coiled platinum wire, and floated on to the surface of broth when it is desirable to grow the organism on fluid media.

### (2) Preparing Objects.

**Gametogenesis of Grantia compressa.***—A. Dendy obtained this sponge from near the Plymouth Laboratory, from Drake's Island and Rum Bay. A large number were microscopically examined in the living condition, either by teasing, or by hand sections, or by pipetting out the contents of the central gastral cavity, but search for living spermatozoa was fruitless. The material that turned out satisfactory was fixed either in strong Flemming's solution, or in a mixture of Flemming, formol, and sea-water. In the former case, it was graded up after washing to 70 p.c. alcohol, in the latter it was preserved in formol sea-water.

The sections were for the most part cut of a thickness of $5\mu$, and stained on the slide. Iron-brazilin gave excellent results, but iron-hæmatoxylin was also used. For staining in bulk boraxcarmin or paracarmin was employed, the latter being sometimes followed by picro-indigo-carmin, but without much effect.

### (4) Staining and Injecting.

**Chromosome Complex of Culex pipiens.**†—Monica Taylor fixed the material in Benda's fluid, acetic bichromate, Gilson's mercuro-nitric, Flemming, and Gilson-Petrunkewitsch, the two latter being the most successful for the cytology proper; the two former were useful for interpreting cytoplasmic details. Thionin, iron-hæmatoxylin, Mayer's cochineal, Ehrlich hæmatoxylin, and safranin, were the stains employed. Many slides were first studied in thionin, and then the coverslip removed, the thionin washed out, the sections restained in iron-hæmatoxylin, and comparisons made between the results of the two stains. Although

* Quart. Journ. Micr. Sci., lxxxviii. Ser. B (1914) p. 319.
† Quart. Journ. Micr. Sci., lxxxviii. (1914) p. 379.

the aceto-carmin preparations of the whole gonad are very useful for mapping out quickly the main facts of spermatogenesis, they are not permanent, not so good for finer details, and not useful for somatic mitosis.

**New Reaction of Fats.***—L. Martinotti states that a group of dyes belonging to the class of amino-azo compounds has the property of fixing fats, and in the presence of an oxidizing agent of making them insoluble. In staining by this method, in which chrysoidin and chromium are the essentials, the material is fixed in 10 p.c. formalin, and the sections, cut on a freezing microtome, are immersed for five to ten minutes or so in a 1 p.c. aqueous solution of chrysoidin. After a wash, the sections are immersed in 10 p.c. chromic acid or potassium bichromate for one minute, then washed and mounted.

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

**Mounting Microfungi.**†—J. Burton recommends the use of the following medium as an excellent staining-mounting fluid: Pure glycerin 3 parts, distilled water 1 part, Hoffman's blue solution q.s. The exact quantity of the blue solution cannot be stated, but sufficient should be added to tint the fluid a rather dark blue when in bulk.

### (6) Miscellaneous.

**Diascopy of Traces of Blood.**‡—Angelo de Dominicis finds that the following procedure serves to detect traces of blood in cases where all other methods fail, and is especially valuable where a very small quantity of blood is present on heavily rusted iron. With dried blood adhering to a substrate, a scarcely visible particle is introduced into a trace of origanum oil on a Microscope slide placed on a white background, and is thoroughly disintegrated by means of the rounded end of a glass rod. After the addition of a drop of a saturated or more dilute solution of eosin in paracetaldehyde, the preparation is examined in artificial light passing through a suitable diaphragm. A drop of euparal may be employed subsequently to render the preparation permanent. Where the blood has penetrated the subtrate, the latter and the blood are scraped off by means of a sharp knife in the form of a fine powder, which is treated as above. Particles of blood appear wholly or partly coloured, and the red corpuscles, in groups or isolated, may be distinguished; the diameter of the corpuscles can be measured.

**Study of Restitution Masses.**§—W. De Morgan and G. H. Drew in their study of the restitution masses formed by the dissociated cells of the Hydroids, *Antennularia ramosa* and *A. antennina*, followed the

* Zeitschr. Phys. Chem., xci. (1914) pp. 425–39.
† Journ. Micrology (1914) p. 71.
‡ Boll. Chim. Farm., liii. (1914) pp. 162–3. See also Journ. Chem. Soc., cv. and cvi. (1914) ii. p. 759.
§ Journ. Marine Biol. Assoc. x. (1914) pp. 440–63 (9 figs.)

technique initiated by H. V. Wilson. The Hydroids were cut in pieces, and pressed through bolting silk, 50 meshes to the inch, with the result that isolated cells and small cell aggregates were obtained: these soon aggregated together to form compact masses, and in from 12 to 18 hours a perisarc was secreted by a definite layer of ectoderm cells. The endoderm cells form definite tubules similar in structure to the cœnosarcal tubules continuous with the enteric cavities of the normal hydranths. The masses were kept alive for at least 60 days. No sign of cell division was ever noticed, and hydranths never regenerated.

**Microchemical Detection of Aluminium.***—According to E. Kratzmann, characteristic crystals of cæsium alum are obtained when a drop of a solution containing an aluminium salt is mixed on a Microscope slide with a drop of a reagent consisting of equal volumes of a 2 mol. cæsium chloride solution and an 8 mol. sulphuric acid solution. As little as 0·001 mg. of aluminium nitrate may be detected by the test. Plant ashes may be tested directly, but the addition of sulphuric acid is recommended when much calcium carbonate is present. The crystals are also obtained when sections of plants are treated with the reagent. Aluminium is of very frequent occurrence in plants, but the "alumina grains" mentioned by Radlkofer and Wehnert as being present in the leaves of *Symploceæ* could be identified as aluminium compounds only in the case of *S. lanceolata* and *S. polystachya*.

## Metallography, etc.

**Growth of Metallic Eutectics.**†—F. E. E. Lamplough and J. T. Scott have sought to determine the effect of under-cooling at the beginning of solidification of the eutectic on the structure of lead-tin, cadmium-tin, and many other binary alloys. No relation could be discovered between under-cooling and the formation, around the primary crystals, of a halo or envelope of the second constituent, separating the primary crystals from the banded eutectic. Under-cooling almost always occurred when care was taken to prevent surface oxidation. Whilst in some cases considerable superfusion existed without the formation of such structures, in others marked halos were accompanied by slight superfusion only. When superfusion at the moment of eutectic formation was prevented, either by inoculation, or by shaking, the formation of the envelope was in no way affected. By quenching at various stages in the formation of the eutectic, it was ascertained that in some cases the growth of the eutectic originated at the primary crystals, while in other cases the growth of the eutectic was independent of the primary crystals. The halo appeared to be formed around a primary crystal when the eutectic, originating independently, had reached the primary crystal in its growth. The solidification of the eutectic at this point consisted in the deposition

* Journ. Chem. Soc., cv. and cvi. ii. (1914) p. 678.
† Proc. Roy. Soc., Series A, xc. (1914) pp. 600–4 (4 figs.).

of a layer upon the surface of the primary crystal of that constituent present as primary, the other constituent solidifying as an envelope surrounding the primary.

**Hardening of Metals.***—C. A. Edwards and H. C. H. Carpenter develop a theory of the cause of the hardening of steel and other alloys upon quenching. In the operation of quenching such alloys, severe stresses are set up which cause pronounced crystal twinning. This twinning appears to be directly connected with the intensity of the thermal changes, such as the $Ar_1$ inversion, which occur when the mass is slowly cooled, but are suppressed by quenching. At all the surfaces of slip upon which twinning occurs, amorphous layers are formed, similar to those developed when a metal is hardened by cold-working. The hardening resulting from quenching is due to the presence of the amorphous layers. The authors regard martensite as austenite in which twinning has occurred.

**Theory of Hardening.**†—A. M'Cance gives the results of experimental work on which he bases a theory of the hardening of steel by quenching. $\beta$-iron is not a separate allotropic condition, but is $\alpha$-iron which has lost its ferromagnetism through purely thermal causes. On cooling, the change from $\gamma$ to $\alpha$-iron takes place with very high velocity, and cannot be appreciably retarded by quenching. A quenched steel contains carbon in the state of solution, which retains a portion of the iron in the $\gamma$ condition. Most of the iron is in the $\alpha$ condition, but is hard owing to its state of interstrain, resembling the state of a metal hardened by cold-working. The author describes a peculiar structure developed in a disk of steel, containing 0·86 p.c. carbon, clamped between two larger masses, heated, and quenched, so that the disk was cooled only from its edge. A number of concentric zones, alternately hard and soft, and appearing alternately light and dark in the polished and etched surface, were found surrounding the dark-etching centre of the disk.

**Cast-iron of Unusual Structure.**‡—K. W. Zimmerschied describes the structure of a cast-iron consisting wholly of pearlite and graphite, and compares it with cast-irons having more usual structures.

**Titanium nitride in Steel.**§—G. F. Comstock has investigated the constitution of certain hard non-metallic inclusions found in rails made from steel, to which ferrotitanium had been added. They were never found in rail steel which had not been treated with titanium. The inclusions were minute, were not segregated in groups but always uniformly distributed through the section of the rail, and were not elongated in the direction of rolling. They were usually rounded in shape, and sometimes

* Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 138–91 (28 figs.).
† Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 192–265 (24 figs.).
‡ Foundry, xliii. (1914) pp. 404–8 (11 figs.).
§ Met. and Chem. Eng., xii. (1914) pp. 577–80 (16 figs.).

had angular outlines. In the light from a carbon arc they appeared bright pink in colour. As it was not possible to isolate sufficient of the substance for analysis, various compounds of titanium were incorporated with untreated rail steel, melted in a vacuum, until a substance was found which gave inclusions having the same microscopic characteristics as the pink spots. Titanium sulphide and carbide did not give pink inclusions. Titanium nitride gave inclusions precisely similar to those found in the rail steel, and the same result was obtained when the experiment was repeated with special precautions to exclude alumina, thus indicating that the pink inclusions were not alumina coloured with titanium. The author concludes that the pink inclusions are titanium nitride, possibly containing small amounts of iron or carbon, but no alumina.

**Structure of Manganese Steel.***—In the course of an investigation upon the magnetic and mechanical properties of steel containing 12 p.c. manganese and 1·25 p.c. carbon, R. A. Hadfield and B. Hopkinson have examined specimens microscopically. Quenched from 1000° C. the alloy had a fine-grained polygonal structure, and was non-magnetic and tough. On heating for some hours at 500° to 600° C., the material became magnetic and brittle, and developed an acicular, martensite-like structure. The changes occurring were more evident in specimens which were polished and not etched. The alloy quenched from 1000° C. showed no structure. After heating at 400° C. for six hours, and polishing, the surface became covered with interlacing lines, apparently the edges of plates of hard material. Further heating at about 400° C. caused a growth in the amount of the hard constituent, which appeared to form a stiff unyielding network enclosing grains of a more ductile material. A steel containing 2 p.c. carbon, 0·14 p.c. manganese, quenched from 1200° C., consisted largely of austenite, which was changed to martensite by heating for 75 hours to 200° C.

**Failures of Heavy Boiler Shell Plates.**†—S. A. Houghton discusses the causes of a number of failures of mild-steel boiler plates. Among the defects described and illustrated by photomicrographs are carbonless bands, some of which were high in phosphorus content, local deformation caused by hammering, blowholes, coarse crystallization, and sulphide and silicate inclusions.

**Sulphides in Steel Ingots.**‡—J. O. Arnold and G. R. Bolsover describe the microscopic forms of the sulphide inclusions found in a number of experimental steel ingots containing different amounts of sulphur and manganese, with about 0·25 p.c. carbon. In ingots containing less than 0·1 p.c. manganese and about 0·6 p.c. sulphur, pale brown meshes of iron sulphide only were seen. With 0·4 to 1·1 p.c. manganese, and 0·4 to 0·6 p.c. sulphur, the specimens contained both the pale brown iron sulphide and dove-grey manganese sulphide. An

* Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 106–37 (14 figs.).
† Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 266–316 (31 figs.).
‡ Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 396–406 (7 figs.).

ingot with 1·01 p.c. manganese, 0·28 p.c. sulphur, contained only the dove-grey manganese sulphide. The existence, at some stage in the solidification of the steel, of a eutectic of iron and sulphide of manganese, is inferred from the appearances observed.

**Recrystallization of Deformed Iron.***—C. Chappell describes and discusses the changes of structure, in relation to temperature, which occur when cold-worked iron and steel are heated. In uniformly deformed specimens no change takes place in the external boundaries of deformed ferrite crystals up to about 500° C. At about 350° C., however, changes begin to occur within the crystals. Rough granular markings in the etched crystals, frequently in the form of parallel bands, appear to be regions in which disintegration and incipient recrystallization of the deformed ferrite crystals have taken place. These markings indicate the recrystallization of the very severely deformed ferrite existing on and about the planes along which deformation of the crystal had taken place during cold-working. The disintegration of the crystals develops with rise of temperature until at about 500° C. many of the crystals present a completely granular appearance. With further rise of temperature, minute independent crystals appear in the disintegrated regions: these crystals grow with great rapidity. At about 570° C. the crystal debris is wholly replaced by the new crystals. From 570° to 700° C. these crystals steadily increase in size; above 700° C. further growth is very slow, until complete recrystallization occurs at $Ac_3$. Numerous experiments were made on the recrystallization on heating of locally deformed specimens, in which the degree of deformation varied from point to point. The gross crystallization occurring under certain conditions, in such specimens, is described and explained. It is suggested that the growth of crystals on annealing takes place by the sudden combination into one crystal of two or more contiguous crystals, and not by the gradual absorption by a large crystal of the smaller crystals surrounding it. The process of recrystallization of deformed ferrite crystals is one of refinement followed by growth. The extent to which refinement takes place increases proportionately with the degree of plastic deformation. The ultimate crystal size after annealing deformed iron may be regarded as the resultant of these two opposing tendencies, and increases regularly with decrease in the degree of deformation. The temperature of crystallization becomes lower with increase in the degree of deformation.

**National Physical Laboratory.**—A Leitz† Metallograph has been installed, and has proved useful for rapid work. Two metallurgical Microscopes have been mounted on hinged supports, over openings in the table. By a single movement of the hand, the Microscope can be pushed into a receptacle, formed by a large bellows, beneath the table; the opening being then covered, the table is clear, and the Microscope completely protected. The progress made in various researches is indicated in the report.

* Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 460–502 (25 figs.).
† Nat. Phys. Lab. Annual Report, 1913–14.

**New Reagent for Etching Mild Steel.***—W. Rosenhain and J. L. Haughton, give an amplified account of this reagent.† The formula recommended is :—

| | |
|---|---|
| Ferric chloride ($Fe_2Cl_6$) .. .. .. .. .. | 30 grm. |
| Hydrochloric acid (conc.) .. .. .. .. | 100 c.cm. |
| Cupric chloride ($CuCl_2$) .. .. .. .. .. | 1·0 grm. |
| Stannous chloride ($SnCl_2$) .. .. .. .. | 0·5 ,, |
| Water .. .. .. .. .. .. .. .. .. | 1 litre. |

The steel surface must be perfectly clean before etching ; this is best secured by finishing the polishing on a very wet block, washing the specimen immediately in a jet of alcohol, and immersing it completely in the reagent. The structure of martensite is developed very clearly. The principal value of the reagent, however, lies in its capacity for indicating phosphorus segregation, as described previously.

* Journ. Iron and Steel Inst., lxxxix. (1914, 1) pp. 515–27 (17 figs.).

† See this Journ., 1914, p. 222.

# PROCEEDINGS OF THE SOCIETY.

## MEETING

HELD ON THE 21ST OCTOBER, 1914, AT 20 HANOVER SQUARE, W. E. HERON-ALLEN, ESQ., F.L.S., F.G.S., VICE-PRESIDENT, IN THE CHAIR.

**The Minutes** of the Meeting of June 17, 1914, were read, and when confirmed were signed by the Chairman.

**The List of Donations** (exclusive of exchanges and reprints) received since the last Meeting was read as follows, and the thanks of the Society were accorded to the donors :—

| | From |
|---|---|
| Professor Sigmund's Histological Preparations. Part 8, with text .. .. .. .. .. .. .. .. .. .. .. | *Messrs. Carl Zeiss, London.* |

**The Chairman** said it had been considered desirable to announce from the Chair that the Conversazione which should ordinarily have taken place that evening had been postponed owing to circumstances over which indeed they had no control, but which, however, it was to be hoped would not affect them as a scientific society. He wished to say that a debt of gratitude was due from all to Messrs. Scourfield and Rousselet for the immense amount of trouble they had taken in the preparations for that Conversazione, some of the results of which were being exhibited to Fellows of the Society that evening. They had thrown themselves into the scheme with the enthusiasm all knew they possessed, and they and their friends had drawn upon their inexhaustible stores and brought together an exhibition of Entomostraca and Rotifera which would, he knew, be greatly appreciated by all. He would ask Mr. Scourfield and Mr. Rousselet to say a few words on the subject of this exhibition.

**Mr. Scourfield** in the course of his remarks on the exhibition of Rotifers and Entomostraca, said that it had been considered advisable to arrange occasionally an exhibition of a particular group or groups of organisms with the help of those who had not specialized in that direction, for not only should such an exhibition prove of benefit to the exhibitors themselves, but it would be useful in aiding Fellows and visitors to concentrate their attention for a little while on some one or two types of microscopic life. He wished to take the opportunity of thanking those who had responded so well in giving up their own exhibits that evening in order to come forward and show things with which they were not perhaps specially familiar.

It was unfortunate that certain forms of the Entomostraca and Rotifera were not easily obtainable just when required, and so in order to fill up some of the gaps a few mounted and preserved specimens were being shown, but the majority of the exhibits were living specimens. Personally, he could only speak about the Entomostraca, and of these there were one or two forms belonging to the order Cladocera to which he would like to draw attention. For instance, there was *Holopedium gibberum*, the sole member of the family Holopedidæ, which was surrounded by a nearly spherical and remarkably hyaline mass of jelly. This species was not to be found in the south and east of England but only in certain lakes in Scotland, Ireland, and the Lake District, living away from the shore, out in the open water. The meaning of the jelly was not very evident, whether it served as a float or as a protection against being taken for food by other animals. The jelly was probably tasteless and not very nourishing and therefore not particularly palatable to fishes. The remarkable persistence of the jelly was proved by the fact that he had taken perfectly recognizable examples from the bottom of Loch Morar, the deepest lake in the British Isles, where they had possibly been for several years.

Of the family Daphnidæ there were four different genera represented, viz. *Daphnia*, *Simocephalus*, *Ceriodaphnia*, and *Scapholeberis*. Species of *Simocephalus* differed from those of *Daphnia* by having no shell-spine and by the tip of one of the setæ on the antennæ being modified into the form of a tiny hook, by means of which the animal could suspend itself even from glass. This was explained by the fact that the hooks could usually discover minute irregularities in the glass unless the latter had an exceptionally good surface. *Ceriodaphnia* differed from ordinary *Daphnia* by having hexagonal markings over the valves. *Scapholeberis* was interesting because of its being the only representative of the order (Cladocera) making use of the surface film. By means of little hairs and scales on the flattened ventral margin it could produce minute capillary depressions in the water which thus held the animal suspended just under the surface.

Another family, the Macrothricidæ, was represented by a bottom-loving form, *Ilyocryptus agilis*, incapable of proper swimming. It was red in colour, which was a characteristic of bottom forms, due probably to a substance resembling hæmoglobin, and no doubt possessing the same function of taking up and retaining a considerable amount of oxygen. This species was rare—in fact the one shown was the first he had seen in the Epping Forest district, in spite of much collecting extending over many years. He had, however, found it on two or three occasions elsewhere—first of all in the *Victoria regia* tank at the Royal Botanic Gardens in Regent's Park.

The family Chydoridæ, better known as the Lynceidæ, was represented by two rather rare species, *Camptocercus rectirostris* and *Chydorus globosus*.

Lastly he might refer to a mounted specimen of *Leptodora kindtii*, which species formed the type, and was the only representative of the family Leptodoridæ. It was remarkable for its large size, being nearly ½ in. in length, and its extremely hyaline character. It lived in the open water, and no doubt depended upon its transparency to enable it to get into touch with its prey, which consisted of other Entomostraca.

In conclusion, he said that in exhibitions of this kind there should evidently be some reciprocity, and he therefore trusted that those who specialized on groups other than those before them that evening would insist upon organizing similar exhibitions of their own favourite organisms, when he was sure they could rely on the same generous help that he and Mr. Rousselet had received on that occasion.

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**The Chairman** called upon Mr. Rousselet to make a few remarks on the subject of the Rotifera brought to their notice that evening.

**Mr. Rousselet** said that he had tried to bring together a collection of Rotifera from the ponds for purposes of exhibition that evening, but it had been exceedingly difficult to find good specimens owing to the long continued very dry weather. He had, however, brought about twenty different species of well known forms, and a number of slides of Australian Rotifera. There was also one specimen from China. He would like to acknowledge his gratitude to Fellows for having so kindly brought their Microscopes for the purpose of exhibiting these various forms.

The very hearty thanks of the Society were accorded to Messrs. Scourfield and Rousselet for their very interesting exhibition and communications.

**The Chairman** said he wished to take this opportunity of bringing to the notice of the Society two very noteworthy books, with a view to their occurrence being recorded in the Journal. It was a subject which was perhaps of interest mainly to Bibliographers of Microscopical Science, as the books were of extremely early date, but as he had become the fortunate possessor of the two books, one of which was apparently unique, and the other being one of only two known existing copies, he thought it would be interesting to record them in the Journal.

Both these books referred to the subject in which he and Mr. Earland were particularly interested, namely the Foraminifera. The first was a work by Walker and W. Boys, entitled "**Testacea minuta rariora, nuperrime detecta in Arena Littoris Sandvicensis a Gul. Boys Arm. S.A.S. Multa addidit et omnium figuras ope Microscopii ampliatas accurate delineavit Geo. Walker." London, 4to,** by no means a rare book *per se*, as there were a considerable number of copies extant, but these copies merely had the legend upon the title page "Printed for the Author" without any date. In a copy of the work in the library of the British Museum, there was a letter from the author, William Boys, to Sir Joseph Banks, stating that he was sending him a copy of his book, with the usual complimentary observations, and bearing date the 2nd May, 1784.* A little time ago he (the speaker) had secured a copy of this work from a scientific bookseller to send to a friend in Germany who had never seen it, and on looking at the title page he found inscribed there, instead of the usual legend "Printed for the Author" a

* See W. K. Parker and T. Rupert Jones, "On the Nomenclature of the Foraminifera," Ann. and Mag. Nat. Hist., Ser. 3, iv. (1859) p. 334.

list of booksellers, but still no date; at the back of the title page, however, was a small square printed label gummed on, headed "Errata," containing a list of five corrections to be made in the text, and at the bottom, "The Defects in the Punctuation it is hoped will be excused; and the Date May 1, 1784, added at the End of the Introduction."

The other book he would like to bring to the notice of the Society was really a triumph for the collector: It was a book mentioned in Sherborn's Bibliography under the heading Batsch. The work of Batsch was a trial to students of the Foraminifera because his book was most extraordinarily scarce, yet he was the first authority for the specific nomenclature of several very important Foraminifera. Mr. Sherborn records Batsch's well-known "Sechs Kupfertafeln mit Conchylien des Seesandes, gezeichnet und gestochen von A. J. G. K. Batsch," a work published in 1791, which consisted of six copper-plates, some copies of which were coloured by hand, and a wrapper on which was printed their description. Of this original work there were some five or six copies known to be extant, the only perfect copy in England being in the library of the Royal Society. Then Mr. Sherborn gives the title of a Latin edition of this work: "**Testaceorum/Arenulæ Marinæ/Tabulæ Sex Priores/ad opus, Testacea minutiora, hucusque [? minusque] nota, nondum in scriptis divulgata, accuratius designata complectens elaboratæ, speciminis loco secundum naturam delineatæ et aeri incisæ.** 4to, *Jena*, 1791": which he stated to have been referred to by Schroeter in 1803, and he gave the full title from Engelmann's Bibliography of Natural History published in 1846. A little time ago he had advertised in the "Publisher's Circular" for certain extremely rare books on the Foraminifera which he had been anxious to get—Batsch among the number—and a bookseller wrote saying he had a copy, and sending for it he had found on its arrival that it was the "Testaceorum arenulæ," the Latin edition referred to by Schroeter in 1803, and which had apparently disappeared since that date. He collated the title with Engelmann's description of it, and found at least four discrepancies in the title as transcribed by Sherborn in his bibliography. The correct title is as follows: "Testaceorum/Arenulæ Marinæ/Tabulæ Sex Priores/ad opus, Testacea minutiora, huc usque nota, vel nondum/in scriptis divvulgata, accuratius designata complectens/elaborandum, speciminis loco secundum naturam/delineatæ et aeri incisæ ab Aug. Io Georg. Car. Batsch/Profess. Ienensi/Ienæ Saxorum/Prostant in Bibliopolio Academico/in Commissis m.d.cc.xci." There was no copy of this work in the Library at Jena, nor had he (the Speaker) been able to find a copy in any public library in Europe, at which he had been able to make enquiries.

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**The Chairman** announced that the Roll was there for Fellows to sign who had not already done so.

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The next Meeting of the Biological Section would be held on Wednesday, November 4, at the Society's Rooms, at 7 o'clock.

That of the Brass and Glass Section would be held on Wednesday, October 28.

The death on July 12 of Mr. John Hood, a Fellow of the Society since the year 1881, was recorded with regret. For many years he collected Rotifera for Mr. P. H. Gosse, Dr. C. T. Hudson, and many others, and wrote several papers on Rotifera; he also discovered a good many new species of Rotifers in the Scottish Lochs and the pools around Dundee.

The Chairman further said that he had been asked by Mr. Ogilvy to call the attention of the Society to the fact that he and several coadjutors were making an effort to get up lectures in the nature of entertainments for the benefit of our soldiers in camps, who were waiting to be sent on foreign service, or were training for home defence, thereby hoping to lighten the periods of idleness and lack of occupation and amusement which must be felt during the long winter evenings. These lectures would take the form of interesting and popular discourses on zoology, natural history, medicine, and hygiene, in so far as these subjects were likely to affect the men in the field and camp. Mr. Ogilvy would be glad to have the names of any Fellows of the Society who would be willing to offer their services as lecturers, or who would throw themselves into the scheme by lending Microscopes or lantern slides, and arrangements would be made to convey both the lecturers and their apparatus and demonstrations by motor car to and from the camps. He was quite sure that such a scheme would appeal to the sympathies of the Fellows and meet with a cordial reception, in the knowledge that they were doing a real service to these men by affording them interest and entertainment in a life which, when the day's work is over, was apt to be monotonous, and devoid of interest.

The following Rotifera were exhibited:—

| | |
|---|---|
| Mr. C. F. Rousselet . . | *Anuræa aculeata.* |
| ” ” . . | *Anuræopsis hypelasma.* |
| J. Milton Offord . . . | *Asplanchna brightwelli.* |
| Mr. Daniel Davies . . | *Brachionus pala.* |
| Mr. Robert Paulson . . | *Callidina nana.* |
| Mr. C. F. Rousselet . . | *Cephalosiphon limnias.* |
| ” ” . . | *Diurella Dixon-Nuttalli.* |
| Mr. G. K. Dunstall . . | *Habrotrocha pusilla*, etc. |
| Mr. E. E. Banham . . | *Hydatina senta.* |
| Mr. C. F. Rousselet . . | *Limnias ceratophylli.* |
| ” ” . . | *L. cornuella.* |
| Mr. E. Cuzner . . . | *Melicerta ringens.* |
| Mr. E. E. Banham . . | *Metopidia lepadella.* |
| Mr. David Bryce . . . | *Philodina aculeata.* |
| ” ” . . | *P. roseola.* |
| Mr. C. F. Rousselet . . | *Polyarthra platyptera.* |
| Mr. S. C. Akehurst . . | *Stephanoceros Eichhornii.* |
| Mr. H. Jewell . . . | Ditto ditto. |
| Mr. C. F. Rousselet . . | *Synchæta oblonga.* |
| ” . . | *S. pectinata.* |

Slides of Australian Rotifera shown by Mr. C. F. Rousselet:—

*Lacinularia elliptica* (Shephard).
*L. natans* (Western).
*L. pedunculata* (Hudson).
*L. reticulata* (Anderson and Shephard).
*L. striolata* (Shephard).
*Megalotrocha spinosa* (Thorpe).
*Trochosphæra æquatorialis* (Semper).
*T. solsticialis* (Thorpe).

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The following Entromostraca were exhibited:—

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|---|---|
| Mr. Thos. N. Cox . . | *Bosmina longirostris.* |
| Mr. W. Baddeley . . . | *Camptocercus rectirostris.* |
| Mr. C. D. Soar . . . | *Ceriodaphnia laticaudata.* |
| Mr. C. H. Huish . . . | *Chydorus globosus.* |
| Mr. Tierney . . . | *Chydorus sphæricus.* |
| Mr. W. R. Traviss . . | *Daphnia pulex.* |
| Mr. James Grundy . . | *Diaptomus gracilis.* |
| Mr. H. Whitehead . . | *Holopedium gibberum.* |
| Mr. C. J. H. Sidwell . . | *Ilyocryptus agilis.* |
| Mr. W. Gardner . . . | *Leptodora kindtii.* |
| Mr. D. J. Scourfield . | *Leydigia quadrangularis.* |
| Mr. W. J. Marshall . . | *Scapholeberis mucronata.* |
| Mr. J. Wilson . . . | *Simocephalus vetulus.* |

Amphipoda.

| | |
|---|---|
| Mr. N. E. Brown . . . | *Talitrus allmandii.* |

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**New Fellows.**—The following were elected *Ordinary* Fellows of the Society:—Charles S. Boyer, A.M., H. Bertram Harding, John Rudd Leeson, M.D., C.M., F.R.A.S., etc.

## MEETING

HELD ON THE 18TH NOVEMBER, 1914, AT 20 HANOVER SQUARE, W., MR. J. E. BARNARD, VICE-PRESIDENT, IN THE CHAIR.

**The Minutes** of the Meeting of October 21, 1914, were read, and, when confirmed, were signed by the Chairman.

**The List of Donations** (exclusive of exchanges and reprints) received since the last Meeting was read as follows, and the thanks of the Society were accorded to the donors :—

| | From |
|---|---|
| An old portable Microscope, by Cary .. .. .. .. | *Mr. E. E. Banham.* |
| Six ivory sliders of botanical sections .. .. .. .. | *Mr. T. G. Taylor.* |

**Mr. Rousselet** said that the portable Microscope designed by Cary in 1828 would prove a valuable addition to the collection of the Royal Microscopical Society.

**Mr. Frederic J. Cheshire** made a communication on "Some Notes on Focometric Methods," which was elucidated by means of the various forms of Focometric apparatus and by illustrations drawn on the black-board.

Mr. Maurice Blood remarked that some time ago Mr. Cheshire had brought his apparatus to the notice of members of the Brass and Glass Section, and he (Mr. Blood) had then arranged with Mr. Cheshire to bring up nearly 100 objectives, eye-pieces, condensers, etc., to the Society in order that their focal length should be measured by Mr. Cheshire's first apparatus. Time did not allow of the whole number being measured, but a considerable number were, and in an entirely satisfactory and wonderfully rapid manner. He had been particularly struck, too, by the neatness of Mr. Cheshire's turn-table apparatus, which he (the speaker) certainly thought was new as Mr. Cheshire claimed, and Mr. Cheshire spent a large part of his time in demonstrating to other people that their "novelties" were old, so that when he ventured on such an assertion it meant a good deal.

Mr. Bruce J. Capell said that a good many of the lenses were made to use for a particular objective so as to be accurate so far as corrections went ; he would like to know whether there would be any difficulty at all in gauging the focal length as read, say, in an objective made for a short tube. He understood that Mr. Cheshire's apparatus was made for a uniform Microscope and a uniform distance. Was any difference made by variations in the correction? Mr. Cheshire spoke of parallel rays, and in these there was only one focus.

Mr. Cheshire, in his reply, said that his apparatus gave simply the distance on the axis between nodal and principal focal points without any reference to the positions of the conjugate points for which the objective was corrected, i.e. for which it satisfied the sine condition.

Mr. Rheinberg said he would like Mr. Cheshire's opinion on an old "pinhole" method, which he found convenient and very quick for measuring the focal lengths of complicated lens systems, though he had not attempted to apply it to Microscope lenses. A pinhole photograph of, say, 50 cm. focus was taken, once and for all, of a distant view including two points of reference—for example, two lamp-posts. To measure the focal length of a lens system it was then only necessary to focus the same view by its means on a piece of ground-glass, and measure the distance between the two lamp-posts in the image. The desired focal length then equals :—

$$\frac{\text{Distance between the lamp-posts in the image} \times 50 \text{ cm.}}{\text{Distance between the lamp-posts in the pinhole photograph.}}$$

Mr. Cheshire pointed out that he (Mr. Rheinberg) was evidently referring to an approximate method of finding the focal length of a photographic lens in which, in effect, the size of the image of a distant object *of known angular size* is determined. The preliminary pinhole determination gives this angular magnitude once for all so long as the same distance of the object is maintained.

Mr. T. F. Connolly said that as a visitor to the Society he would like to say he was extremely interested in the simplicity and neatness of Mr. Cheshire's methods. He thought the last instrument described was theoretically perfect, but there was one practical objection to it from the point of view of anyone desiring to determine varied focal lengths. The objective had practically to be mounted as a telescope pivoted over the graduated circle. Dealing with varying focal lengths would mean that a fairly elaborate apparatus to take the objective would be demanded. He would like to congratulate the speaker on the simplicity of the apparatus shown.

In reply to Mr. Connolly's objection, Mr. Cheshire said he agreed with the speaker that the rotating table focometer was not well adapted for determining focal lengths quickly. It furnished rather, in his opinion, a court-of-appeal method. In the collimator method the telecentric disc was preferably adjusted in the principal focal plane of the objective to be tested by using a two-lens afocal system as an eyepiece, or more simply by taking out the draw-tube and focusing the objective directly by looking down the body tube. As a matter of fact, however, the remarkable thing was that in this apparatus, once the scale in the collimator had been adjusted very accurately, it appeared to be almost a matter of indifference where the lens whose focal length was to be tested was placed so long as the highest order of accuracy was not required. By putting the lens on the telecentric disc, very good results were obtained.

The Chairman (Mr. Joseph E. Barnard) said he was sure Mr. Cheshire's paper had been extremely interesting, and was indeed such a model of lucidity as might be expected from the author. The method described was a simple one, and what was of most importance seemed to be easily applicable to the Microscope. The ascertaining of the exact focal length of an objective had always been a subject for discussion, for which there seemed to be no sort of finality. Mr. Cheshire's arrangements were simple as well as novel, and all the more meritorious for that reason. The use of a telecentric disc instead of a central spot was one of the most important points in the whole process, and instituted an advance in focometric methods. Further, there was no subsidiary optical system introduced to complicate or lessen the accuracy of the results. There was one little point mentioned by Mr. Cheshire, but which was really outside the range of the subject, and that was the employment of sodium light as a source of monochromatic light. He thought a very much better source was obtained by using the green lines in the spectrum of the mercury arc, as this approached as nearly as possible to the monochromatic light. He wished to express the indebtedness of himself and the Society to Mr. Cheshire for his interesting paper, and he was sure that all present would show their appreciation of what they had heard.

In reply to Mr. Barnard's criticism in regard to sodium light being employed as a source of monochromatic light, Mr. Cheshire nodded assent.

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**Dr. Shillington Scales** gave notice that the next General Meeting would be asked to suspend By-law 36 so far as related to the President, for twelve months. According to By-law 37, the duty of the present Council was to make up a list of the proposed Council for the ensuing year. Four Ordinary Members would retire, and, according to the rules and by-laws of the Society, nominations for the Council were made in November by the Council, and voted for at the Annual Meeting in January. It had been suggested, however, that Fellows would appreciate more opportunities of nominating Fellows of their own choice to the Council than was provided hitherto, and so it had been arranged that the four vacancies should not have definite nominations made for them by the Council now, but that the Fellows of the Society should be asked themselves to suggest names between now and the next meeting, failing which the Council would proceed in the usual way. If any Fellows present, therefore, wished to take advantage of this proposal, it would greatly facilitate the work of the Council if they would send in their suggestions before the next Council Meeting.

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**The Chairman** announced that the next Ordinary Meeting would be held on December 16, when he (Mr. Barnard) would make a communication on the subject of X-rays in relation to the Microscope.

The next Meeting of the Biological Section would be held on December 2, at 7 o'clock, in the Society's Rooms.

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

Focometric Apparatus of various types, by Mr. Frederic J. Cheshire.

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**New Fellows.**—The following gentlemen were elected *Ordinary* Fellows of the Society :—G. A. C. de Boinville, Edward J. Stormer.

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