JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

F. JEFFREY BELL, M.A.,

One of the Secretaries of the Society
and Professor of Comparative Anatomy and Zoology in King's College;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

A. W. BENNETT, M.A., B.Sc., F.L.S.,
Lecturer on Botany at St. Thomas's Hospital,
R. G. HEBB, M.A., M.D. (*Cantab.*), AND

J. ARTHUR THOMSON, M.A.,
Lecturer on Zoology in the School of Medicine, Edinburgh,

FELLOWS OF THE SOCIETY.

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JOURNAL
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AUGUST 1893.

TRANSACTIONS OF THE SOCIETY.

VIII.—*Notes on some of the Digestive Processes in Arachnids.*

By Henry M. Bernard, M.A. Cantab., F.Z.S.,
from the Huxley Research Laboratory.

(*Read* 19*th April*, 1893.)

Plate VI.

Observations on the digestive processes of the Arachnids have hitherto, as far as I am aware, been mainly confined to the Araneids. A comparative treatment of the subject suggested itself to me during my researches on the comparative anatomy and morphology of the

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EXPLANATION OF PLATE VI.

Fig. 1.—Two digestive cells of a Chernetid (one only in outline). Beneath, i. e. outside the basement membrane, are seen the vacuolated peritoneal cells. The fæcal "crystals" are seen streaming out into the lumen of the gut between the cells.

Fig. 2.—The different stages, as seen under the Microscope, in the reduction of the homogeneous food-globules into the fæcal "crystals."

Fig. 3.—Three digestive cells of *Scorpio*. The food-globules are being assimilated within large vacuoles, there being one vacuole in each cell, The distal end of the cell is a dense cushion of granular staining protoplasm, through which the fæcal "crystals" pass. The peritoneal cells are filled with food-globules apparently temporarily stored up. Here and there these globules are being digested and reduced to "crystals," which escape into the blood and are found in the blood-corpuscles.

Fig. 4.—A group of digestive cells of *Scorpio* crowded out of the epithelium, and floating free in the lumen of the gut. The nuclei are completely obscured.

Fig. 5.—Part of section of the abdomen of an emaciated house-spider; small parts of four digesting diverticula are seen; the fæcal crystals are massed close to the basement membrane. Two fragments of Malpighian tubules are seen running through the highly vacuolated peritoneal cells; these tubules are crowded with fæcal "crystals."

Fig. 6.—Portion of a longitudinal section of an abdominal diverticulum of a *Galeodes græcus;* the epithelium is completely disorganized. A small mass of stained coagulum (containing moth's scales) not yet converted into food-globules in the middle. The fæcal "crystals" have sunk to the ventral side of the tube. They are seen in a bright yellow fluid, which is the assimilable product of the food-globules. This is also seen dorsally on the outside of the tube, having passed through the basement membrane, to mix with the blood. No trace of a peritoneal layer is visible.

Fig. 7.—A group of digesting cells of *Galeodes araneoides* (?) showing mulberry-like food-masses breaking down into fæcal "crystals." These food-masses have

Galeodidæ. As might be expected in such an unworked field, many points have come to light not only new in themselves, but affording new interpretations of facts well known but incompletely understood.

For the sake of clearness, I shall keep the observations on each group distinct.

The Chernetidæ.

I take these first because, as will be seen from what follows, they are in many respects the least specialized. The specimens examined were *Obisium museorum* and *O. cancroides*, kindly given me by Dr. Günther, F.R.S.

The digesting cell of *Obisium* is a large lobate body, so filled with food-globules that the nucleus is quite obscured (fig. 1). I have not been able to follow the conversion of the food, which in the sections looks like a granulated coagulum lying in the lumen of the gut, into the clear, homogeneous food-globules within the cells.

The importance of commencing with the Chernetidæ lies in the fact that the homogeneous spherules in the mid-gut cells of these animals are at once recognizable as food-globules, and not as the secretions of gland-cells. In the Araneids, on the other hand, this point is not so evident. The long, thin tubules branching from the gut in these latter animals are more like glands than digesting diverticula, and they have almost universally been considered as such. There was, therefore, every excuse for those who examined these gland-like diverticula when they imagined that the contents of the cells were secretions which were to be poured into the gut for the digestion of the food. It is true that Bertkau found that food sucked in found its way to the tips of these diverticula, but that fact alone was hardly sufficient to lead him to recognize the refractive globules in the cells as ingested food. Had he begun with any of the Chernetidæ, as I was fortunate enough to do, he would at once have recognized this fact, because in these Arachnids it is quite impossible to mistake the mid-gut diverticula for glands of any kind; they are simple distensions, often very shallow, of the digestive tube.

While, therefore, the observations of Plateau * and Bertkau †

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dropped out of some of the vacuoles in the process of section-cutting. The protoplasm of the cell is much vacuolated. A tracheal tube runs through the peritoneal cells.

Fig. 8.—A group of vacuolated digesting cells of *Rhax*, there being no food-globules in the vacuoles. The whole digestive system is empty, excepting that here and there groups of fæcal "crystals" occur, the remains of a previous meal, which have failed to find their way out into the central canal.

* "Recherches sur la structure de l'appareil digestif et sur les phénomènes de la digestion chez les Aranéides dipneumones.' In three parts. Bull. Ac. R. Bruxelles, xliv. (1877).

† "Über den Bau u. die Function der sog. Leber bei den Spinnen," Arch. f. Mikr. Anat., xxiii. (1884).

retain their value as records of facts, they require re-stating from this new point of view, viz. the contents of the so-called liver-cells are not products of secretion, but food in various stages of digestion.

It is worth noting that these food-globules are quite indistinguishable from those found in Amœbæ, which have the appearance of oil-drops. In neither case, however, do they consist of pure fat. The food-globules in the digesting cells of Araneids, according to Bertkau, do not darken under the action of osmic acid more deeply than the other parts of the cells. They do not dissolve in ether, and are easily dissolvable in glycerin and water.

In the process of assimilation, these homogeneous globules become first finely and then coarsely granular, and are gradually transformed into groups of small refractive bodies which look black by transmitted, but white by reflected light (fig. 2). If the food-globule is small, one single crystal-like body is all that is left. * These so-called "crystals" are either rhomboidal, or rod-like, or they may have no definite form. This breaking-down of the food-globules is clearly indicated in Bertkau's drawings.

Following these crystal-like residual bodies further, we find that they are gradually excreted at the sides of the cells (fig. 1), and that here they slowly collect, to be discharged in a stream into the lumen of the gut, where they mix with the raw food not yet taken up by the digesting cells and converted into the fat-like food-globules. From end to end of the digesting portion of the canal, these small fæcal bodies are to be found mixed with the sucked-in food. The separation is effected at the point where the canal suddenly narrows to form the hind-gut. Whether this long coiled tube is morphologically the true hind-gut, I cannot say, but functionally it must be considered as such. At this point the epithelium suddenly changes, and a thick stream of the crystalline bodies is seen leaving the coagulated food in the mid-gut and forming into fæcal masses, which are to be found at intervals along the hind-gut as far as the stercoral pocket. In this pocket a great number of the fæcal masses accumulate, being held back for some reason before being finally ejected.

A close examination of the contents of the stercoral pocket shows that it consists almost entirely of countless numbers of these minute crystal-like bodies which in the aggregate also look black by transmitted light, but are chalky white by reflected light. The only other substance I could find was an occasional food-globule, whose presence is to be accounted for as follows. The digesting cells (as shown in fig. 1) are often distended to such an extent by ingested food that they break down. Here and there, fragments of cells and escaped

* Cf. Mr. Moore's paper on the Amœba (in Ann. and Mag. Nat. Hist., Feb. 1893), in which he considers the so-called "crystals" in these animals to be the irreducible remains of the food-globules.

food-spherules are to be met with in the lumen of the tube. Any of these which fail to find their way back again into the digesting cells would be carried on into the hind-gut and so into the stercoral pocket. Comparatively few, however, so escape, as some selective process evidently goes on at the aperture of the hind-gut, otherwise it would be impossible to account for the separation of the fæcal "crystals" from the coagulum. The epithelium of the hind-gut apparently has no power of dissolving down the food-globules into assimilable fluids.

Before escaping into the blood, the assimilable fluids resulting from the dissolution of the food-globules have to pass through a layer of cells which clothes the whole alimentary canal externally. These cells seem to be characteristic of the Arachnids, but are differently developed in different genera. Bertkau has called them the "fat-body" cells, and suggests that the functions of this "fat-body" are probably supplementary to those of the alimentary canal. My own observations tend fully to confirm this latter proposition, viz. that these mesodermal cells, clothing the alimentary canal externally, play a definite, and in some cases a very important rôle in alimentation. But I prefer to use the more indefinite description of these cells as the peritoneal covering of the alimentary canal.

In the Chernetidæ, these peritoneal cells are often so vacuolated as almost to appear like a layer of connective tissue with large nuclei suspended on the threads (fig. 1). As far as one can judge by appearances alone, one would say that this is in order to allow the nourishing fluids to flow freely through the wall of the alimentary canal into the blood.

In one specimen examined, the animal was infected with bacteria, and it is perhaps significant of the nourishing character of the fluids contained in or passing through these peritoneal cells that the great round nests of bacteria show a decided tendency to form within these cells.

To sum up, then, we find that the juices sucked in are turned by the digesting cells of the Chernetidæ into homogeneous globules, indistinguishable from the so-called fat-globules of Amœbæ; that these are slowly dissolved, leaving small crystalline bodies also indistinguishable from the so-called crystals of Amœbæ; that these bodies are excreted and eventually found as the chief constituent of the fæces in the stercoral pocket.

Scorpionidæ.

The usual claim that *Scorpio* has salivary glands is incorrect. The whole of the internal space of the cephalothorax in these animals is so compressed longitudinally that the single pair of cephalothoracic diverticula comes so far forward that it has been mistaken for a salivary gland, whereas serial sections show that it does not differ from the other diverticula. As far as my own researches with the Chernetidæ, Scorpionidæ, Araneidæ, and Galeodidæ extend, none of the diverticula of the alimentary canal are specialized into glands; they are all simple digesting diverticula.*

The cells lining the alimentary diverticula of *Euscorpio* differ from those of the Chernetidæ in being somewhat more specialized. They are smaller, and each contains one enormous food-vacuole. Between the food-vacuole and the lumen of the gut, there is a thick layer of staining protoplasm (fig. 3). These cells are sometimes found long and narrow, the food-vacuoles bulging out the individual cells in such a way that in section there is a confused mass of cells out of which it is difficult to make any order. In other places the digesting cells are short and square, and appear to have plenty of room (fig. 3).

Within the food-vacuoles, the typical food-globules are found in all stages of disintegration, ending as in the Chernetidæ in the same minute crystal-like bodies which, however, tend rather to be long and rod-shaped than rhomboidal. These are excreted, passing lengthwise through the thick cushion of protoplasm at the distal boundary of the cell. Cases can be found in which the cushion has "crystal" bodies standing out all over it like the bristles of a hedgehog. This fact led me to see if I could find any case of the discharge of these fæcal bodies by the bursting of the vacuoles. I am inclined to think that this does not take place. The "crystal" bodies in Amœbæ pass directly through the ectosarc, round the outer edge of which they are often found adhering in considerable numbers, and further in the Chernetidæ they must pass out directly through the protoplasm of the digestive cells.

As in the Chernetidæ, these fæcal crystals in *Scorpio* are the chief constituent of the contents of the hind-gut, which, owing to its length, has no need of a stercoral pocket.

At the anterior end of the hind-gut, however, one is aware of the presence of large clear bodies mingled with the fæces which give the latter, when viewed by transmitted light, a mottled appearance. On close examination, these are found to be cells, which, owing to the crowding of the digestive cells when their vacuoles are full, had broken away and travelled down the gut. Such detached cells are found in enormous numbers, generally in groups (fig. 4), in all the wider lumina of the alimentary diverticula, and many of them at least, if not all of them, ultimately arrive with the fæces in the hind-gut. During this passage, the gradual digestion of the contents of their vacuoles goes on, and the excretion of the crystalline remains can be seen to take place as in the stationary cells (fig. 4). But what

* As such digesting diverticula would naturally give all the reactions of the different secretions necessary to the digestive process, the attempt to show that these diverticula are pancreatic glands by means of chemical reagents cannot be conclusive. Cf. Griffith and Johnstone, Proc. Roy. Soc. Edinburgh, xv.

becomes of these cells? Advancing further down the hind-gut, they apparently get fewer and fewer, and the fæcal masses less and less mottled. It seemed to me unlikely that these living cells should be lost to the body, and I searched diligently to see if I could find any cells passing through the wall of the hind-gut. I found none actually passing through, but what I did find was almost more interesting in its suggestiveness. Between the fæcal masses and the wall of the canal, round cells of granular protoplasm with a rather indistinct nucleus were found. These cells appeared in all the sections, some apparently just leaving the fæcal masses. There can, I think, be little doubt that these cells belong to the places in the sections where they are found, and have not been swept-in in the processes of cutting and mounting. If so, there can also be little doubt that they are the representatives of the digesting cells which through overcrowding had broken loose and had been carried down into the hind-gut. These round cells within the hind-gut are quite indistinguishable from the blood-corpuscles in the blood-plasma outside the gut. Without making any positive affirmation, I think that it is highly probable that these digestive cells, instead of being lost to the animal by passing out with the fæces, pass through the wall of the gut and function as blood-corpuscles. There seems no reason why this should not take place, although the actual fact would probably be difficult to establish.

This is, however, not the only interesting point in the digestion of *Euscorpio*. The peritoneal cells clothing the whole alimentary canal externally are found to be so full of globules, exactly resembling the typical food-globules, that both the nuclei and the cell divisions are entirely obscured. Bertkau found bodies somewhat similar to food-globules in the peritoneal cells of an Araneid (*Atypus*), but said that they differed from the latter in being built up of regular concentric layers, and further in their chemical reactions. While the typical food-globules, according to Bertkau (who, however, did not recognize them as such), are dissolvable in glycerin and water, but indissoluble in ether and alcohol, the bodies in the peritoneal cells resist the action not only of alcohol and ether, but also of water and glycerin. With osmium they are quickly and intensely blackened, and iodine makes them red-brown. Bertkau also found traces of these bodies occurring in the peritoneal layer of *Eresus;* indeed there is reason for believing that they are very commonly present in the peritoneal cells of spiders (cf. next section).

The homogeneous globules found in the peritoneal cells of *Euscorpio* show no traces whatever of lamination viewed under the highest power. They are in every respect indistinguishable microscopically from the food-globules within the digestive cells. So great is the similarity that it is difficult to believe that bodies so alike, and separated from one another only by the fine basement membrane of the digestive cells can be really different; indeed, from what follows it will be seen that they are essentially similar. The presence of these food-globules in the peritoneal cells is probably to be attributed to the inability of the digesting cells to hold all the food taken in, which is therefore passed temporarily into the cells outside the alimentary canal as into a kind of storehouse for undigested food. Metschnikoff* has already shown in the Ctenophora that endoderm cells pass on solid particles such as carmine grains to adjacent mesoderm cells.

The question, then, naturally arises, if these are food-globules why are they not digested in these cells as they would be in Amœbæ? Examining them carefully to ascertain this point, I was speedily convinced that a slight digestive process does go on. Here and there globules are seen no more clear and homogeneous but finely granular; others are even broken down completely into the typical crystal-like bodies which are apparently the invariable remains of such food-globules when their assimilable elements have been extracted. Compared, however, with the immense number of food-globules stored up in these cells, only a very small percentage were being assimilated. When such extra-enteric digestion does take place, the crystalline residue does not pass back into the alimentary canal, but is carried away by the blood-corpuscles (fig. 3). What the ultimate fate of these blood-corpuscles is I have been unable to ascertain.

If this description of the phenomena is correct, the life-history of these blood-corpuscles is curious. Originating as digesting cells within the alimentary canal, they break loose and pass down the gut, assimilating the contents of their food-vacuoles during the passage, and finally pass out through the wall of the hind-gut and become free blood-cells. When in the blood, among other functions, we find them carrying away fæcal masses from the peritoneal cells which have somewhat irregularly digested the food-globules temporarily stored up in them.

I am indebted to my friend Prof. Howes for calling my attention to the somewhat similar observations recorded by Kükenthal in an Oligochætan Annelid (*Tubifex*).† Kükenthal found the lymph cells carrying about brown granules which they obtained from the walls of the dorsal blood-vessel and its branches, which latter surround the alimentary canal in a close network. When full of these brown granules the lymph cells are distinguished by the name of chloragogen cells, which seen massed on the above named blood-vessels form the brown body thought at one time to be the liver. The brown granules undergo a change within the lymph cells; they are dissolved down into minute dark bodies. These dark bodies are finally got rid of by means of the nephridia, the tubules of which Kükenthal describes

* "Über die intracellulare Verdauung bei Cœlenteraten, Zool. Anzeig., 1880, p. 261.

† "Über die lymphoiden Zellen der Anneliden," Jenaische Zeitschr., xviii. (1885).

as being full of them. In the next section, we shall find that in the Araneids the Malpighian tubules are completely filled with fæcal "crystals." We reserve further discussion of this striking parallel until we have described the process in the Araneids.

Araneidæ.

The Araneids are almost the only Arachnids whose digestive processes have been investigated, chiefly by Plateau and Bertkau. The interpretations of the facts described by these writers require, however, to be considerably modified by what we have learnt from *Obisium* and *Scorpio*. The contents of the so-called liver cells are not secretions, but food-globules and their crystal-like remains. How near Bertkau came to the recognition of this fact may be gathered from his discovery that the cells lining the cæca took in the carmine granules which he mixed with water and gave the animals to drink. Why then, he asks, should they not also take in "assimilated nutriment"?—or, *we* naturally add, the raw food as food-globules?

The digesting cells do not all appear to have specialized vacuoles as in *Euscorpio*. Schimkevitch * describes and figures two kinds of cells in *Epeira*, one kind resembling those of *Obisium* (fig. 1), and the other resembling the vacuolated cells of *Scorpio* (fig. 3). It would be interesting to find out in what portions of the gut this specialization of the digesting cells takes place.

The food-globules break down into the typical crystals, the latter appearing in two forms, as rather large glassy looking bodies, often rod-shaped, and as very minute bodies, which are found massed in the bases of the cells, giving this part of the cells a brownish appearance. This fæcal matter appears to be discharged in two different ways. One portion of it is excreted from the cells into the lumen of the gut, to find its way down the long narrow tubules into the central canal. *Another portion appears to pass through the wall of the canal into the peritoneal cells, and from these into the Malpighian tubules, by means of which it finds its way into the stercoral pocket* (fig. 5). The evidence for this somewhat remarkable conclusion will be found in what follows.

On opening the body of many spiders, e. g. the common garden spider, *Epeira diadema*, the whole abdominal portion of the alimentary canal, with its ramifying tubules, has a very striking chalky look. In *Epeira*, the chalk-white shines through those parts of the skin which are free from pigment and gives rise to the white cross and spots which characterize it. Many observers have noticed that this chalky appearance in spiders is due to a layer of fine particles often showing a metallic glitter. There have been many conjectures as to what these particles are. The last conclusion arrived at (by Bertkau) is that the bodies strongly resemble certain constituents of the fæces

* "Études sur l'Anatomie de l'Epéire," Ann. Sci. Nat., xvii. (1884).

found in the stercoral pocket, and they give the same chemical reactions; that they are, in fact, guanin.

How does this fæcal matter come to be in the peritoneal cells outside the alimentary canal? Two answers to this question are suggested by our observations on *Obisium* and *Scorpio* above described.

We find in *Obisium* the digesting cells of the gut crowded from end to end with food-globules (fig. 1), the peritoneal cells adjoining having apparently nothing else to do than to pass on the assimilated fluids. In *Scorpio*, we have the digesting cells more specialized, each containing a large vacuole capable of reducing only a limited number of these food-globules. A large number of them, therefore, pass out of the endodermal digesting cells into the adjoining mesodermal cells, probably returning again to be assimilated in the digesting vacuoles. While, however, they are thus stored up, the peritoneal cells occasionally commence to assimilate them for themselves, reducing them, when they do so, into minute crystal-like bodies, essentially similar to those within the gut. The round globules found by Bertkau in the peritoneal cells of *Atypus* can, I think, be nothing else than food-globules which have passed through the wall of the gut, probably as into a temporary storehouse. Unfortunately, as none of my preparations of Araneids show any food-globules in the peritoneal cells, I have been unable to ascertain whether they are there subjected to any digestive process. But this is what may take place in the Araneids. Food-globules pass out of the digesting cells into the adjoining mesodermal cells, and may there be, normally or abnormally, digested, the fæcal remains being carried away by the Malpighian tubules.

A second method of accounting for these fæcal "crystals" in the peritoneal cells and the Malpighian tubules is by supposing that the digesting diverticula are so branched and their lumina are so narrow that the fæcal masses resulting from digestion within the more distal portions of these tubules fail to find their way into the central canal, and have to be got rid of by passing through the wall of the gut and into the Malpighian tubules. The difficulty of getting rid of fæces from the digestive tubules has indeed already been suggested as an objection to the supposition that the so-called "liver" diverticula might be digesting, and not secreting, organs. It is obvious that this difficulty could be got over if the fæcal "crystals," or at least a portion of them, could pass out of the gut and be discharged through the Malpighian tubules.

Fig. 5 represents part of a section of the abdomen of an emaciated house-spider caught in mid-winter. It represents parts of four digesting diverticula, between which are seen the peritoneal cells, which in this case were highly vacuolated, the nuclei being suspended on threads, and portions of two Malpighian tubules. The digesting cells contain round granules which I take to be food-globules, though they are deeply stained. The fæcal crystals are seen here and there travelling up into the lumen of the gut from between the cells. But by far the greater number of the crystals were massed along the bases of the cells, just inside the basement membrane, giving a brown appearance to the basal half of the digesting epithelium.* No food-globules could be found anywhere among the peritoneal cells. The Malpighian tubules, however, were full of fæcal "crystals." Where did they come from? Close examination showed them suspended here and there on the protoplasmic strands of the peritoneal cells, apparently on their way from the digesting diverticula to the Malpighian tubules.

We have here, then, a case of a fasting spider with no surplus food-globules stored up in the peritoneal cells, and yet an immense number of fæcal "crystals" in the Malpighian tubules. I can only suggest that these fæcal "crystals" came from the basal ends of the digesting cells, this being no more difficult to believe than that food-globules or carmine-grains pass out from the endodermal into the mesodermal cells.

With regard to these two explanations of the presence of this guanin in the peritoneal cells, I do not see why both of them should not be correct. We know that bodies strongly resembling food-globules are found in the peritoneal cells of the Spiders, and we know from *Euscorpio* that such bodies may undergo a process of digestion in these cells. But unless the digestion of food-globules in the peritoneal cells is more frequent in the spiders than it apparently is in *Euscorpio*, it would hardly account for the enormous number of fæcal "crystals" found in their peritoneal cells and Malpighian tubules. I therefore think that we must look for the main supply of these bodies to the digesting tubules themselves in the manner above described. I am inclined to think that a certain number of the fæcal "crystals" in the digesting cells are broken down into smaller bodies, able to pass easily through the wall of the gut, or else that the smaller bodies are selected for this purpose, while the larger, or those not broken down, are excreted into the lumen of the gut. The bodies which find their way into the Malpighian tubules seem to be ground down to form the minute round bodies found in the stercoral pocket, which differ from those forming the fæcal masses, and which Plateau has traced to the Malpighian tubules.

In putting forward this explanation of the phenomenon, I do not lose sight of the fact that these crystal-like bodies in the peritoneal cells and the Malpighian tubules of Araneids may be some form of normal waste product, some compound of urea, presenting a close resemblance to the fæcal "crystals" which result from the digestion of the food-globules within the gut. So far, however, we have no

* Cf. Bertkau's figures (tom. cit., p. 428), where he shows the crystalline contents of the cells collected chiefly at their bases.

evidence of such an interpretation, while on the other hand there is a certain amount of evidence in favour of the view put forward in this paper. We have, further, some indirect evidence against the supposition that this peritoneal fæcal matter results from normal waste. Garrod's * researches tend to show, in Vertebrates at least, that urates in the blood and tissues are derived either directly from the food, if it happens to contain urea, or by absorption from the kidneys where it is normally formed. Assuming that the same law applies to the Arachnida, it is hardly likely that these crystal-like masses in the peritoneal cells of spiders are due to the presence of uric acid in their food, as we find no trace of such substance in the peritoneal cells of the Chernetidæ and Galeodidæ, whose food very much resembles that of the Spiders.† Further, I think it highly improbable that this substance is formed in the cells of the Malpighian tubules partly to be discharged into the stercoral pocket, and partly to be absorbed by the surrounding tissues. The Malpighian tubules, of no other Arachnids, produce such bodies. Plateau distinctly calls attention to the fact that there is "no guanin in the products of the Malpighian tubules of Phalangids, so characteristic of the urinary secretions of Araneids." ‡ The Malpighian tubules of *Euscorpio* and of *Galeodes* are searched in vain for any such substance, while *Obisium* has no Malpighian tubules.

Again, the arrangement of the Malpighian tubules in the Araneids seems to be unique among the Arachnids. Instead of being bathed by the body fluid, they form, with the peritoneal cells and the digesting tubules, a compact mass. In fig. 5, and again even more clearly in Bertkau's figure,§ the Malpighian tubules are seen to be completely embedded in the peritoneal cells. This seems to imply a close physiological connection between these tubules and the peritoneal cells, which latter we have seen are in close physiological connection with the alimentary canal. Indeed, it seems to me not altogether improbable that in the Araneids, which are the only Arachnids whose spinning glands are always functional, and presumably always carrying away waste products, the Malpighian tubules may have become specialized for the purpose here described, viz. of removing fæcal matter from the peritoneal cells. Further, a point of some significance deserves mention. The greater part of the chalky matter, in the peritoneal cells, is found at the periphery of the compact mass formed by the digesting tubules. This is where we should naturally expect to find it, because it is most difficult to get rid of the fæces from the blind ends of the tubules. The essential similarity between this chalky-looking matter in the peritoneal cells and the

* "On the Place of Origin of Uric Acid in the Animal Body," Proc. Roy. Soc., xl. (1886) p. 484.

† It deserves mentioning, however, that the food of spiders may be mixed with the secretions of their own poison-glands.

‡ Tom. cit., p. 441 (p. 753).

§ Tom. cit., p. 428 (plate xii. fig. 4).

matter within the blind ends of the tubules was clearly recognized by Plateau,* who, however, thought that it was some fatty substance. The fact that the granular contents of the Malpighian tubules looks white by reflected light, and black by transmitted light, has been further recorded by Bertkau.

Taking, then, further into consideration this very close resemblance between the chalky substance in the peritoneal cells and Malpighian tubules of Araneids and the undoubted fæcal crystals within the gut and stercoral pockets of the Arachnids, I think there is a considerable weight of evidence in favour of the interpretation of the phenomena here suggested.

The above-mentioned cases of extra-enteric digestion make it not impossible that the processes described by Kükenthal, and above referred to (p. 433), may admit of a similar interpretation. It is to be specially noted that the brown bodies taken up by the lymph cells appear on the dorsal vessel and its branches, which are directly related to the mid-gut. As the contents of these vessels would be largely derived from the products of enteric digestion, it seems more probable that these brown bodies are food-products than waste products. We have, further, the fact that these brown bodies undergo a change within the lymph cells very much resembling the change undergone by the food-globules when assimilated. I have examined the chloragogen cells of *Lumbricus* with an apochromatic oil-immersion lens (Zeiss), and though I could not find any of the brown globules being dissolved down into black bodies as Kükenthal describes, yet microscopically the brown bodies themselves were quite indistinguishable from the typical food-globules so often alluded to above. The suggestion that the function of the chloragogen cells is digestive is not new. I think, however, that the observations here described justify me in repeating the suggestion.

There is nothing new in principle in these cases of digestion by mesodermal cells. Although the undoubted rule among the Metazoa is that the endoderm cells, even from the first digestion of yolk in the embryo, undertake the processes of digestion, we have records of digestion both by ectoderm and by mesoderm cells. There is no claim here put forward of mesoderm cells becoming specialized for digestion, at least in the Arachnids, but only that mesoderm cells occasionally digest food stored up in them, therein simply reviving the power once possessed by their Protozoan ancestors, and still possessed by their free phagocyte brethren.

For the purposes of this paper some young spiders, just hatched and clinging helplessly to the nest, were examined. These, when seen entire, cleared in cedar or clove oil, show the digesting diverticula

* Tom. cit., p. 428 (p. 344: "Chez tous les Epéires la glande est granitée de blanc ou de blanchâtre à la surface, fait dû à la présence vers le sommet des cœcums superficiels d'une accumulation de graisse incolorée finement divisée. *Il arrive parfois que cette graisse remplit entièrement les cœcums de la surface*").

very marked and regular in the cephalothorax, but as a confused mass in the abdomen; in both cases they were black or mottled. Sections show that this black colour is due to accumulations of the minute crystal-like bodies with which we are now familiar, but which must, in this case, be due to the reduction of yolk, as the animals had certainly not taken in any extraneous food. This is very suggestive when taken in connection with the great resemblance under the Microscope between the food-globules and yolk-granules. The fact that the digestion of the yolk-granules in these Arachnids leaves as a residue the typical fæcal "crystals" of ordinary enteric (intracellular) digestion of food-globules, may throw some light upon the nature of the yolk. May it not be possible that the yolk is in this case unassimilated food, such as in *Euscorpio* passes out of the digesting cells to form the stored up food-globules in the peritoneal cells, and in *Tubifex* probably forms the brown bodies on the walls of the dorsal blood-vessels, which bodies are taken up, and apparently assimilated, by the chloragogen cells? It would be interesting to know whether these fæcal "crystals" *always* result from the assimilation of yolk.

Galeodidæ.

The Galeodidæ agree with the Araneids in having no long hind-gut such as we find in the Chernetidæ and the Scorpionidæ. The diverticula open into a central canal, which again opens into a hind-gut specialized into a stercoral pocket. As in *Scorpio*, the digesting cells are of all shapes, according to the space they have for their development. That there is no specialization of the epithelium lining the diverticula in Galeodes has lately been pointed out by Birula,* who shows that the cells throughout the whole intestinal canal are of essentially the same character. They are sometimes long, and almost thread-like, preserving, however, their character throughout. The peritoneal cells are very unevenly developed, sometimes quite undemonstrable.

One specimen examined (*Galeodes græcus*, kindly sent me by Prof. Möbius) had been killed immediately after a good meal; its abdomen was so swelled up that I had taken it for a pregnant female. The abdominal diverticula and even the central canal were surcharged with coagulum, and a wonderful confusion reigned. The epithelium was completely disorganized, and the tubes were distended by an amorphous mass of coagulum, food-globules, fæcal "crystals," and here and there moth's scales, or feathers (fig. 6). I was quite prepared for the breaking off of the distal ends of the digesting cells when overloaded with food-globules, but the complete disintegration of the whole epithelium I did not expect, and could hardly believe, in spite of my inability, after prolonged searching,

* "Der Mitteldarm der Galeodiden," Biol. Centralbl., xi. p. 295.

to find any trace of cell-divisions. I was eventually quite convinced that the cells were mixed in a confused mass with the contents of the tubes, to form what is practically nothing else than a living digesting fluid, by finding that most of the tubes were lined along their inner ventral sides by a thick layer of fæcal "crystals" (fig. 6). The most likely explanation for this fact seems to be that the "crystals" are formed by the cells floating in this fluid, and then sink under the action of gravity.

The epithelium lining the central canal had also completely disappeared into the mass of coagulum which distended it. In the diverticula the lumen is comparatively small, but in the central canal the lumen is in some parts large, and the epithelium, compared with the size of the lumen, very insignificant. The entire absence of the epithelium, in specimens otherwise not badly preserved, can only be accounted for by its complete disintegration, the cells wandering into the mass of food.

Whether the cells thus mixed up like free amœbæ in the coagulum in the gut find their way back again to the basement membrane to *re*-form the epithelium, I cannot say. It is unlikely that these living cells should be lost to the animal. Their nuclei may pass out through the walls of the stercoral pocket to function as blood-corpuscles, as I believe to take place in *Scorpio*. If so, the regeneration of the epithelium from the stripped basement membrane would form a most interesting object for research.

On dissecting another specimen of *Galeodes græcus*, I found many of the liver diverticula soft and blackish brown; they would hardly stand the touch of the needle without breaking down into a brown powdery substance; others, again, in the same animal were firm and white like the other healthy tissues of the body. This difference may perhaps be explained by assuming that in the latter cases the epithelia were in the normal condition, while in the former they were disintegrated.

In the sections above described I found for the first time the assimilable products of the decomposition of the food-globules. It is seen as a highly refractive yellow coagulum within the tubules and in thick layers on their outer surfaces. In fig. 6 there is a mass of it within the tube immediately above the collection of fæcal "crystals," and further, an accumulation of it outside the gut on its dorsal surface.

As above-mentioned, the short hind-gut is enlarged into a great stercoral pocket. The area of the extremely thin wall of this receptacle for the fæces is further enlarged by being folded. Under a low power the wall looks thick, which appearance is due to a close pleating of the membrane. Between the pleats on the inner side of the membrane, are found strands of fæcal matter, out of which the still serviceable fluids are being extracted. Between the same pleats, but on the outside, are strands of the same yellow substance which has just been mentioned as the final product of the digestion of the food-globules.

In another specimen of *Galeodes* (probably *G. Araneoides*) the food-globules were found to be no longer homogeneous globules like fat-drops, but mulberry-like, i. e. composed of a compact round or oval mass of granules, which, unlike the typical food-globules, were stainable with hæmatoxylin (fig. 7). I can only account for this by assuming that there was some change in the diet. It looked almost as if the blood coagulum might have been taken into the cells as it was, without being converted into the typical form. These staining food masses were slowly disintegrated, passing through a stage which resembled the typical food-globule, but was slightly greenish yellow; these were slowly broken down till nothing but the typical crystal-like bodies remained. These, as usual, were excreted either at the tips or at the sides of the cells, according to the position of the mass of food in the cell. In this case, there was a distinct tendency of the cells to form vacuoles in which these mulberry-like bodies were dissolved. The protoplasm between these mulberry masses was so vacuolated as to have a frothy look (fig. 7). I am inclined to think that these mulberry masses are rather unusual, and that this reticulated frothy appearance represents the normal structure of the cells, and indicates the usual size of the food-globules.

In this specimen I found clear traces of the re-ingulfing by the cells of the central canal of the food-masses which had broken away from other digesting cells. How easily these mulberry-like masses break loose can be judged from fig. 7, which shows one such held in by a very thin layer of protoplasm. Both the central canal and the stercoral pocket were filled with these detached food-masses.

The last case which requires description is that of a species of *Rhax*. The digesting cells show no trace of food at all. They are, however, not shrunk together, but maintain very nearly the same shape they would have if filled with food-globules. This, of course, is only possible by the persistence of the vacuoles in which the food had been digested. We therefore find the cells composed of a reticulum of protoplasmic strands in the meshes of which the food globules are usually dissolved. They stand up from the basement membrane like sponges, fig. 8. I am inclined to think that this may explain the reticular structure of the internal protoplasm of many Infusoria, which, without such an arrangement, would have to vary in size according to the amount of food ingulfed, whereas we know that the external layers are often far too specialized to allow of any such variations.

Phalangiidæ.

The digestive processes of this group have been worked out by Plateau,* but naturally from the old point of view, that the digesting

* "Notes sur les phénomènes de la digestion chez les Phalangides," Bull. Acad. Belg., xlii. (1876) pp. 719–54.

diverticula are hepatic or pancreatic glands, and the contents of their epithelial cells secretions. One of the more interesting facts recorded by Plateau relates to the detachment of a great number of the epithelial cells which float off into the lumen of the gut; their contents, according to Plateau's figures, are similar to those of detached or stationary digesting cells of other Arachnids, viz. round homogeneous globules, which can hardly fail to be food-globules, and minute black points, which are doubtless the fæcal "crystals" so often mentioned above. It would be interesting to investigate the fate of these detached cells in the Phalangiidæ, to see whether they offer any support to my suggestion that in *Scorpio* they become blood-corpuscles. It should not, however, be forgotten that the Phalangiidæ have a rich system of tracheal respiratory tubes, and that consequently the circulatory blood system is not so highly developed as in *Scorpio* with its respiration localized in the lung-books.

In both these Arachnids, *Scorpio* and *Phalangium*, I attribute the detaching of the cells to the fact that they are digesting cells, a certain number of which, when they are all distended with food-globules, are crowded out. The storing up of the food-globules in the peritoneal layer observed in *Scorpio* and the Araneids, may be but a further attempt to obtain relief from this excessive crowding of the distended cells. Plateau's drawings of the peritoneal cells of *Phalangium* (his "fat-body") seem to indicate that they are full of round granules which may perhaps represent stored-up food-globules.

Acaridæ.

I have only examined sections of *Tetranychus tiliarum*, which undoubtedly feeds on vegetable juices. Its hind-gut was full of the typical "crystals" which seem invariably to result from the assimilation of protoplasmic compounds. I could make nothing of the digestive cells themselves.

I learn, however, from Mr. Michael, that it is not uncommon to find great accumulations of white chalky matter either being slowly got rid of, or else permanently located in the body-cavities of certain mites. That this chalky matter is similar to the chalky matter in the peritoneal cells of Araneids and also to a small extent in the peritoneal cells and blood-corpuscles of *Scorpio* seems to me very probable. Some further light is perhaps thrown on this phenomenon by the fact, for which I am also indebted to Mr. Michael, that the digesting cells in Acarines are often found detached from the epithelium. This suggests the overcrowding of the cells with food, and might also imply the storing up of food-globules in mesodermal cells, the digestion of which would account for the chalky matter. We can only hope that Mr. Michael will shortly publish an account of his extremely interesting observations on this subject.

We have, then, in the foregoing pages, examined some of the digestive processes, as revealed under the Microscope, in the Chernetidæ, the Scorpionidæ, the Araneidæ, and the Galeodidæ, and, very cursorily, of the Phalangiidæ and the Acaridæ, and found that in all cases the process is essentially the same. We find that the so-called "liver" is no true liver, but merely a tubular enlargement of the digestive surface. We have further found in *Scorpio*, traces of extra-enteric digestion in the mesodermal cells surrounding the alimentary canal, and that this process probably occurs in the Araneids also, where the Malpighian tubules are utilized to remove the fæcal remains, which however are found in such quantities in the peritoneal cells that we are driven to the conclusion that the greater portion of them are derived directly from the digestive tubules. While, lastly, in some Acarines, chalky matter is found in the body-cavity, which the animals are unable to get rid of at all. This physiological resemblance between the Acarines and the Araneids is interesting in connection with the morphological evidence of their affinities.*

The only important Arachnids which we have not examined are the Phrynidæ and the Telyphonidæ, which are so clearly related to the Scorpionidæ that we are perhaps justified for the present in assuming that their digestive processes would not differ in essentials from what we have described. These animals would, however, probably repay examination, as nothing can be more instructive than the study of slight variations in details. It is only by this comparative method of research that we can gain any true insight into the vital processes of animal life.

* 'Some Observations on the Relation of the Acaridæ to the Arachnida," Linn. Soc. Journ. Zool., xxiv.

IX.—*On Floscularia pelagica sp. n., and Notes on several other Rotifers.*

By Charles F. Rousselet, F.R.M.S.

(*Read June* 21*st*, 1893.)

Plate VII.

When Dr. Hudson established the Rotatorian order of Rhizota (the rooted, fixed when adult) it seemed to be such a well-defined group, with all its members permanently fixed to plants or submerged objects, except *Conochilus Volvox*, in which the animals of the colony are attached to each other in a common gelatinous envelope, and excepting also the very aberrant genus *Trochosphæra*. But before having completed his great work, Dr. Hudson had to describe a *Conochilus* (*C. dossuaris*) not fixed, nor aggregated together in colonies, but swimming about solitarily in his tube, and a free-swimming Floscule (*F. mutabilis*) which he called at the time "a horror to every classifier." Since then, Mr. Western has found a free-swimming *Lacinularia*, and Surgeon Gunson Thorpe, R.N., has just described a free-swimming *Megalotrocha* and another free *Lacinularia*, so that both families of the Rhizota furnish us at present with examples of animals that are not rooted or fixed when adult.

To these I have now to add another Floscule having a corona of vibratile cilia in addition to five tufts of stiff setæ, and living in the open waters of lakes, which is as much a free swimmer as the Asplanchnæ, Anurææ, and Polyarthræ, amongst which it sails steadily and deliberately, carrying its narrow gelatinous tube with it.

Floscularia pelagica sp. n. Pl. VII. fig. 1.

Specific characters: Corona circular without any lobes, furnished with a wreath of vibratile cilia; within this five fleshy prominences with short, stiff, radiating setæ; free-swimming; eyes absent in adult; gelatinous case hyaline, very narrow and elongated.

EXPLANATION OF PLATE VII.

Fig. 1 *a.*—*Floscularia pelagica*, in tube, ventral view.
„ 1 *b.* „ corona.
„ 1 *c.* „ dorso-ventral optical section through anterior part of body. *a*, dorsal antenna.
„ 1 *d.* „ male.
„ 2 *a.*—*Colurus cristatus*, dorsal view.
„ 2 *b.* „ side view.
„ 3 *a.*—*Notops pygmæus*, side view.
„ 3 *b.* „ dorsal view.
„ 3 *c.* „ jaws, front view.
„ 3 *d.* „ jaws, side view.
„ 4 *a.*—*Œcistes brevis*, ventral view.
„ 4 *b.* „ anterior part of body, side view.

I found this remarkable little animal in the small lake on Keston Common, which derives its clear water from Cæsar's Well, a few hundred yards further on, in company with *A. priodonta* and other free-swimming Rotifers. I collected only from one spot, near the surface of the water, taking no weeds at all from the lake, which is fairly deep, and found about twenty specimens in the single bottle I filled.

This, then, is a thoroughly free-swimming Floscule, quite at home in the open water, propelling itself slowly by means of a wreath of vibratile cilia, just like the Ploïma, but instead of being driven forward, it invariably swims backwards, and looks then like a long, narrow, sternwheel boat, except that the wheel is at the head. The whole body and the gelatinous case are white, of glassy transparency, which is an additional character of pelagic animals.

Its nearest ally is *Floscularia mutabilis* of Hudson, from which it differs in many particulars, as will be seen by the specific characters, and from the description.

The animal as a whole is greatly elongated and very narrow, measuring 1/85 in. to 1/65 in. from head to end of foot, and not more than 1/450 in. at the widest part of the body. The foot when extended is generally one and a half to twice as long as the body, but of course it can contract, and is then more or less reduced in length.

The corona, fig. 1 *b*, is circular without any lobes, and fringed all round with a wreath of fairly long lashing cilia, by means of which the animal swims slowly through the water. The characteristic stiff setæ of Floscules are not apparent at first; they are seated on five fleshy prominences, one of which is dorsal, within the ciliary wreath, and in a direction at right angles to, and across the coronal cup. The animal has the habit of sometimes contracting the lower part of the cup, by which action the rim of the cup becomes slightly everted, and the setæ stand out, slanting upwards, and are then visible above the corona. The setæ are short, only reaching three-quarters across the corona; the dorsal prominence and setæ are slightly larger than the others. Two small white globules near the rim of the dorsal side of the corona I at first thought might represent the eyes, but I found a number of very similar globules on various parts of the corona. A very small dorsal antenna is situated on a pimple about midway on the dorsal side of the coronal cup, as shown in fig. 1 *c*, *a*. The lateral canals and vibratile tags are present, but I could not find the contractile vesicle.

In other respects the anatomy of the animal is exactly like that of other Floscules; at the bottom of the coronal cup is the usual semicircular band of very fine vibratile cilia, bounded at each end by a knob bearing a bundle of larger flagella; then comes the diaphragm, with the buccal orifice, and the undulating elastic tube hanging down into the crop; the jaws have two teeth as usual. Eight narrow muscular bands run from the rim of the corona to the tip of the foot. The foot is smooth when extended, but transversely wrinkled when contracted, and has an opening at the tip, from which, I think, the secretion forming the tube is extruded. The animal can contract wholly within its tube, but expands again very readily. The eggs, one to five in number, are carried in a cluster, round the middle of the foot; in mature ova, two pale red eyes can be seen. The male eggs are only slightly smaller than the female eggs. I saw a young male born; it is of usual shape, with two red eyes, fig. 1 *d*.

The sheath, as will be seen in the figure, is very narrow, extending some distance beyond the foot, and ending in a cone, and so transparent that it is absolutely invisible by transmitted light, but becomes evident by dark ground illumination.

Length of animal 1/85 to 1/65 in.; width 1/450 in. Habitat: clear lake on Keston Common.

Colurus cristatus sp. n. Pl. VII. fig. 2.

This very peculiar Rotifer has been found in America by Mrs. Pell, who sent me the sketch and short description from which this account is taken.

The lorica, seen dorsally, is ovate, low in front, and very high and arched at the back; ventrally it is slightly concave. From the middle line of the anterior dorsal edge of the lorica proceeds a long, stiff, pointed, hyaline crest, slightly milled at the edge, which gives a very peculiar appearance to the animal. The head is square, and has the usual frontal plate, appearing like a hook from side view. Two colourless eyes are situated wide apart on the anterior margin of the head. The foot is long, three-jointed, the third joint being the longest, ending in two long, pointed, slightly recurved toes. The internal organs appeared to be normal, but the lorica was so stippled that it was not possible to see much through it.

Length 1/50 in.; width 1/60 in.; length of crest 1/60 in. Habitat: Highland Falls, New York.

Notops pygmæus Calman. Pl. VII. fig. 3.

This minute but handsomely coloured rotifer* was found, in the summer of 1891, in the domestic water supply of Dundee, by Mr. John Hood, who sent it at the time to his numerous correspondents.

It first appeared very sparingly, but from May to October of 1892 it was very abundant, as it is again at the present moment. Mr. Hood had named it *Notops ruber*, but delayed too long publishing his discovery, and so when a paper of his to the R.M.S. was

* In order to give an idea of the appearance in life of this rotifer, students are advised to colour fig. 3 *a* either with water colours or crayons as follows:—First colour the large oil-globules orange; then the larger central division of the stomach marked *b* blue; then the three smaller divisions *g g* yellowish green; and the whole remaining parts, except the brain, a light red; and, finally, the eye crimson with red ink.

announced at the November meeting, it was found that an account of it had just been published by Mr. W. T. Calman,* giving it the above name. A second account has since been published by Dr. O. Zacharias,† who found this same rotifer in 1892 as a pelagic inhabitant of the large freshwater lake of Plön, in Holstein. Dr. Zacharias has named it *Hudsonella picta*, but it is so very closely allied to some other Rotifers of the genus *Notops*, that it cannot very well be separated without at the same time removing several other species of this genus. No doubt the genus *Notops* needs revision. *Notops Brachionus* and *clavulatus* are illoricate animals and have one type of jaws, and *Notops hyptopus, minor* and *pygmæus* have quite another type of jaws and are loricate. But in order to avoid multiplying synonyms, I will in this paper describe the animal under the name it has first received.

The two published accounts and figures hardly do justice to the peculiarities of this remarkable rotifer, and are incorrect in some particulars. I have had a good opportunity of studying it, and so hope to be able to give a fairly complete description, although, owing to its minute size, it has proved an unusually difficult object.

Notops pygmæus most nearly resembles *Notops minor* in shape and in having a decided chitinous lorica; the foot protrudes from a circular opening in the lorica high up on the ventral side. Its greatest peculiarity are the rich and vivid hues with which the various parts of the body are coloured: the stomach is deep blue and green, interspersed with orange-coloured oil-globules, while the whole of the hypodermis or protoplasmic layer lining the shell, and the other organs except the brain, are of a rich rose red. The shell itself is colourless (contrary to the statements of Calman and Zacharias), very thin and hyaline, as can be seen by squeezing out the animal. In form the lorica is broadly oval with a wide neck, the edge of which is broadly scalloped; it is greatly compressed laterally, and in addition pinched in along the dorsal side.

The foot is long, cylindrical, without a joint, and wholly retractile within the lorica, in which position it is usually carried; it terminates in a very small toe. Some friends think they have seen two toes, but with the best optical means I have only been able to make out one; if there are two, they are very rarely separated.

The corona is broadly truncate and bears long vibratile cilia in tufts, by means of which the animal swims in a wobbling manner, revolving at the same time on its longer axis. The whole of the head and corona can be retracted within the lorica by means of two pairs of narrow, transversely striated muscles, attached to the sides of the shell. The mastax is of unusual form and presents some unique

* W. T. Calman, "On Certain New and Rare Rotifers from Forfarshire," Ann. of Scott. Nat. Hist., 1892, pp. 240–5.

† Forschungsberichte aus der Biologischen Station zu Plön, i. (1893) pp. 25–6.

peculiarities. Its position is upside down, as it were, with the biting parts of the trophi directed downwards and inwards; a long thin-walled, chitinous tube connects the mouth opening on the ciliary wreath with the lower part of the mastax, and small particles of food were seen gliding down this tube to the jaws. This arrangement is quite unknown in any other rotifer. The trophi are shown in fig. 3, *c* and *d*; they consist of a rod-shaped fulcrum, two rami, and two unci; the outer points of the latter are connected by a very thin stirrup-shaped piece; the manubria are absent. The tube is fixed at the point where the rami and unci meet and remains attached to the trophi when dissolved out with potash.

The stomach, which begins at once behind the mastax, is very large, saccate, and interspersed with numerous large orange and white oil-globules; it is partly coloured blue and partly green. The blue colour resides in the cells of the stomach, but the green appears to be due to food particles, and is sometimes absent. A small, conspicuously ciliated intestine is situated at the posterior end near the root of the foot; it terminates in a cloaca in the usual way. Dr. Zacharias states that there is no anal opening, but this is incorrect, as I have observed the discharge of fæces. Gastric glands and lateral canals, if present, could not be distinguished owing to the nature of the stomach. A rounded ovary and a contractile vesicle, both situated near the foot, and four vibratile tags on each side are present. Animals have been observed to deposit their eggs on the glass slip, and they do not carry the eggs with them; a prickly winter egg was seen in one animal.

The brain is a large rounded and cellular sac with a neck reaching forward to the corona, and white in colour. A large red eye, often surrounded by white opaque granules, is situated on the under side of the brain mass. The dorsal antenna, consisting of a bundle of setæ, protrudes out of a tubule situated above the brain and a little to the right of the median line; lateral antennæ of similar form are also present and asymmetrically placed; the right lateral antenna protrudes low down on the side, near the posterior edge of the lorica, and the left is placed higher up nearer to the centre of the side, as shown in the figures. The antennæ and their position are best seen when the animal slowly revolves on its longer axis, they then come into view one after the other. The male is not known.

Size 1/250 to 1/150 in. Habitat: reservoir, Dundee (Hood, Calman); large lake of Plön, Holstein (Zacharias).

Œcistes brevis sp. n. Hood. Pl. VII. fig. 4.

Corona slightly oblong, body and foot stout and short, ventral antennæ stout and of moderate length; oral aperture prominent; tube soft, gelatinous, roughly made. Eyes absent in adult, but present in the young.

This, the smallest of the known species of *Œcistes*, was found by Mr. John Hood in 1889 in various lakes in Scotland; it appears to be widely distributed but not very abundant. The corona is oval and quite as large in diameter as that of *Œcistes muscicola* or *socialis*, but the dorsal gap appears to be absent.

The tube is built singly on stems and leaves of Ranunculus and Myriophyllum and is like that of *Œ. crystallinus* in appearance. The internal organs are normal, but the characters enumerated above distinguish it sufficiently from all other species of *Œcistes*.

Size 1/120 to 1/105 in. Habitat: lakes in Scotland and Ireland.

Asplanchna priodonta Gosse.

This, abundant and widely distributed species has been so often studied that it seems difficult to find anything new in its organization. Yet by the application of staining agents I have discovered that the body-cavity of this rotifer is divided into two distinct compartments by a very thin membranous septum, running from the head to the posterior part of the body, in a plane at right angles with a dorso-ventral one, and in such a way that the body-cavity becomes divided into a larger ventral and smaller dorsal compartment.

In the living animal, towards the dorsal side of the body, four threads are easily seen, running from side to side, across the body-cavity, markedly parallel to each other, like ruled lines. The septum appears stretched on these threads, but is so thin and so hyaline that it cannot be seen by ordinary means, and appears so far to have been overlooked.

The dorsal compartment contains no organs except the nervous threads of the dorsal antennæ, which pass through it, and two other, either nervous or muscular, threads, fastened to the integument a little below the antennæ. The ventral compartment contains the stomach and all the other organs.

The staining *in toto* of well-preserved rotifers by selective stains promises to produce very important results, and certainly will greatly facilitate the study of these animals, as, by this means obscure and unsuspected details may often be made very prominent.

X.—*List of New Rotifers since* 1889.

By Charles F. Rousselet, F.R.M.S.

(*Read June* 21*st*, 1893.)

The Supplement to Messrs. Hudson and Gosse's great work on the Rotifera was published early in 1889, and, together with the two previous volumes, contains an account of all species that were known to the authors to the end of 1888. The publication of this book has had an immense stimulating effect upon students of this well-defined and interesting group of animals, with the result that no less than 186 new species have been described since that date. Almost all parts of the world have contributed to the number—from Greenland to Australia, and from China to America. Some of these so-called new species are, however, not new, and can be recognized as old friends, and some have been named twice over, while a number of others have been described and figured in so unsatisfactory a manner, that it will be quite impossible to recognize them again. It will be a difficult task to arrange all these species in the system and separate the good species from those insufficiently known. A word of advice may not be out of place here to all workers in this field; it is, Avoid as much as possible making new species. It must be borne in mind that a great many forms are imperfectly known, and have been described years ago, when the optical means at the disposal of observers were much inferior to those now available; again, the animals have not always been observed under the most favourable conditions, and there can be no doubt that Rotifers, like most other animals, vary a little in different localities. It is therefore very natural that new details can sometimes now be seen which were overlooked or invisible before, and that other details are not exactly as originally described. Such corrections and variations should be recorded, but it is not necessary to make new species, especially in the more difficult and obscure genera, when animals are found which do not agree in every minute particular with the type. As a general rule a closely allied animal should only be described as new when the type itself is known to the observer. Descriptions of insufficiently observed animals should not be published; it is better in such cases to make a note and await another opportunity. I am afraid Mr. Gosse has set a bad example in this respect, in naming a new species (*Distemma labiatum*) from a single observation, when the animal swam across the field of view and was then lost.

But when a really new species has been found it should be figured and described in such a manner that the animal may readily be recognized when found again by a different observer, and a good figure is often worth more than a good description. A figure of the jaws should always be added. The true character of the jaws cannot always, and even rarely, be made out in the living animal, but they are readily dissolved out with a drop of potash solution.

Badly described and ill-figured species are worse than useless: they increase the difficulties and waste the time of observers, swell the literature, and are then dropped.

I trust this list, with Bibliography attached, compiled with much care and labour from the widely scattered literature, and containing all new forms known to me to the end of June, will be useful to all workers on the Rotifera, and that it will prevent the same species being described several times under different names. Ehrenberg's *Euchlanis lynceus* has been renamed three times within the last two years, and some of the animals associated with it in the three new genera are probably also identical. The numbers refer to the Bibliography at the end.*

Rhizota.

Floscularia torquilobata Thorpe (41).
,, *quadrilobata* Hood (18).
,, *Gossei* Hood (18).
,, *annulata* Hood (17).
,, *diadema* Petr. (36).
,, *Evansonii* Anderson (2).
,, *spinata* Hood (19).
,, *tenuilobata* Anderson (1) (= *F. Coronetta*).
,, *pelagica* Rousselet (40).
,, *unilobata* Wierzejski (51).
Limnias myriophylli Western (48).
Œcistes Stephanion Anderson (1).
,, *Wilsonii* Anderson and Shephard (2).
,, *brevis* Hood (40).
Lacinularia natans Western (47).
,, *megalotrocha* Thorpe (42).
,, *racemovata* Thorpe (42).
,, *reticulata* Anderson and Shephard (2).
Cephalosiphon furcillatus Kellicott (27) (= *Œcistes ptygura* Ehr.).
Megalotrocha procera Thorpe (42).
,, *spinosa* Thorpe (42).
Conochilus unicornis Rousselet (39).
Trochosphæra solstitialis Thorpe (42).

New Genera.

Octotrocha speciosa Thorpe (42).
Atrochus tentaculatus Wierzejski (52).

* In view of the difficulty and delay in knowing of all the papers on Rotifera that are published in various parts of the world, and for the purpose of extending this list at a future date, I shall be greatly obliged if authors will be good enough to send me a copy of their memoirs addressed to the care of the Society.

Bdelloida.

Philodina hirsuta (Ehrenberg) Anderson (1, 26).
„ *commensalis* Western (49).
„ *hexodonta* Bergendal (12, 26).
Rotifer mento Anderson (1, 26).
„ (*Macrotrachela*) *Roeperi* Milne (32, 26).
„ *phaleratus* Glascott (16).
Actinurus ovatus Anderson (1, 26).
Callidina magna Plate (34, 26).
„ *magna-calcarata* Parsons (33, 26).
„ (*Macrotrachela*) *reclusa* Milne (32, 26).
„ „ *multispinosa* Thompson (43, 26).
„ „ *papillosa* Thompson (43, 26).
„ *russeola* Zelinka (55, 26).
„ *lutea* Zelinka (55, 26).
„ *Mülleri* Zelinka (55, 26).
„ *Holzingeri* Zelinka (55, 26).
„ *Lejeuniæ* Zelinka (55, 26).
„ *plicata* Bryce (8, 26).
„ *lata* Bryce (8, 26).
„ *spinosa* Bryce (8, 26).
„ *aspera* Bryce (8, 26).
„ *cornigera* Bryce (10).
„ *pusilla* Bryce (10).
„ *sordida* Western (49) (= *C. longisrostris* Janson).
„ *lævis* Bergendal (12, 26).
„ *tentaculata* Bergendal (12, 26).
„ *longirostris* Janson (26).
„ *vorax* Janson (26).
„ *Ehrenbergii* Janson (26).
Adineta clauda Bryce (9).
„ *barbata* Janson (26).
„ *tuberculosa* Janson (26).
„ *gracilis* (Janson (26).

Ploïma. I. Il-loricata.

Microcodon robustus Glascott (16).
Asplanchna syringoides Plate (34).
Ascomorpha (*Sacculus*) *agilis* Zacharias (54).
„ („) *amygdalum* Zacharias (54).
Synchæta monopus Plate (34).
„ *apus* Plate (34).
„ *tavina* Hood (20).
„ *grandis* Zacharias (54).
„ *stylata* Wierzejski (51).

Polyarthra platyptera var. *euryptera* Wierzejski (50, 51). } (Same species).
„ *latiremis* Imhof (24). }
„ *aptera* Hood (19).
Triarthra longiseta var. *limnetica* Zacharias (54).
Rhinops orbiculodiscus Thorpe (41). (Is not a *Rhinops.*)
Notops minor Rousselet (38).
„ *pygmæus* Calman (14, 40, 54).
„ *lotos* Thorpe (42).
„ *quadrangularis* Glascott (16).
„ *forcipata* Glascott (16).
Taphrocampa Levinseni Bergendal (12).
Pleurotrocha grandis Western (48, 49) (re-named *Diglena ferox* Western).
„ *aurita* Bergendal (12).
„ *marina* Bergendal (12).
Notommata cuneata Thorpe (41).
„ *tarda* Bergendal (12).
„ *grönlandica* Bergendal (12).
„ *celer* Bergendal (12).
„ *distincta* Bergendal (12).
„ *longipes* Bergendal (12).
„ *lucens* Glascott (16).
„ *gigantea* Glascott (16).
„ *volitans* Glascott (16).
„ *cylindriformis* Glascott (16).
„ *larviformis* Glascott (16).
„ *rubra* Glascott (16).
Copeus Americanus Pell (35).
Proales daphnicola Thompson (54).
„ *inflata* Glascott (16).
Furcularia tenuiseta Burn (4).
„ *neapolitana* Daday (56).
„ *tubiformis* King (28).
„ *semisetifera* Glascott (16).
„ *megalocephala* Glascott (16).
„ *rigida* Glascott (16).
Eosphora striata Glascott (16).
Diglena ferox Western (49).
„ *elongata* Glascott (16).
„ *rugosa* Glascott (16).
„ *natans* Bergendal (12).
„ *Hudsoni* Glascott (16).
„ *dromius* Glascott (16).
„ *inflata* Glascott (16).
„ *revolvens* Glascott (16).
Distemma dubia Bergendal (12).

New Genera.

Microcodides dubius Bergendal (12) (= *Rhinops orbiculodiscus* Thorpe).
Dinops longipes Western (47, 37) (= *Asplanchnopus eupoda* Gosse).
Hudsonella picta Zacharias (54, 40) (= *Notops pygmæus* Calman).
Hypopus Ritenbenki Bergendal (12).
Notostemma macrocephala Bergendal (12).
„ *affinis* Bergendal (12).
„ *bicarinata* Bergendal (12).
Diops marina Bergendal (12).
Arthroglena Lütkeni Bergendal (12).

PLOÏMA. II. Loricata.

Mastigocerca bicuspes Pell (35).
„ *cylindrica* Imhof (23).
„ *capucina* Wierzejski and Zacharias (53, 51, 54).
„ *brachydactyla* Glascott (16).
Rattulus antilopæus Petr. (36).
„ *bicornis* Western (49).
Cœlopus similis Wierzejski (51).
Dinocharis serica Thorpe (42).
„ *intermedia* Bergendal (12).
Stephanops intermedius Burn (3).
„ *dichthaspis* Anderson (1).
„ *grönlandicus* Bergendal (12).
Salpina cortina Thorpe (41).
Euchlanis subversa Bryce (5) (= *Diplois propatula* Gosse).
„ *parva* Rousselet (39).
„ *elegans* Wierzejski (51).
Cathypna Stokesii Pell (35).
Distyla depressa Bryce (6).
„ *muscicola* Bryce (6).
„ *Hudsonii* Lord (29).
„ *Gossei* Lord (29).
„ *clara* Bryce (7).
„ *agilis* Bryce (7).
„ *inermis* Bryce (7).
„ *ichthyoura* Shephard (2).
Monostyla arcuata Bryce (6).
„ *bifurca* Bryce (7).
„ *galeata* Bryce (7).
„ *Quennerstedti* Bergendal (12).
Colurus cristatus Rousselet (40).
„ *pachypodus* Glascott (16).
„ *tessellatus* Glascott (16).

Colurus rotundatus Daday (56).
,, *truncatus* Daday (56).
Metopedia rhomboidula Bryce (5).
,, *parvula* Bryce (11).
,, *torquata* Anderson (1).
,, *angulata* Anderson (1) (= *Notogonia Ehrenbergii* Perty).
,, *ovalis* Shephard (2).
,, *affinis* Bergendal (12).
Pterodina cœca Parsons (33).
,, *intermedia* Anderson (1).
,, *trilobata* Shephard (2).
,, *emarginata* Wierzejski (51).
Brachionus furculatus Thorpe (41).
,, *longipes* Anderson (1).
,, *bidentata* Anderson (1).
,, *forficula* Wierzejski (50).
,, *dorcas* var. *spinosus* Wierzejski (50).
,, *amphifurcatus* Imhof (21, 15) (= *Schizocerca diversicornis* Daday).
,, *tridens* Hood (19).
Schizocerca diversicornis var. *homoceros* Wierzejski (50).
Anuræa procurva Thorpe (41).
,, *scutata* Thorpe (41).
,, *cruciformis* Thompson (45).
Notholca Hoodii Western (49).
,, *ambigua* Bergendal (12).

New Genera.

Elosa Worrallii Lord (30).
Anapus ovalis Bergendal (13).
(*Gastroschiza lynceus* Bergendal) (13) (= *Euchlanis lynceus* Ehr.).
,, *triacantha* Bergendal (13).
,, *foveolata* Jägerskjöld (25).
,, *flexilis* Jägerskjöld (25).
(*Gastropus Ehrenbergii* Imhof) (22) (= *Euchlanis lynceus* Ehr.).
,, *stylifer* Imhof (22).
,, *Hudsonii* Imhof (22).
(*Bipalpus lynceus* Wierzejski and Zacharias) (53) (= *Euchlanis lynceus* Ehr.).
,, *vesiculosus* Wierzejski and Zacharias (53, 51, 54).

Scirtopoda.

Pedalion fennicum Levander (31).

Synonyms of rejected Genera not mentioned in the 'Rotifera,' Hudson and Gosse.

Theora uncinata Eyf. and Tessin (46) = *Pleurotrocha uncinata* Ehrbg.
,, *leptura* Eyf. and Tessin (46) = *Pleurotrocha leptura* Ehrbg.
Plagiognatha gracilis Tessin (46) *Notommata lacinulata* Ehrbg.
Monommata longiseta Bartch and Bergendal (12, 46) = *Furcularia longiseta* Ehrbg.
,, *grandis* Tessin (46) = *Furcularia longiseta* Ehrbg.
Acanthodactylus tigris Tessin (46) = *Cœlopus porcellus* Gosse.
,, *rattulus* Tessin (46) = *Cœlopus brachiurus* Gosse.
,, *gracilis* Tessin (46) = *Cœlopus tenuior* Gosse
,, *rattus* Tessin (46) = *Mastigocerca rattus* Ehrbg.
,, *carinatus* Tessin (46) = *Mastigocerca carinata* Ehrbg.
,, *bicornis* Tessin (46) = *Mastigocerca bicornis* Ehrbg.

BIBLIOGRAPHY.

N.B.—This Bibliography only refers to the New Rotifers in preceding list, and is not a complete bibliography of all the papers on Rotifera since 1889.

1. Anderson, H. H.—Notes on Indian Rotifers. Journ. Asiatic Society of Bengal, 1891, 3 pls.
2. Anderson, H. H., and J. Shephard—Notes on Victorian Rotifers. Proc. Royal Soc. of Victoria, IV. (1892) pp. 69–80, 2 pls.
3. Burn, Dr. W. Barnett—New and little-known Rotifers. Science Gossip, 1889, pp. 179–81, 2 figs.
4. —— New and little-known Rotifers. Science Gossip, 1890, pp. 34–36, 2 figs.
5. Bryce, David—Two new Species of Rotifers. Science Gossip, 1890, pp. 76–79, 5 figs.
6. —— Genus *Distyla* and three new Rotifers. Science Gossip, 1891, pp. 204–7, 8 figs.
7. —— Moss-dwelling Cathypnadæ. Science Gossip, 1892, pp. 271–5, 5 figs.
8. —— On Macrotrachelous Callidinæ. Journ. Quekett Micr. Club, V. (1892) pp. 15–23, 1 pl.
9. —— On the Adinetadæ. Journ. Quekett Micr. Club, V. (1893) pp. 146–51, 1 pl.
10. —— Two new Species of Macrotrachelous Callidinæ. Journ. Quekett Micr. Club, V. (1893) pp. 196–201, 1 pl.
11. —— Metopedia parvula. Journ. Quekett Micr. Club, V. (1893) (to be published in October).

12. Bergendal, D.—Zur Rotatorienfauna Grönlands. Kongl. Fysiografiska Sälskapets Handlingar. Ny Följd, 1891–2, III. Sep. ed. Lund, 1892, 6 pls.

13. —— Ehrenbergs *Euchlanis lynceus* wiedergefunden. Lunds Univ. Årsskrift, 1892.

14. Calman, W. T.—On certain new or rare Rotifers from Forfarshire. Annals of Scott. Nat. Hist., Oct. 1892, 1 pl.

15. Daday, Dr. Eug. von — *Schizocerca diversicornis* Daday, oder *Brachionus amphifurcatus*, Imhof. Zool. Anz., 1891, pp. 266–8.

16. Glascott, Miss L. S.—A List of some of the Rotifera of Ireland. Proc. Royal Dublin Society, VIII. (1893) pp. 29–86, 5 pls.

17. Hood, John—*Floscularia annulata.* Science Gossip, 1888, pp. 8–10, 2 figs.

18. —— *Floscularia quadrilobata* and *Floscularia Gossei.* Inter. Journ. of Microscopy and Nat. Science, January and April, 1892, 4 pls.

19. —— Three new Rotifers. Journ. Quekett Micr. Club, V. (1893) (to be published in October) 1 pl.

20. —— *Synchæta tavina.* Inter. Journ. of Microscopy and Nat. Science, 1893 (to be published in October) 1 pl.

21. Imhof, Dr. O. E.—Notizen üb. die pelag. Fauna der Süsswasserbecken. Zool. Anz., 1887, pp. 457–60.

22. —— Fauna der Süsswasserbecken. Zool. Anz., 1888, pp. 166–72.

23. —— Ueber die pelag. Fauna einiger Seen d. Schwarzwaldes. Zool. Anz., 1891, pp. 33–8.

24. —— *Brachionus amphifurcatus* and *Polyarthra latiremis.* Zool. Anz., 1891, pp. 125, 446–7.

25. Jägerskiöld, L. A.—Zwei der *Euchlanis lynceus* verwandte neue Rotatorien. Zool. Anz., 1892, pp. 447–9, 2 figs.

26. Janson, Dr. Otto — Die Rotatorien-familie der Philodinæen. Abhandl. des Natw. Ver. Bremen, XII. (1893); also sep. ed. Marburg, 1893, 5 pls.

27. Kellicott, Dr. D. S.—*Cephalosiphon furcillatus.* Proc. of Amer. Soc. of Micr., XI. (1889) p. 32, 1 fig.

28. King, Hy. W.—Pond Life from the West Indies. Journ. Quekett Micr. Club, V. (1893) pp. 137–45, 2 pls.

29. Lord, J. E.—The Genus *Distyla.* Science Gossip, 1890, pp. 201–2, 5 figs.

30. —— A new Rotifer, *Elosa Worrallii.* Inter. Journ. of Micr. and Nat. Science, 1891, 1 pl.

31. Levander, K. M.—Eine neue Pedalion-Art. Zool. Anz., 1892, pp. 402–4, and 1893, pp. 26–7.

32. Milne, E.—Rotifer as a Parasite or Tube-dweller. Proc. Phil. Soc. Glasgow, 1888–9, XX. pp. 48–50, 2 figs.

33. Parsons, F. A.—Note on two Rotifers found at Epping Forest. Journ. Quekett Micr. Club, IV. (1892) pp. 378–80, 1 pl.

34. Plate, Dr. L. — Rotatorienfauna des bottnischen Meerbusens. Zeitschr. f. Wiss. Zool., XLIX. (1889) pp. 1–42.
35. Pell, Alfred—Three new Rotifers. The Microscope, X. (1890) pp. 143–5, 3 figs.
36. Petr, F.—Böhmische Rotatorien. SitzB. K. Böhm. Ges. Wiss., 1890, pp. 215–25, 2 figs.
37. Rousselet, C. F.—Note on *Dinops longipes*. Journ. Quekett Micr. Club, IV. (1890) p. 263.
38. —— On *Notops minor*. A new Rotifer. Journ. Quekett Micr. Club, IV. (1892) pp. 359–60, 1 pl.
39. —— On *Conochilus unicornis* and *Euchlanis parva*. Journ. Quekett Micr. Club, IV. (1892) pp. 367–70, 1 pl.
40. —— On *Floscularia pelagica*, &c. Journ. Royal Micr. Soc., 1893, pp. 444–9, 1 pl.
41. Thorpe, Surgeon V. Gunson—New and Foreign Rotifera. Journ. Royal Micr. Soc., 1891, pp. 301–6, 2 pls.
42. —— The Rotifera of China. Journ. Royal Micr. Soc., 1893, pp. 145–52, 2 pls.
43. Thompson, Percy G.—Moss-haunting Rotifers. Science Gossip, 1892, pp. 56–9, 8 figs.
44. —— Parasitic Tendency of Rotifers. Science Gossip, 1892, pp. 219–21, 1 fig.
45. Thompson, I. C. — *Anuræa cruciformis*. Trans. Liverpool Biol. Soc., 1892, pp. 77–81.
46. Tessin-Butzow, Dr. G.—Rotatorien der Umgegend von Rostock. Archiv 43 d. Freunde d. Naturg. i. Mecklbg., pp. 133–74, 2 pls. 1886 ?
47. Western, Geo.—Notes on Rotifers. Journ. Quekett Micr. Club, IV. (1891) pp. 254–8, 1 pl.
48. —— Notes on Rotifers. Journ. Quekett Micr. Club, IV. (1891) pp. 320–322, 1 pl.
49. —— Notes on Rotifers. Journ. Quekett Micr. Club, V. (1893) pp. 155–60, 1 pl.
50. Wierzejski, Prof. Dr. A.—Liste des Rotifères observés en Galicie. Bull. Soc. Zool. de France, XVI. (1891) p. 49.
51. —— Rotatoria (Wrotki) Galicyi. Akademie d. Wiss. in Krakau, 1892, pp. 160–265, 3 pls. (also reprint Krakau, 1893, Polish).
52. —— *Atrochus tentaculatus*. Ein Räderthier ohne Räderorgan. Zeitschr. f. Wiss. Zool., LV. (1893) pp. 696–712, 1 pl.
53. —— und Dr. O. Zacharias—Neue Rotatorien des Süsswassers. Zeitschr. f. Wiss. Zool., LVI. (1893) pp. 236–43, 1 pl.
54. Zacharias, Dr. O.—Forschungsberichte aus der Biol. Station zu Plön. 1893, I. Theil, 1 pl.
55. Zelinka, Dr. Carl—Studien über Räderthiere, III. Zeitschr. f. Wiss. Zool., LIII. (1891) pp. 323–428, 6 pls.
56. Daday, Dr. Eug. Von—Rotatorien des Golfes von Neapel. Math. Termes. Ertes. (Math. Nat. Anz. d. Akad.) VIII. pp. 4–8. Math. Nat. Ber. aus Ungarn, VIII. (1891) pp. 349–53.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Parthenogenetic Segmentation of Ova of Mammals.‡—M. L. F. Henneguy's observations on the degeneration of the ova of Mammals confirm and extend those of Flemming and Schottländer. They show that the ovule in follicles that are undergoing atresia may present not only a precocious maturity, as evidenced by the appearance of a directive spindle and a polar globule, but also a commencing, irregular, parthenogenetic segmentation. They further show that the chromatic substance of the nucleus, when dispersed in the cytoplasm, continues to exercise an action on it. In the absence of centrosomes the chromosomes become centres of attraction and orientation for the achromatic filaments.

Origin of Mesoderm.§—Dr. J. Perényi gives the following account of the origin of the mesoderm in the frog. In the blastula the dark pole consists of three layers of cells. These curve inwards at the equatorial margin at one side, and a unilateral epibole results. This epibole begins in the form of an angle with a right and a left margin, i. e. the duplication takes place in two portions. Subsequently, in the position defined by the two margins, there arises the primitive streak, the basis of the medullary groove. The original orientation of the egg changes; the dorsal part of the embryo appears at one side of the white pole, the ventral part on the dark pole. The originally outermost layer of ingrowing cells extends first vertically and forms the notochord, then horizontally, to right and

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., 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, and Reproduction, and allied subjects.

‡ Comptes Rendus, cxvi. (1893) pp. 1157-9.

§ Math. Nat. Ber. Ungarn, viii. (1891) pp. 272-8 (2 pls.); Math. Termés. Értes. (Math. Nat. Anzeig. Akad.), viii. pp. 11-9.

left, and forms the endoderm. But the two rows of cells beneath the original covering cells curve to right and left, and form the mesoderm. The notochord is constricted off, first from the covering cells, then from the endoderm. Where the duplication of rows of cells begins, is not the blastopore, but the beginning of the notochord. The blastopore lies where the duplication of cell-rows ends, i.e. at the end of the notochord. Keeping pace with the development of the germinal layers, the notochord comes to lie along the embryo between the two mesoderm plates.

Origin and History of the Graafian Follicle.*—Dr. J. Schottlaender has investigated the ovaries of the cat, rabbit, pig, &c., and has compared them with the human ovary. In the human ovary, ova and follicular epithelium arise directly from the germinal epithelium. Waldeyer's *Eiballen* are first formed. From these, with increased growth of connective tissue, there arise (*a*) the Pflüger-Valentin tubules, (*b*) the typical primordial follicles, (*c*) atypical primordial follicles, with two or three ova (which secondarily become primordial), (*d*) *Eiballenfollikel*, which arise by connective delimitation of larger or smaller portions of the *Eiballen* and modification of these into follicles, and (*e*) tubular follicles which arise by connective delimitation of larger or smaller parts of (*a*). It seems likely that most, if not all, of the larger follicles in the ovary of a child are Eiballen- or tubule-follicles; these are rapidly formed, and that they may represent an organic economy the author explains. He gives a decided negative answer to the question whether new Graafian follicles arise in the adult human ovary. The unchanged Graafian follicle is described in detail, as regards ovum, follicular epithelium, and theca folliculi.

The degeneration of an unburst follicle (follicular atresia) is a physiological process, whose chief criterion is to be found in the state of the follicular ovum. The state of the follicular epithelium is less important, for the epithelium always degenerates in the formation of the liquor. In the ovum and in epithelial cells, the nucleus undergoes (*a*) chromatolysis or (*b*) atrophy, the cell-substance exhibits degeneration either fatty (α) or otherwise (β) (perhaps albuminous ?). There are various combinations of (*a*) and (*b*) with (α) and (β). The effect of (α) and (β) is to liquefy the cell-substance which seems to lead to hyaline coagulation of the ovum. Even the primitive ova may exhibit degeneration. The corpus luteum arises without the participation of epithelial or wandering cells by the proliferation of the epithelioid cells of the theca interna of a follicle which is ready to burst.

Placenta of Rodents.†—Dr. A. Fleischmann has succeeded in demonstrating the uniformity of placentation in the Rodentia. He has previously shown that the so-called "inversion" in mouse and guinea-pig can be harmonized with what occurs in rabbit and porcupine. He has now succeeded in harmonizing the varied relations of the blastodermic vesicle to the lumen of the uterus. A study of *Spermophilus citillus* has enabled him to connect the state of affairs in *Lepus* and *Sciurus* with that in *Mus*, *Cricetus*, *Arvicola*, and *Cavia*. In all cases, what may be called the prodiscoidal type is demonstrable. The techni-

* Arch. f. Mikr. Anat., xli. (1893) pp. 219–94 (2 pls.).
† SB. K. Preuss. Akad. d. Wiss., 1892, pp. 445–57 (1 pl.).

calities make a summary of an already condensed narrative exceedingly difficult; we therefore restrict our report to noticing the important result gained—that there is a morphological unity in the placentation of Rodentia.

A Duck with Drake's Plumage.*—Mr. A. Willey has examined a female of *Anas boschas* var. *dom.* L., whose plumage closely resembled that of a male. The oviduct was normal in length and form, except that the wall of the lower part was thickened and the lumen divided into two. There was no mesovarium. The ovary was much reduced; no follicular epithelium was recognizable; all the ova were invaded by wandering cells, and were being absorbed. For two years the bird had been kept in the Zoological Institute at Freiburg, and had laid no eggs; but its original owner stated that it had laid for several years, and that it had exhibited male plumage from its youth. Is this then a case of a female organism inheriting some of the secondary sexual characters of the male; or was the male plumage correlated with a degeneration of the essential female organs? Mr. Willey points out that a sure answer cannot be given without knowing more definitely about the bird's life-history.

Development of the Teleostean Vertebral Column.†—Dr. C. Scheel has studied this in embryos of *Rhodeus amarus*, trout, salmon, &c., and comes to the following conclusions:—

In Teleostei there is a regular, single-layered, chorda-epithelium. The notochord is surrounded by a non-cellular sheath, and outside this by a non-cellular elastic membrane. In *Rhodeus* the superior arch and the parapophysis of each side have a common origin in an aggregation of cartilage cells lateral to the notochord. In the trout there is apparent discontinuity between superior arch and parapophysis, but the intervening perichondrium unites them. In *Rhodeus* the superior arches unite in a median process, as is the case also posteriorly in trouts. Medianly and anteriorly, however, the arches in the trout run parallel, and small transverse pieces form a (primitive) bridge between them. Cartilaginous fin-rays extend along the whole dorsal surface far beyond the definite fin-regions—a fact which proves the primitive dorsal extension of the fin. In *Rhodeus* there is, especially in the anterior region, a very great development of cartilage around the notochord—forming a thick ring—the common basis of superior arches and parapophyses. In trouts this mass is much reduced. The inferior caudal arches are ventrally directed parapophyses, but not true hæmapophyses. Indeed, these are not developed in Teleosteans, except perhaps in the anterior trunk of *Rhodeus*. The ribs are abjointed from the parapophyses, and those of Teleosteans must be regarded as homologous with those of Amphibians.

Development of the Pancreas.‡—Dr. E. Goeppert has studied this in embryos of the salmon-trout. The organ makes its first distinct appearance in embryos twenty-one days old. A dorsal rudiment—a direct outgrowth of the gut—is first seen, but by the thirtieth day there are two other outgrowths on the ventral surface. These arise from the

* Ber. Nat. Gesell. Freiburg i. B., vi. (1891) pp. 57–61 (1 pl. and 2 figs.).
† Morphol. Jahrb., xx. (1893) pp. 1–47 (3 pls.).
‡ Tom. cit., pp. 90–111 (6 figs.).

primitive duct of the liver. Subsequently there is a union of the three parts. The duct of the dorsal portion degenerates; the ducts of the two ventral parts unite in a common terminal region (ductus Wirsungianus), which opens first into the ductus choledochus, but ultimately into the gut.

In the sturgeon there are four rudiments of the pancreas, as v. Kupffer has shown; in Amphibians there are three; in the chick (according to Felix) there are three; in at least some mammals there is a dorsal and a ventral rudiment. It is probable that the fourfold origin, as seen in the sturgeon, is the primitive condition, and that the most posterior portion has in most cases been dispensed with.

β. Histology.

Attractive Sphere.*—Dr. O. Van der Stricht, after a short historical introduction, gives an account of his observations on the attractive sphere in the eggs of *Triton*, and in cartilage cells. In the former some differences were observed from the phenomena described for the Trout and for *Siredon;* in the eggs of *Triton* the division of the attractive sphere is, ordinarily, effected during the quiescent stage of the nucleus, rarely in the anaphase of the mother-nucleus, and exceptionally in the metaphase. The author's account of what he observed in cartilage-cells cannot unfortunately be lucidly reproduced without copies of the figures to which he frequently refers.

Nuclear Division in Cut Nerve-fibres.†—Dr. G. Bizzozero points out, in correction of a paper by O. von Büngner, that the late Dr. A. A. Torre discovered in 1884 the mitotic multiplication of the nuclei of Schwann's sheath. This multiplication is exhibited along the whole course of the peripheral stump of a cut nerve, and the resulting cells are able to absorb the myelin drops which result from the degeneration of the fibres. Dr. Torre also showed that in normal medullated nerve-fibres the multiplication of nuclei in Schwann's sheath is mitotic.

Neuroglia-cells in Peripheral Nerves.‡—Dr. E. Kallius finds numerous neuroglia cells uniformly distributed throughout the optic nerve. Their processes form a very fine-meshed network in the interstices of which the fibres lie. They were demonstrated in man, horse, ox, dog, rabbit, and mouse. Their occurrence corroborates the embryological conclusion that the optic nerve is a modified portion of the brain. They were also found in the Trigeminal, Auditory, and Vagus, but were abundant only at the roots of these nerves.

Cell-multiplication and Replacement.§—Prof. J. Frenzel has an essay on this subject, the gist of which seems to be expressed in the following sentence:—Under the term cell-division we include two essentially different phenomena: On the one hand there is cell-multiplication which by mitosis results in the growth of an organ or of part of an organ, and there is cell-replacement which proceeds by amitotic division with the result of replacing lost cells. That this contrast,

* Arch. de Biol., xii. (1892) pp. 741–63 (1 pl.).
† Arch. f. Mikr. Anat., xli. (1893) p. 338.
‡ Nachr. K. Gesell. Wiss. Götting., 1892, pp. 513–5.
§ Biol. Centralbl., xiii. (1893) pp. 238–43.

demonstrable for Invertebrates, is likely to be to some extent demonstrable for Vertebrates as well, is one of the author's contentions.

γ. General.

Phosphorus in the Tissues.*—Drs. L. Lilienfeld and A. Monti have made a series of microchemical investigations bearing upon the localization of phosphorus in the tissues both of plants and of animals. Their general result is that young cells capable of reproduction are always rich in phosphorus, while much differentiated cells, in which the power of reproduction tends to be lost, have nuclei poor in phosphorus.

B. INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Olfactory Organs of Helix.†—Dr. A. B. Griffiths contends that Sochaczewer's experiments, by which he showed that the tentacula of *Helix pomatia* are not olfactory organs, were untrustworthy from his use of turpentine, which gives off a vapour that is irritating to the sensitive tissues generally. If snails are placed on flat slabs, the edges of which are smeared with eau de Cologne, methyl, ether, or ethyl acetate, liquids the vapours of which are not irritants, such as have the tentacula removed gradually approach the edges of the slabs, while those whose tentacles are uninjured turn away from the edges. He concludes, therefore, that the tentacula are the seat of the olfactory organs in *Helix*.

Opisthobranchs of the 'Hirondelle.'‡—Dr. R. Bergh describes the Opisthobranchs collected by the Prince of Monaco on the 'Hirondelle.' The work is chiefly descriptive of the structure of a few species, some of which are new. *Pleurobranchillus* is a new genus, resembling *Pleurobranchus* in some points.

Histology of Muscle in Heteropods and Pteropods.§—Herr J. Wackwitz has investigated species of *Carinaria*, *Pterotrachea*, *Atlanta*, *Hyalea*, *Cleodora*, *Creseis*, &c., and has compared their muscle with that of other molluscs. Within the relatively narrow range of the two groups above mentioned, there is great histological diversity as regards muscle. There are smooth fibres and striped fibres and gradations between them; and both kinds of fibres occur in two forms, either poor in contractile substance and rich in medullary substance, or the reverse. In those molluscs which creep—a mode of locomotion more laborious than swimming—the contractile substance predominates. And since the medullary substance, through which compensation for waste is obtained, is relatively less, the muscle is adapted for powerful but slow activity. In Heteropods and Pteropods the reverse holds good. In regard to the occurrence of smooth and striped muscle, the author corroborates the conclusion that striped muscle is adapted for more energetic and rapid activity than smooth muscle.

* Atti R. Accad. Lincei—Rend., cclxxxix. (1892) pp. 354–8.
† Proc. Roy. Soc. Edin., xix. (1892) pp. 198 and 9.
‡ 'Résultats Scientifiques,' &c., iv. (1893) 35 pp., 4 pls.
§ Zool. Beitr., iii. (1892) pp. 129–60 (3 pls.).

Range of Placostylus.*—Mr. E. Hedley makes the geographical range of this snail a text for a study in ancient geography. He thinks that the area which it occupies should rank as a zoological province to be called Melanesia; it would embrace the archipelagoes of Solomon, Fiji, New Hebrides, Loyalty, New Caledonia, Norfolk I. (?), Lord Howe I., and New Zealand. This area was never connected with nor populated from Australia, and its fauna was probably derived from Papua viâ New Britain. The presence of genera common to Australia and New Zealand is explicable by the supposition that they derive, in either case, from New Guinea as a common source.

δ. Lamellibranchiata.

Ocular Nerves of Spondylus gœderopus.†—M. J. Chatin reminds the student that he has already demonstrated the existence, in the eyes of Pectens, of an optic nerve which supplies the retina, and of ophthalmic nerves which innervate the peripheral parts. These two kinds of nerves are found in *Spondylus gœderopus*, where they arise separately from the circumpallial nerve. With osmic acid the optic nerve is stained black, while the ophthalmic nerves are hardly tinted at all. The staining is due to the presence of myelin, a very rare occurrence among Invertebrates.

Food of Oysters, Clams, and Mussels.‡—Mr. J. P. Lotsy, on sucking out by a pipette the contents of the stomach, found an abundance of diatoms, but a total absence of Copepods, although these were very abundant in the surrounding water. Cultures of diatoms were taken by the animals, but hashes of Copepods were either refused at once, or, if accepted, were instantly rejected and that forcibly, being driven to a distance of six or seven inches.

Pedal Impression of Pachyerisma.§—Prof. G. Boehm points out that *Pachyerisma* bears a distinct impression of a pedal muscle on the under surface of the anterior lateral tooth, therefore *Pachymegalodon* cannot be separated from *Pachyerisma*, as Neumayr thought necessary.

Lithiotis problematica Gümbel.‖—Prof. G. Boehm finds that the fossils so named are oysters. Often only the ligament region remains. The frequent grooves in this region are due to weathering, and are also seen in Tertiary oysters. He finds further that *Trichites Loppianus* Tausch is an *Ostrea*, and near the so-called *Lithiotis*. The very numerous white bands and streaks in the grey limestone are not wholly sections of the above-mentioned oysters, but also due to *Perna*.

Molluscoida.

α. Tunicata.

Origin of Metagenesis in Tunicata.¶—Prof. W. Salensky sums up the results of an interesting essay on this subject in the following terms:—

* Proc. Linn. Soc. N.S.W., vii. (1893) pp. 335–9.
† Comptes Rendus, cxvi. (1893) pp. 1156 and 7.
‡ John Hopkins Univ. Circ., xii. (1893) pp. 104 and 5.
§ Ber. Nat. Gesell. Freiburg i. B., vi. (1892) pp. 119–20.
‖ Tom. cit., pp. 65–80 (3 pls.).
¶ Biol. Centralbl., xiii. (1893) pp. 126–46.

(1) The primitive form of metagenesis of the Tunicata is to be found in those species of Synascidians which are capable of multiplying asexually in the larval stage.

(2) *Distaplia* alone of the Synascidians exhibits an alternation of generation, while the development of the Didemniidæ has no relation to that process.

(3) The primordial bud of the *Distaplia*-larva is to be regarded as an intermediate stage between the simple bud and the stolo prolifer of the metagenetic Tunicata.

(4) The stolo prolifer is derived from the bud which began to divide before separation from the mother-body.

(5) In the oldest metagenetic forms the "nurse" died after the production of the sexual generation; in the course of metagenesis the length of the "nurse's" life increased. In this connection *Doliolum* represents an intermediate stage between the Synascidiæ and the Salpidæ.

Deglutition in Synascidiæ.*—M. S. Jourdain, from observations on living specimens of *Clavelina* and *Perophora*, comes to the conclusion that one of the functions of the vibratile pit is the secretion of mucus; by the aid of this the food particles are agglutinated into a cord, which is conveyed by the ciliated branchial band into the stomach.

Nervous System in Embryos of Distaplia.†—Prof. W. Salensky has investigated the nature and development of the nervous system in embryos and larvæ of *Distaplia magnilarva*. The larval nervous system consists of a somewhat complex cerebral vesicle, a trunk portion, and a tail portion. The cerebral vesicle is a vesicular tube, opening anteriorly into the oral cavity, continued posteriorly into the trunk region, and expanded medianly into a sensory vesicle. This sensory vesicle lies between what may be called the *Trichterblase* and the *Ganglionblase*. In young embryos the anterior end of the funnel-vesicle is blind; it is at first in a line with the rest of the brain, but is subsequently shunted to the left side. In connection with the sensory vesicle, the author describes the eye and the auditory organ. All the parts of the sensory vesicle, viz. retina, lens, pigment layer, and otolith cell, arise from the differentiation of one and the same epithelial layer of the primitive cerebral vesicle. The ganglion-vesicle lies between the choroid fold and the trunk region. Its lower wall is anatomically and genetically connected with the posterior part of the cerebral ganglion; indeed the latter arises from a thickening of the inferior wall of the ganglion vesicle. The trunk region (*Rumpfmark*) connects the brain and the cord, and consists of an epithelial canal (part of the original neural canal) and of a well-developed layer of nerve-cells (*Rumpf-ganglion*) which has its origin from the cells of the posterior wall of the sensory vesicle. This *Rumpf-ganglion* is perhaps to be regarded as a great reflex centre for the larva, which through the cerebral ganglion conveys the results of sensory stimuli to the muscles. The degeneration of the cord during embryonic life is briefly referred to. After comparing in detail the nervous system of this larval Ascidian with that of other

* Bull. Soc. Philomath., iv. (1892) pp. 35 and 6. See Ann. and Mag. Nat. Hist., x. (1892) pp. 482 and 3.

† Morphol. Jahrb., xx. (1893) pp. 48–74 (2 pls.).

Chordata, Salensky comes to the important conclusions that the sensory vesicle is homologous with the epiphysis and the Ascidian eye with the parietal eye.

Origin of Organs of Salpa.*—Prof. W. K. Brooks has published an abstract of one of the chapters of his forthcoming memoir on the genus *Salpa*. He remarks that "stated in a word the most remarkable peculiarity of the *Salpa*-embryo is this: it is blocked out in follicle cells which form layers and undergo other changes, which result in an outline or model of all the general features in the organization of the embryo. While this process is going on the development of the blastomeres is retarded, so that they are carried into their final positions in the embryo while still in a very rudimentary condition. Finally, when they have reached the places which they are to occupy, they undergo rapid multiplication and growth, and build up the tissues of the body directly, while the scaffolding of follicle cells is torn down and used up as food for the true embryonic cells."

With regard to the aggregated *Salpæ*, which during development undergo complicated changes of position, Salensky and Seeliger are said to have totally failed to understand the changes. The author now amplifies and expands the statement made by him some years ago, that the *Salpa*-chain is, morphologically, a single row of *Salpæ*, all in the same position, with their dorsal surfaces proximal and their right sides on the right of the stolon.

With regard to the ectoderm of the embryo, Salensky would again appear to have misunderstood the facts; Prof. Brooks finds that it is derived from the extra-follicular blastomeres, and that the epithelial capsule is a transitory structure which is lost as the ectoderm replaces it.

The caudal nervous system is represented by scattered blastomeres, which soon degenerate and disappear. The ganglion is formed as an invaginated fold of the somatic layer of the follicle, and the ganglionic blastomeres pass with it from the ectodermal ridge, and become completely folded in among the follicle cells. The nerve-tube of the stolon is formed from the ectoderm in the middle line of the upper surface of the stolon. In the aggregated *Salpæ* the nerve-tube arises as a solid rod, but it soon acquires a lumen; as the ectodermal folds grow inwards and mark out the bodies of the *Salpæ*, they cut the tube up into a series of ganglionic vesicles, one for each *Salpa*. The apparent migration of the ganglion is the result of secondary changes in the position of the bodies of the *Salpæ*, and is not due to any change in the relation of the ganglion to other organs of the body.

The history of the perithoracic tubes and of the atrium cannot be described intelligibly without figures; the author finds that they are formed before the cavity of the pharynx is hollowed out in the mass of visceral follicle cells, and he shows that Salensky mistook them for the "primitive digestive cavity." In the aggregated forms the rudiment of each contains two perithoracic vesicles, derived from the right and left perithoracic tubes of the stolon; their vesicles give rise to the perithoracic system, and to nothing else. Throughout its whole history this

* John Hopkins Univ. Circ., xii. (1893) pp. 93–7.

system is bilaterally symmetrical, although the symmetry is hidden by the changes which take place in the position of the plane of symmetry during growth. The author cannot accept the account given by Seeliger, who met with difficulties in *Salpa democratica* that are not to be found in *S. pinnata*, where the stolon is straight.

The cavity of the pharynx arises by the degeneration of the visceral follicle cells; its endodermal epithelium is derived from the blastomeres, and the gut is formed as a diverticulum of the pharynx.

In the concluding paragraphs the author describes the endodermal tube of the stolon, and the digestive tract of the aggregated *Salpa*; here again he compares his results with the results of Seeliger and Salensky.

Nutrition of Embryo of Salpa.*—Prof. W. K. Brooks points out that the generally accepted idea that the nourishment and aeration of the embryo of *Salpa* is on the same lines as that of the Mammalian fœtus is quite incorrect. As the *Salpa*-embryo is bathed by the water which is constantly flowing past it, there does not seem to be either any need for or adaptation of structure for a respiratory placenta. Nourishment, moreover, is effected in a way quite unlike anything which has been described in the Mammalia.

The remarkable and rapid growth of the young *Salpa* is only partly due to cell-multiplication, for there is a growth of the individual cells, which, instead of growing smaller with repeated divisions, actually increase in size in all parts of the body. The placenta of *Salpa* is an organ for the nourishment of the cells of the placenta by the blood of the chain-*Salpa*; and the subsequent degeneration of these cells, after they have migrated into the body of the embryo, supplies the material for the growth of the embryo. It would seem that those investigators who have described the placenta as divided into a fœtal chamber and a maternal one have been misled by an erroneous notion as to its function.

The placenta is not the only nutritive organ, as the follicle also supplies material which is available for the rapid construction of the body of the embryo. The cells of this follicle become detached and degenerate, and though it is not possible to trace the history of every cell from first to last there is sufficient evidence that the function of the follicle of *Salpa* is exclusively nutritive; the organ is transitory and embryonic.

New Species of Octacnemus.†—Mr. M. M. Metcalf describes a deep-sea Tunicate from Patagonia, which shows many resemblances to *O. bithyus* of Moseley, but differs from it in being colonial and not solitary. It may, of course, be the chain-form and Moseley's the solitary form of one and the same species. Meantime it is called *O. patagoniensis.*

β. Bryozoa.

Classification of Cheilostoma.‡—In an essay on British Palæogene Bryozoa, Mr. J. W. Gregory proposes the following classification of the order Cheilostoma:—

* John Hopkins Univ. Circ., xii. (1893) pp. 97 and 8.
† Tom. cit., pp. 98–100 (6 figs.).
‡ Trans. Zool. Soc. Lond., xiii. (1893) pp. 219–79 (4 pls.).

I. Suborder. STOLONATA. Forms with simple tubular zoœcia, and terminal or subterminal apertures. Families: Æteidæ, Eucratiidæ, and Chlidoniidæ.

II. Suborder. CELLULARIINA. A group of forms with simple zoœcia and tufted phytoid zoaria, and probably including representatives of the three following suborders. Families: Cellulariidæ, Bicellariidæ, Epistomiidæ, Catenicellidæ, and Bifaxariidæ.

III. Suborder. ATHYRIATA. Cheilostoma with the front wall uncalcified or incompletely calcified. Families: Farciminariidæ, Flustridæ, Membraniporidæ, Cribilinidæ, Microporidæ, Steganoporellidæ, and Cellariidæ.

IV. Suborder. SCHIZOTHYRIATA. Cheilostoma which are schizostomatous or trypiate. Families: Schizoporellidæ, Adeonellidæ, and Microporellidæ.

V. Suborder. HOLOTHYRIATA. Holostomatous Cheilostoma which have the front wall wholly calcified. Families: Lepralliidæ, Celleporidæ, and Smittiidæ.

γ. Brachiopoda.

Structure of Brachiopoda.*—Prof. F. Blochmann devotes the first part of his work to the anatomy of *Crania*, of which he gives a detailed descriptive account of the kind which it is not possible to abstract. The student will, however, doubtless find the text, with the illustrations, an important aid in the study of this difficult group.

Arthropoda.

α. Insecta.

Larvæ of British Butterflies and Moths.†—The fifth volume of this work of the late William Buckler was only in part edited by Mr. H. T. Stainton, who, unfortunately, died before it left his hands. His task was completed by Mr. W. D. Roebuck, under the supervision of Mr. G. T. Porritt. In the present volume the Noctuæ, which will be completed in the next, are continued; it is only necessary to call the attention of the entomologist to the appearance of another part of this work.

Classification of Hesperiidæ.‡—Mr. E. Y. Watson proposes a classification of the Hesperiidæ, and revises the genera. The characters which have been found of the greatest value in dividing the family into groups are, firstly, the position of vein 5 of the fore-wing, taken in conjunction with the length of the cell; the position assumed by the species when in a state of complete repose is a character of great importance, and a third useful point is to be found in the secondary male characters found on the upper side of the fore-wing. As subfamilies he recognizes (1) the New World Pyrrhopyginæ, (2) the Hesperiinæ, in which the antennæ nearly always end in a fine point, and (3) the Pamphilinæ. The author fully diagnoses the genera, many of which are new.

* 'Untersuchungen über den Bau der Brachiopoden,' 4to, Jena, 1892, 66 pp., Atlas of 7 pls.

† London. For the Ray Society. 1893, 8vo, 90 pp., pls. lxx. to lxxxvi.

‡ Proc. Zool. Soc., 1893, pp. 3–132 (3 pls.).

Mimetic Forms of Hypolimnas.*—Col. C. Swinhoe's investigations, an abstract of which has been published, had for their subject the changes undergone by the species of a small group of Butterflies as they are traced from one locality to another, and to ascertain the bearing of the facts on the theory of mimicry. Representations of the Indian *Hypolimnas bolina* are found in Malaya, Polynesia, and Africa; though the local representatives differ from one another and from the Indian form, they agree in possessing in one or both sexes a more or less superficial resemblance to some conspicuous species belonging to a specially defended group inhabiting the same locality.

The author would appear to have devoted himself to such questions as (1) the special liability of the female to become mimetic; (2) the ancestral form from which the various mimetic varieties have been derived; (3) the mimetic resemblance to different species in the same locality; (4) the divergent conditions under which mimicry appears in closely related species: and (5) the relation between selection and variation in the production of mimetic resemblance.

Ants' Nests.†—Dr. A. Forel gives a most interesting account of the nests of ants, nests temporary and permanent, nests natural and artificial, nests of earth and of wood and of other materials, nests tenanted by one kind of ant or by several, and so on. It is a fortunate thing when a master of the subject gives us in so pleasant a manner the results of his long experience.

Notes on Ants.‡—M. A. Forel has some notes on *Acanthognathus ocellatus* Mayr. Three long stylets end in a recurved trident, and each bears near its base a long strong tooth, curved downwards and inwards and ending in two denticles. The specimen was sent to Forel by Dr. Müller of Blumenau (S. Brazil) who gives a short description of the habits of this ant. With the bidentate end of the lower teeth the ants seize and carry their eggs and particles of earth. In the allied *Strumigenys* there are no lower teeth. F. W. Urich from Trinidad observes that *Camponotus atriceps* is nocturnal; *Cryptocerus atratus* raises its abdomen in a threatening manner on to its head but does not sting; *Odontomachus hæmatodes* and *Anochetus* (*Stenomyrmex*) *emarginatus*, which sting virulently, are called "Tack-Tack" by the natives on account of the noise which they make by sharply shutting their mandibles; *Azteca instabilis* and *Dolichoderus bispinosus* have an aromatic odour; the nests of the last-named are formed from the vegetable débris and particles of earth glued together by a resinous secretion, and not merely from the capsules of *Bombax ceiba* as has been believed.

The Pharaoh-Ant.§—Dr. J. Ritzema Bos gives an interesting report on *Monomorium Pharaonis*—a happily rare import to North Europe. The ants invaded the postal buildings, &c., in Leeuwarden (Friesland). They are so small that they cannot do much harm in the way of destroying the eatables over which they swarm, for a million do not weigh

* Proc. Roy. Soc. Lond., liii. (1893) p. 47.
† Neujahrsblatt Nat. Ges. Zürich, xcv. (1892) p. 37 (1 pl.).
‡ Bull. Soc. Vaud. Sci. Nat., xxix. (1893) pp. 51–3.
§ Biol. Centralbl., xiii. (1893) pp. 244–55.

60 grammes. In fact the author cannot blame them for any direct damage, but, none the less, they make a house uninhabitable and life a burden. The author has much that is interesting to relate in regard to these pests, why they are called after Pharaoh, that they eat everything edible except butter, that they do not (as often reported) destroy furniture, and many other items of information, but he refrains from noting how they may be got rid of, which to many would be the first and last question.

Change of Diet in a Beetle.*—Dr. J. Ritzema Bos notes a case in which *Harpalus ruficornis* F., habitually an insectivorous insect, had taken to a diet of ripe strawberries. On another occasion they visited in the evenings the beds of the country folk and bit the sleepers virulently.

Reducing Division in Spermatogenesis of Gryllotalpa.†—Dr. O. vom Rath finds that up to the last spermatogenetic division but one the number of chromosomata is twelve, and that the mitoses are like those of the body-cells. But before the last division but one twenty-four chromosomata are seen in the mother-sperm-cell arranged in six groups of four. These are reduced by the second last division to the typical number (12), and by the last division to six. Four spermatozoa are formed from the mother-sperm-cell, and each contains a chromosoma from each of the six groups.

A Diluvial Cockroach.‡—Dr. E. Schäff describes as *Periplaneta fossilis* the remains of a cockroach found by Dr. C. Weber in an interglacial peat-bed in Schleswig-Holstein. The remains are exceedingly like parts of a female Asiatic cockroach. Now, if Dr. Weber be right in asserting that the insect could not have penetrated at a recent date into the peat-bed, two possible interpretations of its occurrence remain. Either the records which state that *P. orientalis* came to Europe about 200 years ago are wrong, or the insect lived in Europe in diluvial times, and afterwards died out.

Halobatidæ of Plankton Expedition.§—Dr. F. Dahl, after a short account of the typical structure of a Halobatid, has a few notes on the apparent small number of specimens and species collected in the Atlantic in 1889 during the now well-known "Plankton Expedition." Questions that remain to be answered regarding them are, among others, On what do they live? do pelagic fish live on them? how do the limbs act?

β. Myriopoda.

Eye of Scutigera coleoptrata.‖—Dr. T. Adensamer shows that though the eye of this Millipede has the external appearance of a true facetted eye, it presents essential differences from the typical form. The cornea is the product of two cells; the refractive body which lies below it, though it has the same functions as the crystalline cone of facetted eyes, has, as Grenacher has shown, a different structure; it is made up

* Biol. Centralbl., xiii. (1893) pp. 255-6.
† Ber. Nat. Gesell. Freiburg i. B., vi. (1891) pp. 62-4.
‡ Zool. Anzeig., xvi. (1893) pp. 17-9.
§ Ergebnisse der . . . Plankton-Exp. in 1889, Bd. ii. G. a. (1893) 9 pp. (8 figs.).
‖ SB. Zool. Bot. Ges. Wien, xliii. (1893) pp. 8 and 9.

not of four, but of six cells; nuclei, which are generally persistent throughout life, are only found on these cells in quite young examples of *S. coleoptrata*. The crystalline body, as the structure may be called, does not, like the cone of true facetted eyes, lie in front of the nervous portion of the eye, but is largely enveloped by it. The retinal portion consists of two layers of cells, in the upper of which there are twelve, and in the lower four retinular cells, whereas the ordinary number is seven.

A new Stage in the Development of Male Iulidæ.*—Herr C. Verhoeff found in an autumn collection of *Hemipodoiulus Karschi* that all the adult males had the first pair of legs hook-shaped, and were thus different from those collected in May and June, whose first limbs were leg-like. The two sets agree in form, sculpturing, colour, size, and in the characters of the anal segment, foramina, ocelli, antennæ, and head; they differ as to "cheeks," first pair of legs, and copulatory organs, the autumn males representing an adult stage, the spring males an intermediate stage (*status medius* or *Schaltstadium*). The embryological and taxonomic importance of this discovery is emphasized.

δ. Arachnida.

Extreme Case of Parasitism.†—Dr. R. Hessler relates a case of a partly paralysed man whose body was covered with thick scales, which literally covered him like a fish. These were found to be due to itch-mites, of which it is calculated that there were on his body two millions, while of egg-cases and eggs there were seven millions. As in an ordinary case of itch the number of mites does not exceed one hundred, it is clear that this may well be called an "extreme case."

Circulatory Apparatus of Mygale cæmentaria.‡—M. M. Causard states that the heart of this tetrapneumonous Spider resembles in many points that of other Araneidæ. There are four pairs of ostia, whereas dipneumonous Araneids have three pairs, or, in rare cases, less. The heart of *Mygale Blondii* is stated by Blanchard to be divided into chambers; but this is not the case in *M. cæmentaria*, where there is but a single chamber with four enlargements. There are only two pairs of pulmonary veins; the blood is brought back to the heart by a pair of large lateral arteries, and two which are much smaller. Between the origin of these last there is a large trunk which takes a vertical course, and soon gives off backwards a branch which the author considers as corresponding to the caudal artery of other Araneids; later on it divides into two branches which branch right and left of the digestive tube, and ramify in the posterior region of the abdomen.

ε. Crustacea.

Cement-glands of Lobster.§—Mr. F. H. Herrick has a note on the cement-glands and origin of egg-membranes in the Lobster (*Homarus americanus*). The gland appears to be limited to the five anterior pairs

* Zool. Anzeig., xvi. (1893) pp. 20–6.
† Amer. Natural., xxvii. (1893) pp. 346–52.
‡ Comptes Rendus, cxvi. (1893) pp. 828–30.
§ John Hopkins Univ. Circ., xii. (1893) p. 103.

of pleopods, and these, for some time before oviposition, are filled with a milky-white substance. On the removal of the cuticle from a pleopod the tissue is seen to be studded with very minute round bodies, which are the cement-glands. In section the gland is composed of a very delicate sheath of connective tissue, and a simple epithelium formed of tall, pyramidal cells. The apices of the cells meet near the centre of the gland, the opening of which to the exterior it is impossible to detect. Shortly after oviposition the glands may be seen to have undergone a remarkable change in structure. They are enlarged and the epithelial cells appear to be degenerated, while the cell-outlines are very dim.

Protective Adaptations in Crabs.*—Dr. V. Haecker discusses, in an interesting essay, "the specific variation of Arthropods," with especial reference to the protective adaptations exhibited by crabs. He begins by noticing that certain lines of variation are characteristic of certain orders and families; thus sexual dimorphism is marvellously varied among Lamellicorns, but restricted among Caraboidea, these being notable for their protective coloration. So the Copepods are manifold in their sexual dimorphism, while the Decapoda are restricted as to this, but are notable for their protective adaptation. Rapid movement, burrowing, and masking illustrate their protective instincts. Some cases of masking have been recently studied with much care by Aurivillius. That the masking of *Hyas*, *Dromia*, &c., is an active process is beyond doubt. It has been repeatedly observed. On *Dromia*, the author found peculiar hooked hairs (noted by Aurivillius on *Hyas*), which make the fixing of foreign objects easier. But these are restricted in *Dromia* to the anterior end of the carapace and to the upper surface of the anterior limbs, for the posterior limbs in the *Dromia*-type have been modified so as to hold large objects on the crab's back. It is suggested that in the history of the *Dromia*-type, two modes of masking—by means of hooked setæ and by means of backward-turned appendages—have predominated at different epochs.

Limnoria lignorum.†—The commission appointed by the Royal Academy of Amsterdam to investigate the life and work of *Limnoria lignorum* has given in an elaborate report. The animal's geographical distribution, structure, and habits are discussed at length, but due attention has been given to its occurrence on the Dutch coast, the damage which it does, and the possibilities of lessening the evil.

Parthenogenetic Ova of Artemia salina.‡—Dr. A. Brauer finds that the directive spindle in these ova consists not of 24–26 bipartite chromosomata, but of 84 tetrapartite elements, which are arranged not in one ring nor in two, but in a round plate. This runs counter to the results of Weismann and Vom Rath.

The maturation occurs in two ways. Only one polar body may be extruded, the remainder becoming the final ovum-nucleus. Or, a second division may occur, but without extrusion, the retained half uniting its chromosomata with those of the ovum-nucleus in the first segmentation-spindle, behaving, in fact, as if it were a sperm-nucleus. In the first

* Ber. Nat. Gesell. Freiburg i. B., vi. (1891) pp. 90–100.
† Verh. K. Akad. Wet. Amstel., 1893, vi., 103, and xcvi. pp., 7 pls.
‡ Zool. Anzeig., xvi. (1893) pp. 138–40.

case, the ovum-nucleus contains 84 bipartite chromosomata; in the second case it contains 84 single chromosomata. In the first case, the equatorial plate of the first segmentation spindle has 84 chromosomata, in the second case 168; but the second case is rarer. The larger number is the normal. It is interesting to find that the occurrence of two divisions is compensated for by the subsequent union of the second directive-nucleus with the too much reduced ovum-nucleus. Brauer's results are in harmony with those of Boveri and O. Hertwig in regard to parthenogenesis.

Podopsis.*—Mr. F. H. Herrick brings forward evidence to show that the remarkable Schizopod genus described, in 1829, by J. Vaughan Thompson as "Podopsis," or the Hammer-headed Shrimp, is a larva of *Stenopus*. No other allusion to the genus has been found by the author. Mr. Herrick points out that the form figured by Thompson is strikingly like the *Stenopus*-larva figured on plate xii. of his account of the Life-history of *Stenopus*.† In the enormous eye-stalks, the antennæ, the huge size of the third pair of maxillipeds, the configuration of the body and of the tail-fin, there is a very close agreement between "Podopsis" and the Mastigopus-larval-stages of *Stenopus hispidus*.

Vermes.

α. Annelida.

Peculiarities in Segmentation of Polychætes.‡—Miss F. Buchanan, referring to Cori's recent paper § on abnormalities in the segmentation of Annelids, points out that there is at least one family of Polychæta in which cases of intercalation and spiral segmentation are so common that they may be regarded rather as normal individual variations than as abnormalities. This family is that of the Amphinomidæ.

In fourteen specimens of the subgenus *Eurythoe* from Torres Straits six have each a half-segment completely or incompletely intercalated; in *Linopherus* one of two specimens has two and a half of its segments arranged as a right-handed spiral. In seventeen specimens of *Eurythoe* from the Gulf of Manaar two have intercalated half-segments, and six have spirals of varying lengths. Of fifty specimens of *Amphinome* in the British Museum, twenty-seven present variations in symmetry of one kind or another; of thirty-three examples in the same collection of the subgenera *Eurythoe* and *Hermodice*, a dozen appear to present irregularities in segmentation; of these the most remarkable is the specimen in which one spiral of two coils begins in the middle of and intertwines with another of seven.

Other examples are cited, including the very distant *Pentastomum*, and reference is made to Cori's observation of intercalations of half-segments in Cestodes.

It is as yet too early to assign a cause to these variations, but some objections to regeneration are offered, and it is pointed out that the spiral arrangement may still require explanation.

* John Hopkins Univ. Circ., xii. (1893) p. 104.
† Mem. Nat. Acad. Sci., v. (1892).
‡ Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 529–44 (1 pl.).
§ See *ante*, p. 38.

Alciopidæ of Berlin Museum.*—Dr. C. Apstein reports that the collection of Alciopidæ at Berlin consists of forty-seven specimens, belonging to thirteen species; of these species, *Vanadis violacea*, *V. Studeri*, *Callizona Moebii*, and *Corynocephalus Gazellæ* are new. There are more or less detailed notices of the species already described.

Maxillary Apparatus of Euniceidæ.†—M. J. Bonnier, referring to the criticisms made by Claparède and Grube on the classification of the Euniceidæ proposed by Ehlers, which is chiefly based on the structure of the upper jaw, shows that in one and the same species the two typical forms described by Ehlers may be seen at different stages of growth. The author gives an account of his observations on *Ophryotrocha puerilis*, where there occur successive modifications which have not till now been described. To complete our knowledge of the genus the male form must be discovered.

New Organ in the Lycoridea.‡—Mr. E. S. Goodrich finds that *Nereis diversicolor* has in every segment, except the first and last few, a pair of large, highly differentiated, ciliated patches of cœlomic epithelium—the dorsal ciliated organs. These organs seem to occur throughout the Lycoridea, as they have been found in all the genera examined.

The nephridium of *N. diversicolor* consists of a compact mass, perforated by a convoluted canal, which communicates with the exterior by a short duct which leads to a nephridiopore on the ventral surface. A long canal springs from the main body of the nephridium, and ends in front by a nephrostome which opens into the next segment; this nephrostome is provided with long ciliated processes.

The author is of opinion that the dorsal ciliated organs may be considered as a not fully developed genital duct, and he points out that the Capitellidæ, which are the only other Polychætes that are known to possess a nephridium like that of *Nereis*, have in many segments a large ciliated patch of cœlomic epithelium, which becomes funnel-shaped, and functions as a genital duct. He thinks that recent researches point to the conclusion that in most Polychætes the nephridium is a compound organ formed from the fusion of a tube with an outpushing of the cœlomic epithelium (Meyer); in the Capitellidæ this funnel is partly nipped off as the genital duct, while in Oligochæta, and perhaps also the Lycoridea, this cœlomic funnel has either never joined the nephridium at all, or is afterwards mostly or entirely separated off as a genital duct.

It has been suggested by Prof. Lankester to Mr. Goodrich that primitively the cœlom of Chætopods may have been ciliated all over—as, for instance, in *Rhynchobolus*. If it were so the ciliated organs might have been formed by the restriction of the cilia to a definite area, and the consequent specialization of the epithelium.

Arenicola marina.§—Prof. E. Ehlers communicates some interesting information in regard to the lobworm. In a recent memoir on the "auditory" organs, he expressed a doubt whether the gelatinous balls

* Arch. f. Naturg., lix. (1893) pp. 141–50 (1 pl.).
† Comptes Rendus, cxvi. (1893) pp. 524–6.
‡ Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 387–402 (2 pls.).
§ Nachr. K. Gesell. Wiss. Götting., 1892, pp. 413–8.

described by Max Schultze as the spawn of the lobworm were really so. This doubt had been previously expressed by Messrs J. T. Cunningham and G. A. Ramage, who reared the ova from these balls, and found that the larvæ had not the characters of *Arenicola*, but perhaps of *Scoloplos armiger*.

Dr. Cl. Hartlaub, in Heligoland, reared the larvæ to a slightly more advanced stage, and Ehlers abandons any idea of their belonging to *Arenicola*.

Mr. E. A. Andrews has recently described a free-swimming young *Arenicola* (*A. antillensis ?*) from the American coast.

Dr. Hartlaub has also discovered this pelagic stage off Heligoland, and a brief description is given.

The fishermen say that the lobworm sometimes swims freely, and Dr. Ehrenbaum has recently corroborated this statement. It seems then as if the adults led an active life for some part of the year. That the young are pelagic has been placed beyond doubt. Prof. Ehlers points out the importance of following up the quest.

Supporting Tissue of the Nervous System.*—Herr E. Wawrzik finds four distinct modes in which the nerve-chord, or, more strictly, its supporting tissue, is related to the subcuticula. (1) In *Sigalion*, *Sthenelais*, *Polynoe*, &c., the connection persists along the entire length of the body. (2) In *Halla*, *Cirrhatulus*, &c., the connection is reduced to a longitudinal strand. (3) In *Arenicola*, *Eunice*, &c., the connection is by means of relatively thin strands, which occur at intervals. (4) In *Hermione*, *Aphrodite*, and the Oligochæta the subcuticular fibrous tissue has formed a cuticular membrane surrounding the nerve-cord and separating it from the subcuticula, except at the tail end. At different parts of the body different modes may obtain. The supporting tissue is a modification of the subcuticula; it not only ensheaths the nervous elements, but penetrates them, passing into their spongioplasma.

New Species of Nais.†—Dr. W. B. Benham has a note on a new species of this genus, found in a ditch near Oxford; *N. heterochæta*, as it is called, has, as a rule, only two chætæ in each dorsal bundle; and these are of different shape and size; one is capilliform and about ·165 mm. long, and the other is furcate and measures ·045 mm.

The nephridia present a peculiarity which, though already described, has hardly been sufficiently insisted on; the fact, that is, that there is usually only one nephridium per somite. This is always the case in *N. heterochæta*, where the nephridium is very long, so that one often occupies two somites, and communicates with a third by a funnel. In such cases there is one nephridium in the place of four. Michaelsen, it will be remembered, has described in *Kynotus* the presence of nephridia in alternate somites.

Anatomy of Sutroa.‡—Mr. F. E. Beddard has some notes on this freshwater Oligochæte, supplementary to the description of Dr. Eisen, who alone has before this worked at the genus. The author has chiefly directed his attention to the generative organs which he has investigated

* Zool. Beitr., iii. (1892) pp. 107–27.
† Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 383–6 (1 pl.).
‡ Trans. Roy. Soc. Edin., xxxvii. (1893) pp. 195–202 (1 pl.).

by means of the section method. The efferent apparatus, while constructed on the Lumbriculid plan, has prostates which suggest those of the Tubificidæ more than those of other Lumbriculidæ. The anterior pair of funnels and the vasa deferentia are so reduced as to suggest a commencing disappearance; were they absent, the structure of the reproductive organs would be those of the Tubificidæ. Mr. Beddard suggests that Dr. Eisen has overlooked the testes, and has mistaken for them peculiar bodies that may be compared with the "septal sacs" of many Perichætidæ and of *Acanthodrilus*. A number of segments have no nephridia.

New Moniligaster.*—Dr. W. B. Benham describes a new species of *Moniligaster* (*M. indicus*) from the Nilgiris, which agrees with none of Prof. Bourne's species in the few characters given by him. The author takes the opportunity of remarking that the position of the various genital pores in *Moniligaster* were wrongly given by him in his "Attempt to classify Earthworms." As various recent writers have pointed out, this octochætous meganephric genus has the male pores between somites x. and xi., a single pair of spermathecal pores between somites vii. and viii., a pair of oviducal pores between somites xi. and xii., and the nephridiopores in line with the dorsal couple of chætæ. He also points out the distinctive internal characters of the genus, and, after indicating briefly seven diagnostic points in *M. indicus*, gives a detailed account of its anatomy.

Notes on Hirudinea.†—Dr. R. Blanchard has a notice of *Theromyzon pallens* described by Philippi in 1867, which he suggests is merely *Glossiphonia bipunctata*. The *Hirudo Nais* of Grube is shown ‡ to be the representative of a new genus which may be called *Mesobdella*, as it unites the characters of the Glossiphoniidæ with those of the Hirudinidæ. Some notes are given § on variations in the constitution of the somite of Leeches; in some cases there is a tendency to the multiplication of rings, which appears to be most extreme in the case of *Lumbricobdella schaefferi* Kennel which has 262 rings.

In his tenth note ‖ Dr. Blanchard makes some observations on the Hirudinea of northern Europe; this group is very rare in boreal regions, and he enumerates only five:—*Hæmopis sanguisuga*, *Glossiphonia bioculata*, *G. sexoculata*, *Placobdella Raboti*, and *P. Guernei*; the last two are new species, and belong to a new genus, which, with a close resemblance to *Hæmentaria*, is distinguished by the absence of a deep transverse groove from the ventral surface of all the rings. The new genus has also some affinities with *Glossiphonia*, which it brings into closer alliance with *Hæmentaria*. In this same new genus ¶ Dr. Blanchard places the *Glossiphonia catenigera* of Moquin-Tandon, and the *Clepsine carinata* ** of Diesing, of both of which he gives full descriptions.

* Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 361–82 (1 pl.).
† Bull. Soc. Zool. France, xviii. (1893) pp. 14–6.
‡ Tom. cit., pp. 26–9 (4 figs.).
§ Tom. cit., pp. 30–5 (4 figs.).
‖ Tom. cit., pp. 92–8 (5 figs.).
¶ Tom. cit., pp. 98–104 (5 figs.).
** Tom. cit., pp. 104–8 (2 figs.).

β. Nemathelminthes.

Germinal Zone of Ascaris megalocephala.*—Dr. von Wasielewski has traced the genital tubes to their ends where they form a very fine coil. A simple membrane encloses a single row of large germ-cells. Lower down the membrane shows a plasmic layer and nuclei. Between the germ-cells and the membrane a distinct cellular layer is formed and the central germinal cells cease to be in a single row. In the centre the rhachis appears as a plasmic pillar.

Even in the large cells of the single row the equatorial plate stage of karyokinesis was detected. The chromatin threads fall into cubical elements with each of which a spindle thread is associated. Sometimes these cubes divide and what looks like a double row of pearls is seen along the equator.

The genital tubule includes, at some distance from its origin, a number of large cells of unknown origin and import. There are also residual bodies, which Lameere regards as due to extrusions of nuclear substance from the differentiating sex-cells. But they are least abundant where cell-multiplication is most active. The author regards them as the results of the degeneration of germ-cells in consequence of pressure and imperfect nutrition, and compares them with degenerations in the testicular canals of man in cases of local tuberculosis.

Oxyuris Paronai and Cheiracanthus hispidus.†—Dr. von Linstow describes a new species of *Oxyuris* found on Branco, one of the Cape Verde Group, in *Macroscincus Coctei*, and he enters at length into an account of Fedtschenko's species *Cheiracanthus hispidus*, sixteen specimens of which were found in the stomach of a Hungarian Pig.

γ. Platyhelminthes.

Turbellarian in Underground Waters.‡—Prof. W. A. Haswell reports an alloiocœle Turbellarian as inhabiting the underground waters of Canterbury, New Zealand. With two exceptions, one of which is very doubtful, all the members of this group are sea-dwellers. All the specimens examined by the author are devoid of eyes and completely destitute of pigment; the largest are nearly an inch and a half long. Further details are promised.

New Genus of Temnocephaleæ.§—Prof. W. A. Haswell has a preliminary note on *Actinodactylus*, a new genus allied, at first sight, to *Temnocephala*, but having twelve tentacles and no eyes; it was found in the branchial cavities of the burrowing land-Crayfish of Gippsland (*Engæus fossor*). In living examples the difference between it and *Temnocephala* is much more marked than in alcoholic specimens.

Marine Planarians of New England‖—Prof. A. E. Verrill has brought together the scattered notes, descriptions, and sketches of the marine planarians of New England, made during more than twenty seasons of work at marine Invertebrates. He does not expect his paper to serve more than as an introduction to the study of a group, which has been much neglected by American naturalists. The author points out

* Arch. f. Mikr. Anat., xli. (1893) pp. 324–37 (1 pl.).
† Arch. f. Naturg., lix. (1893) pp. 201–8 (1 pl.).
‡ Proc. Linn. Soc. N.S.W., vii. (1893) pp. 341 and 2. § Tom. cit., p. 342.
‖ Trans. Connect. Acad., viii. (1892) pp. 459–520 (5 pls.).

the extreme difficulty of determining alcoholic specimens, and urges that species should be studied as fully as possible while living, and preserved as microscopic preparations to show their anatomy.

Eustylochus (for *Planocera elliptica* Girard) is a new genus which, externally, agrees with *Stylochus*, but differs in the structure of its reproductive organs; *Planoceropsis* is a new subgenus of *Planocera* with marginal ocelli. The number of new species is hardly as large as one might have expected.

Dinophilidæ of New England.*—Prof. A. E. Verrill describes two species which appear to be the only known representatives of this group on the New England coast. He calls them *Dinophilus pygmæus* and *D. simplex*, though they differ considerably in structure; the latter may not be a true *Dinophilus*.

Marine Nemerteans of New England and adjacent Waters.†—Prof. A. E. Verrill offers an article which is intended as a descriptive catalogue of all the Nemerteans of the north-eastern coast of North America that have been observed with enough care to permit him to give a description presumably sufficient to enable ordinary observers to identify the species when seen living. He particularly notes any of the few cases in which descriptions have not been made from living specimens. As a rule, undetermined alcoholic specimens of Nemerteans, unaccompanied by notes on their forms and colours while living, cannot be identified with certainty, unless they belong to genera which contain very few and widely differing species.

The author has had to do with collections which include several thousands of specimens, and which represent very fully the Nemertean fauna of the coast from Cape Hatteras to Labrador, and from high-water mark to 2000 fathoms. These worms are much more abundant from 1 to 60 fathoms than at greater depths.

The only two remarkable new forms described are examples of pelagic Nemerteans, taken in the region of the Gulf Stream. In form they resemble *Sagitta*, but they are much larger and stouter, and the general organization is not very different from that of the typical Enopla. The author forms, however, a new family for them, which he calls that of the Nectonemertidæ. With some affinity to *Pelagonemertes* they differ by their form, distinct head, caudal fin, and absence of much subdivided intestinal diverticula. The two new genera are called *Nectonemertes* (for *N. mirabilis* sp. n.) and *Hyalonemertes* (for *H. atlantica* sp. n.).

Nemertea of Lake Geneva.‡—Dr. G. du Plessis points out that Mr. L. Vaillant is wrong in asserting that the Nemerteans discovered by du Plessis in Lake Geneva belong to the genus *Geonemertes*. For the forms in question are wholly aquatic, are provided with cephalic slits and lateral organs, have separate sexes, and so on; they are certainly not related to *Geonemertes*. They are of much interest as forming part of a "Fauna relicta."

Reproduction of Geonemertes australiensis.§—Dr. A. Dendy reports that the eggs of this worm are about 0·6 mm. in diameter, and

* Trans. Connect. Acad., viii. (1893) pp. 457 and 8 (2 figs.).
† Tom. cit., pp. 382–456 (7 pls.).
‡ Zool. Anzeig., xvi. (1893) pp. 19–20.
§ Proc. Roy. Soc. Victoria, 1892, pp. 127–30 (from separate copy).

of a white or nearly white colour. Some thirty are enclosed together in a sausage-shaped mass of colourless transparent jelly; this jelly appears to be common to all the eggs and does not, as in the case of frog-spawn, form a special envelope round each. The eggs probably leave the body separately by the narrow duct which serves also for the admission of the spermatozoa. The author thinks the jelly is a secretion from the surface of the body.

British Marine Turbellaria.*—Mr. F. W. Gamble finds that at present there are known as members of the British fauna fourteen Polyclads, two Triclads, and fifty-five Rhabdocœls; these he describes, giving the distinctive structural and bionomical points. It is, however, to be noted that these numbers represent the examination of a limited extent of the English coast, the Channel Islands, and the Isle of Man during three months of summer (July to September). The author has increased the number of British species by twenty-eight, of which *Provortex rubrobacillus*, *Plagiostoma pseudomaculatum*, *P. elongatum*, and *Automolus horridus* are new species. The faunistic relations of our Turbellaria cannot yet be certainly determined, but it is clear that a large proportion of Scandinavian forms occur, and 33 per cent. are common to Naples, Plymouth, and Trieste. In the investigation of the British Turbellaria there is obviously ample work for the students of minute forms.

Cercaria of Amphistomum subclavatum.†—Dr. A. Lang has discovered that this well-known Trematode (*Diplodiscus subclavatus* Dies.), not unfrequently found in the rectum of Amphibians, has *Planorbis contortus* (L.) Müll. for its intermediate host. No sporocysts were found, which suggests that the rediæ (in summer at least) arise directly from the embryos. The Cercariæ leave the snail by the rectum, swim about, attach themselves to the skin of amphibians and become encapsuled. It is likely that they are swallowed along with portions of cast skin. Experiment showed the efficiency of this mode of infection.

The author also gives an account of the structure of the Cercaria, especially of the excretory system, which has not hitherto been described in detail.

Anatomy of Caryophyllæus mutabilis.‡—Herr H. Will has made an investigation into the structure of this interesting Cestode. The absence of proglottids and the simplicity of the sexual apparatus are sufficient to show that it occupies an important position as a primitive form. But even here there are intermediate stages. Although it is true that the Ligulidæ, when sexually mature, exhibit a formation of proglottids with a repetition of the parts of the sexual apparatus, yet it is doubtful whether isolation is carried as far as in the Bothriocephalidæ, while the proglottis of the latter by no means attains the stage of individuality seen in Tæniæ.

In the nervous system, the two primary trunks which traverse the whole length of the animal, and are connected with one another a short way behind the head by a dorsal and a ventral transverse commissure, are common to it and other Cestodes. In addition there are dorsal and

* Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 433-528 (3 pls.).
† Ber. Nat. Gesell. Freiburg i. B., vi. (1892) pp. 81-9 (1 fig.).
‡ Zeitschr. f. wiss. Zool., lvi. (1893) pp. 1-39 (2 pls.).

ventral paired secondary nerves, which, by the whole of their structure, show a primitive similarity to the primary trunks. The nervous system consists, therefore, of six longitudinal nerves, which stand at pretty regular distances, and are connected with one another by circular commissures; this arrangement agrees completely with the Trematode type. In other Cestodes the secondary nerves have more or less disappeared, though remnants of the same are generally found in the head and neck. By *Triænophorus nodulosus* the excretory system of *Caryophyllæus* is linked on to that of other Cestodes.

A point of structure apparently quite peculiar to our worm is the presence in the median layer of three or four longitudinal cords formed of fibrous cells. These are not found in other Cestodes, unless, indeed, they are represented by the layer of spindle-cells described by Leuckart in *Tænia saginata.*

With regard to its generative apparatus *C. mutabilis* appears to represent a primitive stage, and to be nearest to the Bothriocephalidæ. The male and female apparatus lie behind one another, while the yolk-glands are in the median layer. In the Bothriocephalidæ the male and female generative apparatus lie one above the other, and the yolk-glands are in the cortical layer; this appears, however, to be a secondary condition due to the necessities of space and packing. Further, in *C. mutabilis*, the uterus opens together with the vagina, and this appears to be a unique arrangement amongst Cestodes; it may, nevertheless, be considered to be a starting point, for if the uterus separate from the vagina and open separately we have the type of the Bothriocephalidæ, while in the Tæniidæ the terminal portion of the uterus is degenerated, and the true uterus ends blindly.

We may conclude, then, that in three points—its unsegmented body, its nervous system, and the structure of its generative apparatus—*Caryophyllæus* occupies a primitive position.

Helminthological Notes.*—Dr. M. Stossich has notes on species of *Ascaris* and *Heterakis*, *Dispharagus laticeps*, species of *Filaria*, *Spiropterina dacnodes*, *Agamonema Ranzaniæ* Stossich, *Physaloptera clausa*, *Oxysoma brevicaudatum*, species of *Echinorhynchus*, species of *Tænia*, *Phyllobothrium lactuca*, *Bothriocephalus Wageneri*, *Holostomum variabile*, and *Distomum italicum* Stossich.

Stossich also gives† a revision of the genus *Angiostomum* Dujardin, recognizing five species which live in the lungs of birds, reptiles, and amphibians.

δ. Incertæ Sedis.

Irish Rotifers.‡—Miss L. S. Glascott gives a list of some of the Rotifera of Ireland. As the research extended over only six months and a number of rare and new species were obtained, it seems probable that this group is well represented in that island. In describing her captures Miss Glascott very properly follows the order of Dr. Hudson and Mr. Gosse's book. The following list gives the names of the new species:—*Rotifer phaleratus* ("probably only a variety of *R. vulgaris*"), *Microcodon* (?) *robustus*, *Notops* (?) *quadrangularis*, *Notommata volitans*,

* Boll. Soc. Adriat. Sci. Nat., xiv. (1893) pp. 83-9. † Tom. cit, pp. 90-6.
‡ Sci. Proc. Royal Dublin Soc., viii. (1893) pp. 29-86 (7 pls.).

N. cylindriformis, *N. larviformis*, *N. rubra*, *Furcularia semisetifera*, *F. megalocephala*, *F. rigida*, *Eosphora striata* (large and conspicuous), *Diglena inflata*, *D. revolvens*, *D. elongata*, *D. rugosa*, *Mastigocerca brachydactyla*, *Colurus pachypodus*, and *C. tessellatus*. As "later additions" we have *Notops forcipata*, *Notommata lucens*, *N. gigantea*, *Diglena Hudsoni*, and *D. dromius*; the last, which is said to be very slender and graceful, has manners which "amusingly resemble those of some of the predatory beetles."

Rotatoria of Greenland.*—Dr. D. Bergendal gives an account of the rotifers collected during a visit to Greenland in 1890; he enumerates altogether eighty-two species, of which a number are new. Of the three new genera *Microcodides* (*M. dubius* sp. n.) wants the foot which is so characteristic of *Microcodon*, but in all other respects there is a great resemblance between the two genera. *Hypopus* (*H. Ritenbenki* sp. n) is a new genus of Notommatidæ, which the author for some time thought to be the same as Hudson's *Notops hyptopus*; Hudson's species is to be referred to the new genus, the affinities of which are rather with *Notommata* than *Hydatina*. The third new genus *Diops* is established for *D. marina* sp. n., which some may think to be a *Furcularia* or a *Diglena*; there is a double frontal eye and the mastax has no fulcrum. The author describes his forms in ample detail. From his concluding remarks it is clear that he does not think he has exhausted the points of interest in the Rotiferous fauna of Greenland.

Rotifera of the Gulf of Naples.†—Dr. E. v. Daday studied at Naples twelve species of Rotifers, including *Furcularia neapolitana* sp. n., *Colurus rotundatus* sp. n., and *C. truncatus* sp. n. Six of the twelve were already known from other seas. In all cases saccular salivary glands were found between gullet and gizzard, or beneath the gizzard. Some forms have ovary and yolk-gland, while others have also a uterus. No fertilized thick-shelled ova were found, and no males. Perhaps the conditions of marine life are normally such that neither are necessary to the continuance of the species. From the Baltic 50 species are known, from the North Sea 3, from the Mediterranean 13, from the Adriatic 2, from the Indian Ocean 2, and from the Pacific 1. Of marine forms, 20 are free-living and 8 parasitic; 5 species occur in the seas, in fresh water, and in inland seas; 32 species occur both in fresh and salt water. The Rotifer fauna of inland salt water and of brackish water is to be regarded as transitional between freshwater and the sea. The author believes that Rotifers as we know them are secondarily marine and primarily freshwater organisms, though it is likely enough that their ancestors were originally marine.

New Freshwater Rotifers.‡—Profs. A. Wierzejski and O. Zacharias describe three species—*Bipalpus vesiculosus* W. and Z., *Bipalpus lynceus* Ehrbg. (? *Euchlanis lynceus* Ehrbg.), and *Mastigocerca capucina* W. and Z. Of the first only the female form was studied, but the male was seen. The female has a sack-shaped body, rounded posteriorly, truncate in

* Acta Univ. Lundensis, xxviii. (1892) IV. 180 pp. (6 pls.).
† Math. Nat. Ber. Ungarn, viii. (1891) pp. 319–53; Math. Termés. Értes. (Math. Nat. Anz. d. Akad.), viii. pp. 4–8.
‡ Zeitschr. f. wiss. Zool., lvi. (1893) pp. 236–44 (1 pl.).

front; the crown has a simple wreath of cilia and two lateral ear-lobes, each with a finger-shaped palp with a hint of segmentation; on the middle field of the crown are eight bluntly conical prominences with sensory hairs; the foot is borne ventrally at the beginning of the posterior third of the body; the eye is simple and occipital; the mouth-parts have weak jaws, the hypodermis is vacuolar; there is a V-shaped thickened shield on the back. Of the third species, only the female is known. It has an almost cylindrical body, a distinctly defined head, a characteristic cap-like head-shield, a crown with five finger-like palps and two sensory tufts, and lateral antennæ on the posterior third of the body.

Adinetidæ.*—Mr. D. Bryce has some general notes on this group of Rotifers; in moss-washings no species is of such general occurrence as *Adineta vaga*, on which his observations have been chiefly based. He describes *A. clauda* sp. n. from a single specimen obtained at Garelochhead, N.B., where it lives in moss. By its sucker-like foot it is allied to *Discopus*, and perhaps it is the type of a new genus.

Notes on Rotifers.†—Mr. G. Western finds that his *Pleurotrocha grandis* is synonymous with *Diglena ferox*. *Philodina commensalis* sp. n. was found on *Asellus vulgaris* from Putney, Wandsworth, and Epping Forest. Mr. Hood has sent the author examples of the male of *Stephanoceros Eichhorni*, which has never yet been recorded. *Notholca Hoodi* sp. n. was taken in sea water at Westport, Ireland; *Rattulus bicornis* sp. n. was found at Roehampton, and is common in Scotland and Ireland; *Callidina sordida* sp. n. is a large form, which was found in moss that came from Epping Forest.

Phoronis from Port Jackson.‡—Prof. W. A. Haswell reports that, in addition to the large *Phoronis australis* which he described eleven years ago, he has lately found a smaller species of the same rare genus, in which he can find hardly any point of importance to separate it from *P. psammophila* from Messina; the most important distinctions are the greater number of tentacles (about 100), and the absence of sand-grains from the tubes.

Minute Anatomy of Rhodope Veranii.§—Dr. L. Böhmig treats in detail of the minute anatomy of this much discussed organism. In his opinion the facts of its development are opposed to its being one of the Mollusca, while those of its structure support the view. On the other hand, if we compare it with the Turbellaria we find it has a digestive apparatus which consists of three portions and opens by an anus which is placed on the right; the central nervous system is broken up into a pair of cerebrovisceral ganglia, a pair of pedal and a pair of buccal ganglia; three commissures surround the fore-gut. The excretory system is without the ciliated infundibula which are characteristic of the Platyhelminthes, and, in position and structure, is much more like that of the Nudibranchiata; the chief part of the genital organs is repre-

* Journ. Quek. Micr. Club, v. (1893) pp. 146–51 (1/2 pl.).
† Tom. cit., pp. 155–60 (1/2 pl.).
‡ Proc. Linn. Soc. N.S.W., vii. (1893) pp. 340 and 1.
§ Zeitschr. f. wiss. Zool., lvi. (1893) pp. 40–116 (4 pls.).

sented by a hermaphrodite gland, and in its general structure the generative apparatus has a striking resemblance to that of certain embryonic Gastropods. It cannot, however, be denied that, in many essential points, Rhodope does not exhibit a Molluscan organization. The blood-vascular system, the heart, the foot, the shell, are as much wanting in the embryo as in the adult; and there is no velum. It is more doubtful what stress is to be laid on the absence of a radula.

On the whole, then, we may say that *Rhodope* is anatomically most allied to the nudibranchiate Gastropods, while in its developmental history it is connected with the Turbellaria. At present it would seem to be impossible to assign a precise systematic position to this creature, and it would be well if a close study could be made of its embryology. The only thing we can say with certainty is that *Rhodope* is not a Turbellarian.

Gastrotricha.*—Dr. F. v. Wagner gives an account of what is known (through Zelinka and others) in regard to these small organisms. They are small worm-like animals, without a retractile rotatory apparatus at the anterior end; with two ciliated bands along the whole ventral surface; with two coiled water-vascular canals, each with a long rod-like ciliated lobe and a separate aperture in the middle of the ventral surface; with a simple cerebral ganglion in part still in the ectoderm, simple muscle-cells, paired ovaries, a muscular, nematode-like, fore-gut without jaws, a straight mid-gut without glands, a pear-shaped hind-gut, a rectum, and a dorsal anus; and with a primary body-cavity. The suborder Euichthydina (with a forked tail) includes Ichthydidæ (without spines), viz. *Ichthydium* and *Lepidoderma*, and Chætonotidæ (with spines), viz. *Chætonotus* and *Chætura*. The suborder Apodina (without a forked tail) includes *Dasydytes* and *Gossea*.

After weighing opinions, the author concludes that the Gastrotricha cannot be united with Rotatoria, but that they belong to a common stock and are nearly related.

Echinoderma.

Development in Asterina gibbosa.†—Mr. E. W. MacBride has a preliminary notice of his observations on the development of the dorsal organ, genital rachis and genital organs in this Starfish. His studies have confirmed the accuracy of his earlier observations on *Amphiura squamata*. The axial sinus of the starfish into which the stone-canal opens is obviously homologous with the relatively less developed ampulla of the Ophiurid; in both animals the peculiar cells of the dorsal organ are derived from the peritoneal epithelium, but subsequently by a process of invagination become shut off from it; hence the so-called axial sinus of *Amphiura* corresponds to the canal in the dorsal portion of the "heart" of *Asterina*. The aboral sinus is homologous, and its undulating course in *Amphiura* is evidently due to the way in which the abactinal surface has grown in between the actinal radii in Ophiurids; this mode of growth forces the madreporite and the stone-canal round to the ventral side, while the aboral sinus is pulled out into five inter-radial ventral loops.

* Biol. Centralbl., xiii. (1893) pp. 223–38.
† Zool. Anzeig., xvi. (1893) pp. 169–73 (4 figs.).

The author traces the genital cells back to the epithelium lining the canal which represents the most aboral portion of the dorsal organ, while this last has a cavity which, at an early stage, communicates with the cœlom; its epithelium, therefore, is peritoneal epithelium. From this it follows that in both *Amphiura* and *Asterina* the genital cells are, ultimately, derived from the peritoneum, or, in other words, they have the same origin as the sexual cells of all Cœlomata.

Cleavage of Eggs of Arbacia.*—Dr. J. Loeb has experimented on the dividing eggs of *Arbacia* by exposing them to water containing more or less than the normal amount of sodium chloride. If the irritability of the protoplasm of the egg be reduced by reducing the amount of water contained in it, the nucleus can segment without segmentation of the nucleus. If we now increase the quantity of water the protoplasm at once divides into about as many cleavage cells as there are preformed nuclei. The effect of salt is not to destroy but to suspend the cleavage phenomena; the longer eggs are kept in concentrated water the more numerous are the cleavage cells formed all at once when the egg is returned to normal water. It would appear that the nuclei increase in numbers in salted sea-water, though no cleavage furrows are visible on the outside of the egg, but this increase is not always accompanied by a normal separation.

The normal source of the stimulus which the abstraction of water is supposed to render no longer efficient to produce cleavage is supposed to be the nucleus, but the nature of this stimulus is unknown; there are some reasons for believing it to be of a chemical nature.

On the other hand, the protoplasm has some influence on the nucleus; and it is suggested that the intracellular pressure which determines the form of the cells also fixes the direction of the nucleus.

Crinoids from Sahul Bank.†—Prof. F. Jeffrey Bell has a note on a small collection of Crinoids from the Sahul Bank, North Australia. The only stalked form in the collection is *Metacrinus interruptus* P.H.C., taken from a telegraph wire from about as many degrees south of the equator as the type was north of the line. Evidence is afforded as to the very considerable range of variation in the length of the cirri of *Antedon longicirra* P.H.C.; *A. Wood-Masoni* is a new species of Carpenter's *Spinifera*-group; *A. patula* P.H.C. was also in the collection, and it is hinted that it, *A. flexilis* and *A. robusta*, which were all taken at the same station by the 'Challenger,' may not be as distinct as is at present supposed.

Holothurians from the Eastern Pacific.‡—Prof. H. Ludwig has a preliminary notice of the Holothurians collected by the 'Albatross' deep-sea expedition to the Eastern Pacific. Forty-six species belonging to twenty-eight genera were collected; the most interesting forms are the representatives of a group intermediate between the Aspidochirotæ and the Elasipoda and a rare Holothurian adapted to a pelagic life.

Several examples were obtained of Theel's *Pseudostichopus mollis*; the investigation has resulted in an alteration of the generic diagnosis.

* Journ. Morphol., vii. (1892). See Amer. Natural., xxvii. (1893) pp. 398 and 9.
† Journ. Linn. Soc. London, xxiv. (1893) pp. 339–41 (2 pls.).
‡ Zool. Anzeig., xvi. (1893) pp. 177–86.

More than seventy examples of the same author's *Pælopatides confundens* were taken, and *Benthodytes gelatinosa* of Walsh is found to belong to the same genus, if the diagnosis be amended to contain forms with fifteen tentacles. The two genera just mentioned have no tentacular ampullæ, and in this point three new genera of Aspidochirotæ—*Synallactes*, *Mesites*, and *Meseres*—agree with them; the first may be grouped together in the sub-family Synallactinæ, while the remaining Aspidochirotæ form the Holothuri[i]næ. As the former sub-family exhibits points of affinity to the Elasipoda the author notes with satisfaction the confirmation of the view already expressed by him that the Elasipoda are descendants of the Aspidochirotæ.

Of the six Elasipod Psychropotinæ, *Benthodytes incerta, Psychropotes raripes, P. dubiosa, Euphronides tanneri*, and *E. verrucosa* are new. Of the eight Deimatinæ six are new, and for some of them new genera are formed—*Scotodeima* (*S. setigerum*) stands between *Oneirophanta* and *Orphnurgus*, *Lætmophasma* (*L fecundum*) is perhaps nearest to *Pannychia*, *Capheira* (*C. sulcata*) is placed with some doubt among the Deimatinæ.

Of the sub-family Elpidiinæ one is a variety of *Peniagone vitrea* *P. intermedia* sp. n. is allied to *Scotoanassa*, and *Scotoanassa gracilis* is a new species.

But of all the most interesting is the pelagic creature which forms the type of the new family Pelagothuriidæ. It is distinguished by the development of a special swimming apparatus, which consists of a disc drawn out at the margin into long rays; this is arranged round the circlet of tentacles, and calls to mind somewhat the base of the arms of a Cephalopod. There are no podia or ambulacral papillæ; the mouth and anus are terminal; the body is circular. The tentacular canals arise from the well-developed radial canals, and each sends off a canal into the disc; these disc-canals pass in a radial direction to the periphery of the disc, and extend to the tip of each ray. The longitudinal muscles of the body-wall are simple, and there are no retractors to the pharynx. There are no respiratory trees, ciliated organs, or organ of Cuvier. In the genus *Pelagothuria*, which has thirteen to sixteen tentacles, there is no sign of any calcareous deposits. There is a single stone-canal, which opens directly to the exterior. The species *P. natatrix* is violet or purple in colour, 47 mm. long, while the length of the disc-rays is 50 mm.

In the want of podia the Pelagothuriidæ agree with the Synaptidæ and Molpadiidæ, from each of which they differ by some of the points already noted. Prof. Ludwig regards this new group as derived from the Elasipoda and as having become adapted to a pelagic mode of life.

Of the nine species of Dendrochirotæ seven are new, and for one a new genus, *Sphærothuria*, has to be formed. *S. bitentaculata* has an almost spherical form, and is covered with large plates, from each of which a strong freely projecting spine proceeds. The pair of tentacles which, in decachirote forms, is generally smaller than the other four has completely disappeared, and of the remaining eight six are much shorter than the one right and one left one that are alone well developed. The podia are uncommonly small. *Sphærothuria* would appear to be derived from the *Echinocucumis* group of *Cucumaria*.

Four of the six Molpadiidæ are new, and belong respectively to the genera *Caudina*, *Trochostoma* and *Ankyroderma*. The family Synaptidæ is represented by fragments of Theel's species *Synapta abyssicola*, but there is enough of them to show that they should be marked as a variety, which may be called *pacifica*.

Cœlentera.

Development of a Palæozoic Poriferous Coral.*—Mr. C. E. Beecher gives an account of *Pleurodictyum lenticulare*, a species which represents one of the simpler types of poriferous corals. The nepionic stage is well marked, and comprises the growth of the corallum to the completion of a simple initial cell. In this stage there are no mural pores, and there is an epitheca over the entire exterior of the cup. The septal lines become developed towards the end of this stage. These features are in harmony with the young of many palæozoic corals, and indicate a primitive, simple, and imperforate ancestry for the Perforata. The first nealogic stage, represented by the primitive corallite with one bud, is the first transition towards both a compound and a perforate coral. At this stage we are reminded of *Aulopora*. The basal epitheca limits the fleshy portion of the organisms, and represents an area unfavourable to the acquisition of food, or for the natural development of calices. This would prevent both the maintenance of mural pores and the growth of basal buds.

The author thinks that we may conclude that the mural pores in such genera as *Favosites*, *Striatopora*, *Pleurodictyum*, *Michelinia*, and others are ineffectual attempts at budding, resulting only in the perforation of the cell-walls. As Verrill has shown that the presence or absence of tabulæ is of little or no importance in a natural classification, the non-tabulate nature of *P. lenticulare* is of no special consequence in a discussion of the relations of this species with *Favosites* or other tabulate poriferous genera.

If Mr. Beecher's views are correct a simple conical imperforate protocorallum may be assumed for the Madreporaria Perforata. The next stage has the structure and growth of *Aulopora*, and consists of the parent cell with one or more buds. *Aulopora* may, then, be considered as representing a primitive type of a poriferous coral, in which the number of pores in each corallite corresponds with the number of buds plus one connecting it with the parent cell. It seems that, primarily, the development of mural pores is identical or homologous with the process of gemmation.

Symmetrical Cell-development in Favositidæ.†—Mr. C. E. Beecher is of opinion that the growth of intermural buds compensates for the natural divergence of the corallites. New cells are introduced wherever the old corallites have reached their maximum size, and when their divergence approaches a separation of the cell-tubes. The buds have at first the form of a triangular pyramid or prism, which is due to the mechanical conditions of growth. As they increase they touch or truncate one another, and change from triangular to five- and six-sided prisms. Completely symmetrical normal development produces a corallum with equal hexagonal calices. The process of intermural

* Trans. Connect. Acad., viii. (1893) pp. 207–14 (5 pls.).
† Tom. cit., pp. 215–9 (2 pls.).

gemmation changes the sides of the parent cells to angles, and the older corallites, originally in juxtaposition, become separated from one another by new series of interstitial calices.

Affinities of Madrepora.*—Mr. G. Brook points out that this genus, with its axial corallites and radial bud-corallites, stands alone; so far as he is aware no other genus approaches it in its mode of colony-formation, taking into account the indirect means by which it is attained, and the consequent absence of true cœnenchyma. It is to be noted, however, that the characteristic mode of colony-formation is confined to the formation of independent branches, and that at first in all colonies, and always so long as incrustation continues, the mode of budding is not characteristic. It appears, therefore, reasonable to suppose that the species of *Madrepora* form a specialized group which indicate their affinities in the incrusting stage.

For the present the author adopts the course suggested by Ridley, and divides the Madreporidæ into two sub-families—the Madreporinæ, with the genus *Madrepora*, and the Montiporinæ with the genera *Anacropora* and *Montipora*. For a final decision we must wait till we know much more than we do now with regard to the structure of the polyps and their relation to the skeleton which they produce.

Edwardsiæ.†—Dr. A. Appellöf, after remarking that the external division of the body into three parts, the absence of a pedal disc, the structure, position, and number of the septa are peculiarities of the Edwardsiæ that have already been sufficiently noticed by preceding writers, calls attention to some other points of importance.

He lays stress on the presence of an ectodermal nervous system on the capitulum; this offers an intermediate stage between the Hexactiniæ on the one hand and the Cerianthidæ and some other forms on the other. The remaining part of the body of an *Edwardsia*—with the exception of the hinder end—has a thick investment, so that it is not adapted for the reception of external influences. It is not clear whether or no a nervous system is developed in the physa. On the other hand the ectodermal musculature which is developed on all other forms that have a nervous system on the body-wall is wanting in the Edwardsiæ.

Some attention is given to the tubercles set in rows on the surface which are peculiar to some, and perhaps to most Edwardsiæ. Another point worth notice is the absence, in the Edwardsiæ, of some arrangements which are frequently found in other Actinians. The pharyngeal grooves are either absent or are very feebly developed. Boveri has, on embryological grounds, regarded Edwardsia-like animals as the stem-forms of all other Actiniæ. The want of a slightness of differentiation in the œsophageal tube appears to agree well with this conception, as it may be supposed that the tube of the stem-form was a simple invagination without specially developed parts.

The absence of septal stomata is, perhaps, common to all Edwardsiæ, and the point is of importance since, so far as we know, internal septal stomata at least are found in all Hexactiniæ-Zoanthinæ. In this as in other points the tribe Protantheæ, lately established by Carlgren, shows

* Journ. Linn. Soc., xxiv. (1893) pp. 353–60.
† Bergens Mus. Aarsberet. for 1891, No. 4 (1892) 32 pp. (3 pls.).

a relation to the Edwardsiæ. In both there are only eight complete septa; both have, in the body an ectodermal nervous and muscular layer and both want acontia. On the other hand there is a difference between the two groups in the development of the ciliated bands of the mesenterial filaments; for in *Edwardsia carnea* they are very well developed, while in *Protanthea* they are wanting. Enquiry must still be made as to the conditions that obtain in other species of *Edwardsia*. The development of a parietobasilar muscle in the Protantheæ agrees with their sedentary mode of life; it is wanting in *E. carnea*.

Norwegian Pennatulida.*—Mr. J. A. Greig gives a list, with historical and bibliographical prefaces, of the Pennatulida of Norway; twenty-nine species are recognized in it, and synonymical and other notes are generally given.

Organs of Relation of Hydromedusæ.†—Dr. M. Chapeaux has made an attempt to reconcile the very divergent views of authors with regard to these organs. From his experiments on the fresh-water *Hydra* he comes to the conclusion that sensibility is distributed all over the body, that the peristomial region near the gastrovascular orifice functions as a co-ordinating centre for movement, that the extremities of the tentacles are particularly sensitive, and that the cnidocil is a sensory element. He next describes his histological observations on *Hydra*, *Laomedea*, *Podocoryne*, *Myriothela*, and *Tubularia*, which have resulted in the discovery of facts which show that *Hydra* is not, as has been supposed, an isolated member of the animal series, but has a number of characters which are not only common to it and other polyps of the Hydromedusæ, but also to the Anthozoa, and probably to all the Cnidaria. It may be shown to possess ganglionic cells and muscular cells with a refractive fibril; the structure of its nematocysts is analogous to that of other polyps; the cnidoblast is in relation with the nervous elements as in *Lucernaria* and the Actiniæ; and the peristomial region can be shown morphologically, as well as physiologically, to be the seat of the central nervous system.

The author is, as may be supposed, led to reject the neuromuscular theory of Kleinenberg, though he cannot admit all the arguments which Korotneff advances against it.

Formation of Blastostyle Buds in Epenthesis McCradyi.‡—Mr. C. P. Sigerfors has investigated the mode of reproduction in this Medusa to which Dr. W. K. Brooks was the first to call attention. He finds that the reproductive organs may develope in one of two ways. They may form the normal organs with male or female cells, or they may give rise to blastostyles. In the latter case the young reproductive organ gets its ectoderm much thicker and many-layered, owing to the multiplication of its cells. Meantime the cells of the endoderm enlarge and become vacuolated, though still remaining a single layer. Before the organ becomes mature the outer layer of ectoderm cells is separated off from the rest by the appearance of a supporting lamella beneath it. When maturity is near, the endoderm pushes out evaginations into the

* Bergens Mus. Aarsberet. for 1891 (1892) 24 pp. (1 pl.).
† Arch. de Biol., xii. (1892) pp. 647–82 (2 pls.).
‡ John Hopkins Univ. Circ., xii. (1893) p. 106.

intermediate ectodermal layer, and these increase in size till they come to lie next the supporting lamella. The cells of the endodermal evaginations undergo marked changes, lose their connection with the rest of the endoderm, and lie in the middle mass in the form of closed cylindrical tubes. The outer ectoderm layer now sends inpushings between the tubes, and eventually grows completely around them.

The rudiment of the bud thus formed consists of an endodermal tube which lies in the middle mass of cells, surrounded by a supporting lamella and overlaid by ectoderm. The buds, which are formed from both ectoderm and endoderm, are found as evaginations, in the usual mode of budding in Cœlentera. After the bud begins to form the reproductive organ generally enlarges to several times its usual size; the radial canals enlarge, and quantities of food may pass into the cavity of the reproductive organ for digestion.

Polydonia frondosa.*—Mr. R. P. Bigelow has made some observations on this Medusa, the most interesting of which refer to its sexual dimorphism, the female presenting a special adaptation for the protection of the eggs. In immature forms of both sexes and in males, the appendages of the oral disc have the same structural arrangement as those of the oral arms. In the adult female the oral funnels disappear from the disc, while the oral vesicles increase in number till they completely cover it. The eggs are discharged from the ovaries into the stomach, where cleavage commences; they then pass out on to the oral disc, where they are cemented in small reticulated clusters at the bases of the vesicles; and they remain there till they become free ciliated planulæ.

The vesicles on the arms have the function of capturing food. If a vesicle be rubbed gently with a glass rod, there is an immediate contraction of the muscles on the side stimulated, so that the vesicle, which usually stands upright, is suddenly bent down, and closes the mouth of the nearest funnel. A copopod † striking one of these vesicles is immediately stung by the nettle-cells, and, before it can escape from them, it finds itself within an oral funnel, tightly shut in by the overlying vesicle.

The slime that surrounds the disc may serve also to entrap microscopic food, but, from the experiments which the author has made, he concludes that the usual food of these jelly-fish is not, as is often supposed, microscopic material, but copopods captured in the way described.

Development of Stinging Organs in Hydroids.‡—Herr L. Murbach, in a preliminary notice, states that he finds that the fission of the so-called interstitial cells, which leads to the formation of the stinging cells, is always amitotic. In the cell that forms the stinging capsule part of the nuclear mass is localized at the periphery of the nucleus to form a highly refractive, often curved, rodlet which is especially remarkable for its power of taking stains. The presence of a rodlet of this kind is characteristic of the developing stinging cell. The rodlet soon migrates from the nucleus into the cell-body, where it forms around

* John Hopkins Univ. Circ., xii. (1893) p. 106.
† So spelt, apparently correctly, by Mr. Bigelow.
‡ Zool. Anzeig., xii. (1893) pp. 174 and 5.

itself an area of non-staining substance. The rodlet gradually grows, and as it does so takes on one of the varied forms characteristic of the cell.

At the proximal end of the young capsule the tube is now formed in very regular spiral turns around the nucleus of the cell. When fully formed, or sometimes even earlier, the tube passes into the capsule; the cnidocil, which has the form of a pointed process of the muscular investment of the capsules, appears before the formative cell reaches the surface of the body.

The author points out that the muscular stalks of the small stinging capsules of *Physalia utriculus* are not, as has been hitherto supposed, transversely striated, but have the appearance of fine filaments set in a close spiral. The fibres on the short stalks of the large capsules appear to be of a similar character.

Development of the Scyphostoma.* — Prof. C. Claus discusses the development of the Scyphostoma of *Cotylorhiza*, *Aurelia*, and *Chrysaora*, and the general question of the systematic relations of the Scyphomedusæ. He first describes the monodisc strobilation of Cotylorhiza, and points out that the middle stratum in Cœlentera has not always the same morphological value. Is the proboscis of the Scyphostoma clothed with endodermic epithelium or is it an ectodermic gullet? To this old question Prof. Claus returns with vigour, and many arguments against the naturalness of the group Scyphozoa are marshalled. At the margin of the widely open mouth lies the boundary between the two cell-layers. The inner lining of the proboscis (in which a quadrangular basal tube with four interradial tæniolæ-pads and a flatly expanded or collar-like proboscis region are distinguished) is endodermic. The processes of strobilation in *Aurelia* and *Chrysaora*, the formation of the mouth in the Ephyra, the so-called septal-funnels of the Ephyræ, and the relationships of the Scyphomedusæ are discussed with the author's wonted force. There is much hard-hitting in the course of the argument—sometimes indeed the continuity seems interrupted—and a precise summary is not easy. But the general conclusion is one for which those who know the author's works are prepared, that the Cnidaria are divided into Anthozoa and Polypomedusæ, and the latter into Hydromedusæ and Scyphomedusæ.

A new Stauromedusa.†—Dr. Gr. Antipa describes *Capria Sturdzei* g. et sp. n., a Stauromedusa found near Capri. It has eight adradial marginal lobes modified into true arms, without secondary tentacles, but with a fringe round the arms divided into (16–20) small serrations. There are (5–8) peculiarly large batteries of stinging-cells on the subumbrellar wall. There are not even principal tentacles. The circular muscles of the umbrellar margin are annular, and are not divisible into eight isolated marginal muscles. Longitudinal muscles are distributed in a uniform funnel-like manner over the whole surface of the subumbrella. The four septal ridges of the radial pockets extend almost as far as the margin of the umbrella, where they are penetrated by an annular canal. There is a long oral stalk. There are eight adradial

* Arbeit. Zool. Inst. Univ. Wien (Claus), x. (1892) pp 1–70 (3 pls.).
† MT. Zool. Stat. Neapel, x. (1893) pp. 618–32 (1 pl.).

gonads. An umbrella-stalk serves for attachment. The genus does not seem referable either to the Tesseridæ or to the Lucernariidæ; and for its reception the author proposes a new family Capriidæ.

Classification of Anthomedusæ.*—Dr. C. Hartlaub has some criticisms on E. Vanhöffen's division of the Anthomedusæ into two families (Codonidæ and Oceanidæ) according to the form of the gonads. Thus, the genus *Cladonema* cannot be ranked, as Vanhöffen places it, with the Oceanidæ. It should have been ranked with the Codonidæ. Vanhöffen's union of the genera *Pandæa* and *Tiara* is not justifiable. The author has some notes on the genus *Turris*, and describes a new species *T. cæca*, which closely resembles *T. digitalis* Forbes.

A new Hydroid.†—Dr. R. Zoja describes a new genus of Hydroids under the name of *Umbrellaria*, with the single species *U. Aloysii*. The trophosome, which alone is known, has a rudimentary hydrocaul, ensheathed in a rudimentary perisarc. The hydranths have a single wreath of (10–15) filiform tentacles and a conical hypostome. There is a filiform, branched, prostrate hydrorhiza, and there are two forms of nematocysts.

Porifera.

Australian Calcarea Heterocœla.‡—Dr. A. Dendy has prepared a synopsis of the Australian members of this group of Calcareous Sponges, in which he proposes a classification, and describes some new genera and species. The author's first family is that of the Leucascidæ, established for a new genus *Leucascus*; in it the long and narrow flagellated chambers are copiously branched; they communicate at their proximal ends with exhalant canals which converge towards the oscula, and their blind distal ends are covered by a perforated dermal membrane. Their skeleton consists principally of small radiates irregularly scattered. Two species of the new genus have been found near Port Phillip Heads, and one of them has also been found at Port Jackson. The second family contains *Sycetta*, *Sycon*, and *Sycantha*, and is called that of the Sycettidæ. The third family, Granti[i]dæ, contains *Grantia* (with a new sub-genus *Grantiopsis*), *Ute*, *Utella* g. n., *Anamixilla*, *Sycyssa*, *Leucandra*, *Lelapia*, and *Leucyssa*. The fourth family is that of the Heteropidæ, the first genus in which, *Grantessa* of von Lendenfeld, has, like some others, its characters emended; the other genera are *Heteropia* and *Vosmaeropsis* g. n. The last family Amphoriscidæ contains three of Haeckel's genera—*Amphoriscus*, *Syculmis*, and *Leucilla*, with Poléjaeff's genus *Heteropegma*; the characters of all these four are emended. Seventy-eight species are catalogued, sixteen of which are new.

Sponges of the 'Hirondelle.'§—M. E. Topsent devotes his present memoir to the Sponges of the North Atlantic. Of the 167 species collected in the three campaigns of the yacht, 58 are new to science, and some of them offer characters which are of value for classification, and others present new forms of spicules. *Esperiopsis polymorpha* is cited as an admirable example of polymorphism.

* Nachr. K. Gesell. Wiss. Götting., 1892, pp. 17–22 (3 figs.).
† MT. Zool. Stat. Neapel, x. (1893) pp. 519–26 (1 pl.).
‡ Proc. Roy. Soc. Victoria, 1892, pp. 69–116 (from separate copy).
§ Résultats Scientifiques, &c., ii. (1892) 165 pp., 11 pls.

Gemmules of Spongillidæ.*—Dr. W. Weltner, after some account of the structure and history of the gemmules of fresh-water Sponges, points out that our knowledge of their developmental history is still incomplete; there are two primary questions which still need to be answered—the origin and nature of the cells which form the foundations of the gemmule, and the fate of these cells. It is possible that the gemmule is formed from a single cell which has the value of an ovum, in which case the gemmule would have to be regarded as a mass of segmenting cells. But the internal mass of the gemmule may arise from several equal cells of the mesoderm, or from several unequal cells, or, finally, the gemmule may be formed by cells of two or three germinal layers, in which case the gemmule would be a bud.

Protozoa.

Stigmata of Mastigophora.†—Herr R. Franzé has made a study of the stigmata or eye-spots of Flagellate Infusoria. He finds them to be the simplest optic organs, and to consist of a plasmatic finely marked ground substance; in this there are deposited numerous oily red granules, and one or a few or many highly refractive granules; these latter, in the Euglenoidea, consist of paramylum, and in other Mastigophora of amylum; the granules are generally regularly arranged, but are sometimes irregular, and they exhibit a differentiation into larger, central, or excentric crystalline bodies, and smaller, always more numerous, lens-bodies. The larger granules are generally imbedded in the pigment, while the smaller bodies lie on it.

Besides these stigmata there are others which consist of one layer of grains of amylum, and a layer of pigment which completely surrounds it. Stigmata of this kind are, as a rule, found in Chlamydomonads, Volvocinea, Dinobryinea, and a few others.

The stigmata serve as organs for the perception of light; the crystalline body concentrates the light, the lens-bodies serve to concentrate the perception of light, and the pigment-layer is not only light-absorbing, but also light-perceiving. They are also capable of perceiving heat, and the influence of light produces thermotactic movements, which are either thermophilous or thermophobic.

The eyes of Turbellarians and Rotifers are not homologues of the stigmata; the external resemblance between the two kinds of differentiations are due to similarity of function. The so-called oral-ridge (*Mundleiste*) of various Monads is probably composed of highly refractive granules; what their true function is is still uncertain, but it is certain that they are not specific light-perceiving organs.

Merotomy of Ciliated Infusoria.‡—Prof. E. G. Balbiani finds that in the Ciliated Infusoria, which may be considered as one of the most favourable types for the physiological study of cells, certain functions are fulfilled by the protoplasm alone, and others by it and the nucleus. The former are the different modes of movement, and the power of directing the body during progression. The latter are the various

* Biol. Centralbl., xiii. (1893) pp. 119-26.
† Zeitschr. f. wiss. Zool., lvi. (1893) pp. 138-64 (1 pl.).
‡ Ann. de Micrographie, v. (1893) pp. 1-25, 49-84, 113-37 (2 pls.).

cellular secretions—secretion of the cuticle, of the acid fluid in the food-vacuoles, and, perhaps, other digestive fluids; the regeneration or reconstitution of organs and of the general form of the body, and the ultimate stages of division. There is no antagonism between the protoplasm and the nucleus, but rather there are reciprocal relations whence results a harmonious action, which maintains their vitality and assures the integrity of their functions.

Stentor polymorphus and *St. igneus* were found to be, with regard to merotomy, exactly like *St. cæruleus*; * that is to say, fragments which contained a nucleus were alone capable of regeneration, while fragments which had no nucleus were destroyed after a few days. In *Dileptus anser*, where the nuclear substance is dispersed in the form of small granulations in all parts of the plasma, all the fragments have some power of regeneration, and it is very rapid. This rapid regeneration contracts with the slowness of *Loxodes rostrum*, a species with multiple nuclei, the fragments of which require no less than four or five days for the reconstitution of complete individuals. In the course of the regeneration of the fragments of *Loxodes*, a small secondary merozoite is sometimes formed spontaneously at the expense of a portion of the principal merozoite which contains one or several nuclei; this portion becomes free after being more or less completely organized into a small *Loxodes*.

Paramæcium aurelia forms a remarkable exception to the general property possessed by Protozoa of regenerating the parts which they have lost under the influence of the nucleus. Mutilated individuals may live for a month or more without presenting any signs of regeneration. The contractile vacuoles are the only parts which are regenerated, but this is not an organic new formation. It is only when the loss of substance is slight, as when a small part of one of the extremities of the body is cut, that it is able to effect repair. Fragments which contain no nuclear portion disappear in the cultivations much more rapidly than non-regenerated nucleated fragments. Experiments with colouring matters show that it is probable that the nucleus has an influence on the secretion of acid in the vacuoles, and probably also on that of the other digestive juices. It sometimes happens that in multiplication by division the products do not become free, but remain united and form a kind of colony. During such a multiplication the nuclei may remain connected together, and form a large mammillated mass. There is in this case a suppression of the later stages of division, due probably to a lesion of the nucleus of the merotomized individual; it is never seen except in *Paramæcia* which have suffered a mutilation of their anterior portion. Sometimes lesion is followed by a prolongation of substance in the region of the wound.

Reproduction of Orbitolites.†—Mr. J. J. Lister, from the examination of spirit material, has been able to find that large brood-chambers are formed at the margin of the disc during the later stages of growth. These are at first lined with a thin layer of protoplasm. At a later stage the central region of the disc is found to be empty, and the whole of the protoplasm is massed in the brood-chambers in the form of spores.

* See this Journal, 1892, p. 803.
† Proc. Cambridge Philosoph. Soc., viii. (1893) pp. 11 and 12.

These spores have the structure of the "primitive disc" which, during the early stages of growth of *Orbitolites* occupies the centre of the shells. When they are liberated each becomes the centre of a new disc. In *Orbitolites*, therefore, there is reproduction by spore formation.

Depositions within Foraminifera.*—Dr. L. Rhumbler has studied these bodies, some of which Max Schultze, Carter, and others regarded as reproductive. (1) Within *Truncatulina lobatula* and others there is often a diatom allied to *Cocconeis*. (2) In *Saccammina sphærica*, *Truncatulina lobatula*, *Hyperammina friabilis* there are peculiar corpuscles with a hyaline membrane. They may be fæcal or possibly the results of decomposition. (3) A third kind of body is common in Foraminifera from muddy bottoms or from among rotting detritus, and also occurs in fallen-off spines of *Echinocardium*, &c. They are depositions of silicate of iron and are the result of decomposition.

Nuclear Division and Spore-formation in Rhizopods.†—Prof. A. Gruber has been able to detect karyokinetic division in *Arcella*. The stage observed was that showing two daughter asters. Noteworthy was the very large number of spindle-fibres. The number of chromatin loops was also great. Gruber has observed *Arcellæ* with nineteen, and even thirty-two nuclei, thus confirming the occurrence of spore-formation. He also observed a specimen of *Lecythium hyalinum* with eight nuclei. As a caution he notes how he discovered numerous small amœboid organisms within *Arcella*; they suggested spores; but they were only parasites, for the two nuclei of the host were in some cases quite distinct.

Dimorphism in Development of Hæmatosporidia.‡—M. A. Labbé finds that *Drepanidium ranarum* and *D. Danilevskii* have two modes of reproduction, as is shown by the essential differences in the spores, which may be called macrospores and microspores. Cytocysts with macrospores are of very variable size, and often develope in the leucocytes; they are the only ones yet known, and agree with those already described by Pfeiffer. The cytocysts with microspores are found in the liver and spleen; there may be here as many as fifty or sixty very small sporozoites, 3 to 5 μ long, elongated like bacteria, but provided with a nuclear spot.

The cytocysts with macrospores are found both in spring and autumn, but it is only at the beginning of the summer that those with microspores are met with.

* Nachr. K. Gesell. Wiss. Götting., 1892, pp. 419–28.
† Ber. Nat. Gesell. Freiburg i. B., vi. (1892) pp. 114–8 (1 pl.).
‡ Comptes Rendus, cxvi. (1893) pp. 1209 and 10.

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

α. Anatomy.

(1) Cell-structure and Protoplasm.

Streaming of Protoplasm and Transport of Nutritive Substances.*—Commenting on the observations of Hauptfleisch on this subject,† Herr F. Kienitz-Gerloff brings forward additional arguments in favour of his previous view—as opposed to that of Pfeffer—that the streaming of protoplasm is a general phenomenon in all living cells, and that the protoplasmic connections from cell to cell assist in the transport of food-materials. External irritation may produce a double effect on the streaming of protoplasm, first retarding and then accelerating it.

Reduction of the Chromosomes in Nuclei.‡—Mr. E. Overton refers to the researches of Guignard, Strasburger, and others, which show that a reduction in the number of chromosomes or chromatin-segments takes place in connection with the development of the reproductive cells of Angiosperms. He has followed out a similar line of investigation in Gymnosperms (*Ceratozamia*, *Tsuga*, *Larix*, *Ephedra*), and finds that a similar reduction takes place in the mother-cells of the pollen, and persists through the whole male gametophyte. In the endosperm this reduction occurs in the earliest stages of its development, whereas the nuclei of the cells of the nucellus and of the integument have the full number of chromosomes. The reduction is, therefore, probably effected during the formation of the embryo-sac, and persists throughout the whole female gametophyte or endosperm, including the oosphere. As far, therefore, as investigation has at present been carried, the sexual and the non-sexual generations in Gymnosperms differ in the nuclei of the latter containing twice as many chromosomes as do those of the former. In Pteridophyta and Muscineæ it seems probable—although the investigation is attended with considerable difficulties—that the reduction takes place in the spore-mother-cells, and also persists throughout the gametophyte.

Pectic Substances in Tissues.§—Pursuing his researches on the properties and distribution of pectic substances in plants, M. L. Mangin has, by the process already described,‖ demonstrated their presence in plants belonging to all the chief divisions of the vegetable kingdom,—Phanerogams, Vascular Cryptogams, Muscineæ, and Thallophytes, and in all the tissues the membrane of which is not hardened by lignin or suberin. The chief exceptions to the presence of these substances are furnished by some classes of Fungi—Peronosporeæ, Saprolegnieæ, Perisporiaceæ, Uredineæ, and Ustilagineæ—and by certain hairs, as those of cotton. The membrane of soft tissues—parenchyme, collenchyme, bast,

* Bot. Ztg., li. (1893) 1te Abtheil., pp. 36–42. † Cf. this Journal, *ante*, p. 344.
‡ Ann. Bot., vii. (1893) pp. 139–43.
§ Journ. de Bot. (Morot), vi. (1892) pp. 363–8; vii. (1893) pp. 37–47, 121–31 (2 pls.). Cf. this Journal, 1892, p. 809. ‖ Cf. this Journal, *ante*, p. 417.

and meristem—always contains pectic substances associated with cellulose; the most widely distributed forms being pectic acid and pectose.

Pectic acid is usually found combined with inorganic bases, most commonly lime. The ill-defined substance known as pectose is associated with calcium pectate in all the soft tissues, sometimes replacing it, especially in young tissues. The calcium pectate is found exclusively in the middle layer which separates the cells, cementing them together, and constituting the "intercellular substance" of Mohl.

The detection of these substances is described in detail in a number of species of *Equisetum* and in a variety of flowering plants. It is insoluble pectates, chiefly of lime, that constitute the sculpturings—frequently in the form of rods or knobs, which so often mark the cell-walls which bound intercellular spaces. The substance which clothes the walls of intercellular spaces is also of this nature, and not protoplasmic, as has been asserted by some authors. In some cases a portion of these deposits is capable of swelling up in water and becoming partially gelatinized.

(2) Other Cell-contents (including Secretions).

Pigments of the lower Cryptogams.*—Prof. W. Zopf has studied the nature of the pigments in various Algæ, Fungi, Lichens, Myxomycetes, and Schizomycetes.

The properties are given of the hæmatochrome obtained from *Trentepohlia Iolithus*; the author determined it to belong to the class of carotins (lipochromes). A table is given of the spectra of the various carotins.

The colouring matter of various yellow lichens was investigated. From *Cetraria Pinastri* and *C. juniperina*, especially from the medulla, was obtained a resinous acid ("pinastric acid"); *Sticta aurata* does not contain this acid, but a crystallizable pigment insoluble in mineral acids and alkalies ("stictaurin"). The red colour of the medulla of *Physcia endococcinea* is due to the presence of two crystallizable pigments of an acid character, "rhodophyscin" and "endococcin." *Callopisma vitellinum* yields two pigments, calycin and a new lemon-yellow "callopismic acid." Calycin was also obtained from *Acolium tigillare*. A new yellow acid, "placodic acid," was obtained from *Placodium fulgens* and *Calycium chlorinum*.

The orange-red pigment of *Pilobolus Kleinii*, *œdipus*, and *crystallinus*, insoluble in water, but easily soluble in alcohol, chloroform, and carbon bisulphide, is a lipochrome similar to that of *Chroolepus* and of *Bacterium egregium*. This yellow pigment was found to be taken up also by two parasites of the *Pilobolus*, *Pleotrachelus fulgens* and *Endobiella destruens*.

Carotin was found also in certain insects belonging to the Chrysomelideæ and Coccinelleæ, *Lina Populi* and *Tremulæ*, and *Coccinella septempunctata* and *quinquepunctata*.

The fructification of *Bulgaria inquinans* was found to contain six distinct pigments, a red crystallizable pigment ("bulgarin"), a blue pigment ("bulgarcœrulein"), a yellow resin ("bulgaric acid"), a yellow

* Beitr. z. Phys. u. Morph. niederer Organismen, Leipzig, 1892, Heft 1, pp. 30–56; and Heft 2 (1892) pp. 3–32 (2 pls.).

amorphous pigment soluble in water, a red amorphous pigment soluble in water (" bulgarerythrin "), and a yellow fat.

From *Arcyria punicea* (Mycetozoa) four pigments can be extracted by alcohol, viz. a yellow resinous acid, scarlet when solid, soluble in benzol (" arcyric acid "), a brownish-yellow resinous acid insoluble in benzol, a yellow fatty acid, and a yellow acid soluble in alcohol, insoluble in ether and water. The scarlet colour of the organism appears to be due to the first of these.

New Lichen-acid.*—Prof. W. Zopf has extracted from an alpine lichen *Thamnolia vermicularis*, distinguished by its chalky or greyish white colour, a crystallizable acid which he regards as new, and to which he gives the name thamnolic acid. It occurs in the cortex of the lichen, and its properties are described in detail.

Vegetable Ferments.†—Prof. J. R. Green gives a detailed account of what is known respecting the various kinds of ferment occurring in the vegetable kingdom. He classifies them under four groups, viz.:—(1) Carbohydrate enzymes, including the various kinds of diastase, inulase, invertase, the cytohydrolysts which attack cellulose, and the ferment which forms vegetable jelly from pectic substances; (2) Glucoside enzymes, including emulsin or synaptase, myrosin, erythrozyme, and rhamnase; (3) Proteo-hydrolytic enzymes, including vegetable pepsin, trypsin, and vegetable rennet; (4) Glyceride enzymes, which decompose oils.

Of diastase there appear to be two kinds, one concerned in translocation, the other in secretion, of which the latter is the more active; the former dissolves starch-grains without, the latter with corrosion. The action of diastase is always one of hydrolysis. Inulase is found where inulin replaces starch in various Compositæ. Invertase has the power of inverting cane-sugar, or of hydrolysing it into dextrose and levulose. Cytohydrolysts have been discovered in the germinating barley-grain and in certain fungi. Emulsion has been found in certain species of *Amygdalus* and *Cerasus* or *Prunus*, and is active in the formation of prussic acid; myrosin is the characteristic enzyme of the Cruciferæ; rhamnase occurs in *Rhamnus infectorius*; erythrozyme in madder-root. The ferments of *Drosera*, *Dionæa*, *Pinguicula*, and other insectivorous plants are pepsins; the best-known trypsins are the ferment of *Carica Papaya*, and that of the fig; a rennet occurs in the latex, the bast, the leaves, the flowers, and the seeds of various plants. Glyceride enzymes have been found in various oily seeds.

Besides the above-mentioned groups, the author describes the enzymes of fungi (*Fusarum*, *Botrytis*, *Torula Ureæ*, &c.), and those of bacteria, and also states what is known respecting zymogens or enzyme-generators.

The action of the enzymes is stated to be, in all cases except that of myrosin, one of hydration. It is in no way different from an ordinary chemical reaction. Some of them act only intracellularly, and do not, during their activity, leave the cells in which they are secreted; while others are secreted in particular cells, and are excreted by them to work upon substances contained elsewhere.

* Hedwigia, xxxii. (1893) pp. 66-9.

† Ann. Bot., vii. (1893) pp. 83-137.

(3) Structure of Tissues.

Function of the Protecting-sheath.*—From experiments made with different species of snails, Herr A. Dreyer concludes that the tannin contained in the protecting sheath is an efficient protection against consumption by these animals. The odoriferous oil in the root-stock of the onion answers the same purpose; and the same is the case with the alkaloids of *Aconitum Napellus*, *Veratrum album*, *Colchicum autumnale*, and *Cicuta virosa*. The function of the protecting-sheath is not, therefore, a purely mechanical one; it serves also a conducting purpose. It does not, however, appear to afford any protection against the attacks of parasitic fungi or bacteria.

Sieve-tubes in the Xylem.†—Pursuing his researches on this subject, Prof. R. Chodat records the occurrence, in a large number of natural orders, of islands of sieve-tubes produced from a cambium which acts in a centrifugal direction, forming sometimes xylem, sometimes a soft tissue with sieve-tubes. In other orders an adventitious xylem is formed from a supernumerary generative layer produced at the expense of the pericycle.

Structure of Phytolacca.‡—Dr. O. Kruch describes several details in the anatomical and histological structure of *Phytolacca dioica*. The chief structural specialities are the presence of vascular bundles in the pith, and the increase in thickness of the branches by the formation of supernumerary rings. On the principal axis each leaf has, as a rule, two buds in its axil, of which the one nearest the axis usually developes into a branch, while the other remains undeveloped. On the flowering branches, on the other hand, the axil of each leaf bears only a single bud.

(4) Structure of Organs.

Pollen-grains of Papaveraceæ.§—Dr. E. Baroni describes the pollen-grains of the following species of Papaveraceæ:—*Papaver orientale*, *setigerum*, and *somniferum*, *Chelidonium majus*, and *Eschscholtzia crocea*. The measurements are given of the dry grains, and the changes are described which are produced by immersion in water, solution of sugar, and glycerin.

Development of the Integument of the Seed.—M. L. Guignard ‖ describes the development of the integument of the mature seed in the Cruciferæ and in some other orders, his conclusions differing in several points from those of Brandza.¶

In the Cruciferæ the observations were made on a large number of species belonging to all the more important tribes. In all cases he finds that the internal proteinaceous layer of the testa is derived from the outermost layer of the endosperm, the aleurone layer of authors, and

* 'Beitr. z. Kenntniss d. Function d. Schutzscheide,' St. Gallen, 1892, 57 pp. See Bot. Centralbl., liii. (1893) p. 383.

† Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 481–2. Cf. this Journal, 1892, p. 500.

‡ Atti R. Accad. Lincei, ii. (1893) pp. 52–5.

§ Nuov. Giorn. Bot. Ital., xxv. (1893) pp. 130–5.

‖ Journ. de Bot. (Morot), vii. (1893) pp. 1–14, 21–34, 57–66, 97–106, 141–53 (80 figs.); and Bull. Soc. Bot. France, xxxix. (1893) pp. 392–4; xl. (1893) pp. 56–9.

¶ Cf. this Journal, 1891, p. 491.

not from the epiderm of the ovule. The whole of the endosperm, with the exception of this outermost layer, disappears during the maturing of the seed. The structure of the integument of the ovule at the period of impregnation differs considerably in the different genera and species of the order, and even sometimes in the same species. The external coat may consist of 2, 3, or 4 layers; the internal coat is usually made up of 3 or 4, though in some cases the number is much greater, even up to 15. The modifications which take place in the course of ripening of the seed are also numerous, especially in the outer coat; the outermost layer almost always becomes mucilaginous. The layers of the inner coat usually become more or less consolidated. The proteinaceous layer derived from the outermost layer of the endosperm is always persistent.

The other orders examined were the Capparideæ, Resedaceæ, Balsamineæ, Hypericaceæ, Linaceæ, and Malvaceæ. In all cases the ovule is provided with 2 integuments. In the first-named four orders the remains of the endosperm in the mature seed are reduced to a single layer, as in the Cruciferæ; in the Linaceæ and Malvaceæ it is more completely retained.

Prof. R. Chodat and Mlle. A. Rodrigue* have studied the development of the integument of the seed in the Polygalaceæ. In the section Orthopolygala of *Polygala* the ovule has two coats, each of which is composed of 2 layers of cells; the testa of the ripe seed being derived from the primine only. A very small portion of the nucellus remains in the ripe seed as a band separating the integument from the endosperm. The aril is formed entirely at the expense of the primine. In *Polygala Chamæbuxus* the primine of the ovule is composed of three layers.

Anatomical Characters of Persistent Leaves.†—M. G. Lalaune summarizes the characters, drawn from a great number of examples, in which persistent or evergreen differ from deciduous leaves.

The epiderm is of normal structure during the first year, but towards the end of the period of vegetation the cuticle begins to thicken and the cell-cavities to decrease in size. In the second year this change continues, and there may even be a lignification of the cell-walls, as in *Rhododendron ferrugineum*. There is a tendency for the opening of the stomates to diminish, and for the walls of the guard-cells to thicken, while their cavities almost disappear. The hypodermal collenchyme is more strongly developed, and its walls become thicker and sometimes somewhat lignified. The number of vascular bundles varies within the same species, as is strikingly the case in the ivy; the sclerome is usually strongly developed; sclerenchymatous cells frequently occur in the fundamental parenchyme. The palisade-tissue consists of only a single layer in evergreen, of several layers in deciduous leaves.

Influence of External Conditions on the Form of Leaves.‡—Mr. P. Groom records the fact that in one and the same plant (an epiphytic

* Arch. Sci. Phys. et Nat., xxix. (1893) pp. 319–21.
† Actes Soc. Linn. Bordeaux, xliv. (7 pls.). See Bot. Centralbl., liv. (1893) p. 113.
‡ Ann. Bot., vii. (1893) pp. 152–3.

orchid of Singapore) growing partly in the sun and partly in the shade, strong sunlight and drought combined have the effect of causing a distinct elongation of all the cells in the exposed leaves in a direction at right-angles to the surface; the cuticle is better developed, and the leaf as a whole is thicker and smaller.

Leaves of Irideæ.—Mdme. Balicka-Iwanowska * has studied in detail the anatomical structure of the leaves of *Iris* and allied genera from a systematic point of view. She states that characters derived from this organ must be treated in connection with others dependent on the morphology of the flowers. In some cases, however, histological characters may be used in defining genera or groups of genera. Thus *Patersonia* is characterized by marginal emergencies and by a lignified pith; *Crocus* and *Romulea* by the section of their leaves; *Gladiolus* by a completely lignified fibrovascular bundle in direct contact with the epiderm; *Iris* and allied genera by their marginal hypodermal fibres. The genus *Iris* may be divided into three sections according as the leaves are tetragonal, equitant, or isolateral. The Ixieæ and Gladioleæ have isolateral leaves with a prominent mid-rib which is wanting in the Iridineæ and Aristeæ. The Cipurineæ and Tigridieæ have folded leaves. *Tritonia* and allied genera have marginal epidermal fibres, and opposite or even coalescent bundles. With the exception of *Iris*, *Moræa*, *Galaxia*, and *Crocus*, all the Irideæ have isolateral leaves.

Dr. H. Ross † gives a detailed account of the comparative anatomy of the leaves of Irideæ, derived from a study of 53 out of the 57 genera, and 300 out of the total number of about 700 known species. After a description of the general conformation of the leaves, special attention is directed to the epiderm and trichomes, the fibrovascular bundles, and the mesophyll. The specialities of the genera *Iris*, *Hermodactylus*, and *Moræa* are then referred to.

Structure of Lathræa.‡—Herr E. Heinricher has paid special attention to the structure of the underground organs and the mode of parasitism of *Lathræa squamaria* and *L. clandestina.* The former was found parasitic only on *Alnus incana.* The haustoria occur, as a rule, not on the primary, but only on the lateral roots; they are not placed, as has been described, exclusively at the extremity of the root-branches; they are found along the whole length, and frequently give them a moniliform appearance. The author finds no confirmation of the statement of Kerner that the haustoria disappear completely in the autumn, and that the parasite connects itself again with its host in the spring by fresh haustoria. *L. clandestina* differs from *L. squamaria* chiefly in the abundant formation of roots on the rhizome.

The succulent capsule of *Lathræa* is forced open, when ripe, by the excessive development of the placenta. *L. squamaria* forms a large number of underground cleistogamous flowers which pass by insensible gradations into the ordinary open flowers.

* Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 413–35; xxix. (1893) pp. 185–200, 225–41 (3 pls. and 15 figs.). Cf. this Journal, 1892, p. 818.

† Malpighia, vi. (1892) pp. 90–116, 179–205 (4 pls.).

‡ Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 1–18. Cf. this Journal, *ante*, p. 63.

Cotyledonary Glands of Rubiaceæ.*—Mr. T. Berwick records the occurrence of a pair of glands in the axis of the cotyledons in a large number of Rubiaceæ before germination; their position and form vary according to the species. The process of germination is described in the case of a large number of species belong to the order.

Capitate Hairs with Vibratile Filaments.†—Prof. R. Chodat and M. R. Zollikofer record the occurrence of hairs of this description, not only in the fluid contained in the cups formed by the coalescence of the bases of the leaves in *Dipsacus*, but also completely exposed to the air on plants belonging to the orders Dipsacaceæ, Scrophulariaceæ, and Solanaceæ. Their study is especially easy on the corolla of *Antirrhinum majus*. In the Solanaceæ the vibrating filaments form dense cushions covering the greater part of the trichome.

Velamen of Orchids.‡—Mr. P. Groom calls attention to the fact that the velamen of the roots of orchids does not in all cases perform the same function. In some cases it is essentially an absorbent organ; and it is then not confined to epiphytic orchids, but may be present, and even assume a higher development, when the root is subterranean; while in other species it is mainly protective, preventing loss of water by transpiration, the absorptive function being carried on by the root-hairs on the ventral surface of the root.

Roots of Ranunculaceæ.§—Mr. F. B. Maxwell describes the minute peculiarities in the roots of a number of American plants belonging to this order. His general conclusion is that, in the Ranunculaceæ, it is impossible to distinguish the species, and in many cases even the genus, by the structure of the root. Environment influences the structure much more than specific relations. Plants of different species growing in similar conditions present much more resemblance in the structure of their roots than those of the same species grown in different conditions. The author classifies the species examined under three types as regards the changes effected by secondary growth, and under two as regards the structure of the meristem of the growing point.

β. Physiology.

(1) Reproduction and Embryology.

Structure of Hybrids.‖—From the examination of a very large number of examples, Dr. J. M. Macfarlane arrives at the general result that hybrids hold, in their anatomical properties, an intermediate position between the two parents. This is displayed in the size, number, and position of the trichomes; in the form and size of the nectaries; in the structure of the cuticle and in the distribution of the stomates; in other anatomical details such as the thickness of the cell-walls; in the form and colour of the chromatophores and the form and size of the

* Trans. Bot. Soc. Edinburgh, xix. pp. 159–65. See Bot. Centralbl., liv. (1893) p. 176.

† Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 494–5. Cf. this Journal, 1892, p. 819.

‡ Ann. Bot., vii. (1893) pp. 143–51.

§ Bot. Gazette, xviii. (1893) pp. 8–16, 41–7, 97–102 (3 pls.).

‖ Trans. R. Soc. Edinburgh, xxxvii. (1892) pp. 203–86 (8 pls.).

starch-grains; in the quality of the odour of the flower; in the time of flowering; and in the capacity for resisting cold.

A very striking illustration of this intermediate structure is afforded by the vascular bundle-sheath of the hybrid *Philageria Veitchii*, which consists of eight or nine layers of cells; while that of one of the parents, *Lapageria rosea*, consists of five, and that of the other parent, *Philesia buxifolia*, of eleven or twelve layers.

The graft-hybrid *Cytisus Adami* does not present characters intermediate between those of the parents, but some characters of one, some of the other parent.

The author distinguishes as "unisexual heredity" the property of transmitting a character possessed by one of the parents only. Thus, while *Lapageria rosea* has nectaries on the sepals, and *Philesia buxifolia* has none, *Philageria Veitchii* has nectaries about half the size of those of *Lapageria*. In "bisexual heredity" properties belonging to each of the parents are transmitted. Thus *Ribes Culverwellii* has both the simple hairs of *R. Grossularia* and the oil-secreting hairs of *R. nigrum*.

The author regards the nucleole as the essential carrier of hereditary properties; from the nucleole radiate the chromatic filaments, and these pass into the cytoplasm, and probably form a reticulate connection between the separate cells. The plant may be regarded as a group of connected hermaphrodite cells, descended from a fertilized egg-cell, and bound together by a fine chromatic ramification, the centre of which in each cell is the nucleole.

Cross and Self-pollination.—According to Miss Jane H. Newell * the stamens of the horse-chestnut, which are usually seven in number, open in succession; the first flowers in an inflorescence are staminate, the later ones perfect and proterogynous. The change in colour of the nectar-guides, from yellow to bright crimson, appears to be for the purpose of indicating to the visiting insects that the flowers no longer contain nectar. The authoress believes, however, the flowers to be self-fertile.

Dr. A. Mágócsy-Dietz † states that *Œnothera biennis* is not only pollinated by night-flying insects, but is also self-pollinated. All the species of *Forsythia* grown in Hungary—*F. suspensa*, *viridissima*, and *Fortunei*, are heterostylous, but none of them produce seeds in that country, being but little visited by insects. M. Bruel ‡ asserts that in *F. suspensa* and *viridissima* the structure favours self-pollination.

Herr K. F. Jordan § describes the structure of the nectary in *Echium vulgare*, and the mode in which its position aids in pollination by insects.

According to Dr. Ida A. Keller,‖ pollination takes place within the unopened bud in *Monarda fistulosa* (Labiatæ). Notwithstanding this, the flowers subsequently fully expand, and the stamens, and finally the style, are protruded.

* Bot. Gazette, xviii. (1893) pp. 107–9.
† Mathem. u. Naturwiss. Ber. aus Ungarn, ix. (1892) pp. 399–401 and 414.
‡ Actes Soc. Linn. Bordeaux, xiv. p. 347 (1 pl.). See Bot. Centralbl., liv. (1893) p. 114.
§ Ber. Deutsch. Bot. Gesell., x. (1893) pp. 583–6 (5 figs.).
‖ Proc. Acad. Nat. Sci. Philadelphia, 1893, pp. 452–4 (1 pl.).

Dr. R. Cobelli * records his observations on the following flowers :—*Melandrium rubrum*, *Philadelphus coronarius*, *Pulmonaria officinalis*, and *Primula officinalis*, in all of which he finds arrangements for cross-pollination, and gives a list of the visiting insects observed.

In the last instalment of his paper on Flowers and Insects, Mr. C. Robertson † describes the structure of the flower and the mode of pollination, with the insect visitors, in a number of American plants, mostly belonging to the Orchideæ. In all belonging to this order there appear to be adaptations for entomophily.

Pollination of Naias and Ceratophyllum.‡—M. E. Roze has investigated the mode of pollination in *Naias major* and *Ceratophyllum demersum*, in both of which the whole plant, including the male and female flowers, is completely submerged.

It is doubtful whether *Naias major* is monœcious or diœcious. The female flowers present a similar structure to those of *Zannichellia palustris*. The ovary is surmounted by a very short style ending in three sepaloid expansions, which are not true stigmas. They form a kind of funnel into which the pollen-grains fall, and thus reach the stylar canal.

In *Ceratophyllum demersum* the male flowers are seated on the same branch as the female flower, but below it. The ovary is surmounted by a long style entirely destitute of any stigmatic apex. In the upper part of the style is a canal, which appears to serve as a receiving organ for the pollen-grains, when they put out their pollen-tubes to reach the ovary. When the anthers are ripe they become detached from their filaments, and, buoyed up by the air-vessels which they contain, rise to the surface of the water, where they burst. At the same time the branches rise to near the surface, and bring the pistils into such a position, that the anthers floating on the surface can drop their pollen into the terminal canals of the styles. Fertilization, however, appears to take place but rarely.

Secondary Effects of Pollination.§—Mr. W. M. Munson gives a list of a number of plants in which the pollen appears to exercise an immediate influence on the mother-plant, and of others in which it does not. With several species of gourd and with *Solanum Melongena* seedless fruits were obtained when the access of pollen was prevented. The quantity of pollen has often a distinct effect on the form and size of the fruits, a large quantity promoting the full and symmetrical development of the fruit.

Gynodiœcism in the Labiatæ.‖—Mr. J. C. Willis finds that, in the hermaphrodite plants of *Origanum vulgare*, there are frequently flowers in which one or more of the stamens are abortive; and in the female plants there are occasionally flowers with one or more perfect stamens. Similar variations occur in the hermaphrodite flowers of other Labiatæ. The author regards proterandry as the usual cause of gynodiœcism.

* Nuov. Giorn. Bot. Ital., xxv. (1893) pp. 5-15.
† Bot. Gazette, xviii. (1893) pp. 47-53. Cf. this Journal, 1892, p. 820.
‡ Bull. Soc. Bot. France, xxxix. (1893) pp. 361-4.
§ Ann. Rep. Maine State Coll., 1892, pt. 2, pp. 29-58 (1 pl.). See Bot. Centralbl., liv. (1893) p. 165.
‖ Proc. Cambridge Phil. Soc., vii. (1892) pp. 349-52; viii. (1893) pp. 17-20.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Effect of the Electric Light on Vegetation.*—As the result of a series of experiments Prof. R. Chodat states that the electric light promotes the germination of seeds, and the lengthening of leaves and stems; the leaves, however, are not so well developed as those of plants not exposed to the electric light. Its effect, therefore, is analogous to that of prolonged darkness. On the movement of the leaves of *Oxalis* the electric light had no influence.

Adaptations for Epiphytism.†—Herr E. Loew enumerates a number of plants, natives of northern Germany, which appear to be on the way to becoming epiphytic. He finds them to be specially characterized in two different ways:—In a large number there is a special adaptation for the dissemination of the seeds, either by the fruit being edible, and the seeds therefore passing into the excrements of birds or other animals, or by the fruit or seeds being furnished with a floating apparatus. In other cases the plant is especially adapted for the absorption of food-material from decaying vegetable substances by the possession of an abundant mycorhiza.

Influence of the Seed on the Development of the Fruit.‡—According to Herr A. Müller-Thurgau, the reduction of the number of seeds in the grape from the normal number of four to three, two, or one, or their total suppression, is not due to the failure of pollination; this causes the falling of the flower. It is the result of imperfect impregnation, the pollen-tubes either not reaching the oosphere, or not finding it in a condition for impregnation, the ovules having probably been imperfectly nourished. The growth of the berry stands in direct relation with the development of the seeds, the development of the flesh being dependent on the irritation caused either by the entrance of the pollen-tube or by the growth of the seed. When there is only one seed the flesh developes more strongly on the side on which the seed lies. The presence of seeds also lengthens the period of ripening. Similar results were obtained also with currants, apples, oranges, apricots, and peaches.

(3) Irritability.

Latent Irritability.§—Prof. J. Sachs states that the well-known sensitive motions of the roots of epiphytes can be incited also in aerial roots by placing them in a condition where these movements can be brought into play. The irritability must therefore remain latent in all roots. He has proved experimentally that, while the primary root of a seedling possesses true positive geotropism by which it directs itself vertically downwards, the secondary roots have each a modified geotropism of their own, in consequence of which they assume a definite angle with the primary root. The tertiary roots again do not display geotropism of any kind, but spring from the secondary roots in all directions. These facts were demonstrated by observations made on potatoes

* Arch. Sci. Phys. et Nat., xxviii. (1893) pp. 478–81. Cf. this Journal, *ante*, p. 66.
† Abhandl. Bot. Ver. Prov. Brandenburg, 1892, pp. 63–71.
‡ J.B. Deutsch-schweiz. Versuchsstat., 1892. See Bot. Centralbl., liv. (1893) p. 26.
§ Flora, lxxvii. (1893) pp. 1–15.

grown under conditions where the mode of growth of the roots could be clearly followed out, showing the closest resemblance to that of the roots of epiphytes.

Changes of Pressure in Mimosa.*—M. G. Bonnier has studied, by means of a manometer, the changes of pressure which take place in the motor cushion of the leaf of the sensitive plant when the leaflets are displaying their sensitive movements. He finds that, when the leaves are irritated, the pressure at the base of the lower surface of the motor cushion diminishes, and that it again increases as the leaves assume their normal position. If the leaves are maintained in this position by the action of chloroform, the pressure in the motor cushion remains unchanged. A decrease of pressure in the surrounding air causes a movement in the reverse direction to the sleep position, but does not communicate itself to the tissues of the plant. The variations in the movements of the leaflets are always connected with variations in the internal pressure of the motor cushion.

(4) Chemical Changes (including Respiration and Fermentation).

Physiology of Succulent Plants.†—M. E. Aubert has undertaken an exhaustive series of observations on various points connected with succulent plants. Those examined belonged chiefly to the Cactaceæ, Mesembryanthemaceæ, and Crassulaceæ; but the degree of succulence in the various species of these orders varies greatly.

With regard to their assimilation and respiration, he finds that the atmosphere contained within the tissues of these plants differs from the surrounding air in the proportion of the gases of which it is composed. The value of the fraction $\frac{CO_2}{O}$ varies in direct proportion to the succulence of the species. The Crassulaceæ and Mesembryanthemaceæ with a thin cuticle manifest a greater exchange of gases with the surrounding atmosphere than most of the Cactaceæ, while the succulent Euphorbiaceæ are intermediate between the two. The two processes of assimilation and respiration proceed simultaneously in succulent plants, and the value of the fraction $\frac{O}{C}$ is in direct proportion to their succulence.

With regard to the organic acid contained in the sap, which has so great an influence on the turgor of the cells, M. Aubert finds that in the Crassulaceæ it is malic (isomalic) acid, free or combined, with traces of tartaric; in the Mesembryanthemaceæ it is oxalic acid; in the Cactaceæ it is malic acid associated with a large quantity of gums. The amount of malic acid in the leaves of the Crassulaceæ increases from the terminal bud to a point in the stem where the leaves have almost attained their maximum development; from this point it decreases in the adult leaves, but never completely disappears. The amount of malic acid also varies in different parts of the same leaf; it is least in those

* Rev. Gén. de Bot. (Bonnier), iv. (1893) pp. 513–28 (2 pls.); and Bull. Soc. Bot. France, xxxix. (1893) pp. 365–8.

† Ann. Sci. Nat., xvi. (1892) pp. 1–90 (9 figs.); and Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 203–19, 273–82, 320–31, 337–53, 373–91, 421–41, 497–502, 558–68 (1 pl. and 5 figs.).

parts which are most fully illuminated. In the Crassulaceæ he determined that the formation of organic acids during the night is dependent on the assimilation of carbon previously effected in the day-time. The distribution of water in the different parts of plants belonging to the Crassulaceæ corresponds to that of malic acid; in *Opuntia* and the Crassulaceæ it is the most parenchymatous region that contains the largest quantity of water. The presence of organic acids in the tissues is distinctly unfavourable to transpiration.

Influence of Light on Respiration.*—Herr W. Detmer gives the results of a series of experiments which appear to determine that light has no direct influence on the respiration of plants destitute of chlorophyll; while in the green parts of plants both assimilation and respiration are retarded by the exclusion of light for a considerable period. No daily periodicity could be established in the intensity of the respiration. In germinating potato-tubers the respiration is decidedly more intense in the light than in the dark, light having apparently the power of dissociating the living molecules of protoplasmic albumen.

Formation of Sulphates and Nitrates.†—Pursuing his investigations on the chemical changes which take place in plants during germination, M. E. Belzung finds that sulphates may be formed at the moment of germination by oxidation of the sulphur in the albuminoid reserve-materials; while nitrates are never formed by the oxidation of the nitrogen of the albuminoid substances, but are always transported directly into the seedling from the nutrient material. A process of nitrification unconnected with bacteria is unknown in the vegetable kingdom.

B. CRYPTOGAMIA.

Algæ.

Parasitic Phæosporeæ.‡—M. C. Sauvageau enumerates the following parasitic species of Phæosporeæ:—*Elachista stellulata* on *Dictyota dichotoma*, not a facultative, but a true parasite; *E. Areschougii* on *Himanthalia lorea*; *E. clandestina* on *Fucus ceranoides*; *E. scutulata* in the conceptacles of *Himanthalia lorea*; *E. pulvinata* in those of *Cystosira ericoides* and *discors*; *Ectocarpus investiens* on *Gracilaria compressa* and *multipartita*; *E. velutinus* on *Himanthalia lorea*; *E. Valiantei* on *Cystosira ericoides*; *E. brevis* sp. n., forming yellow-brown tufts on *Ascophyllum nodosum*; *E. minimus* on *H. lorea*; *E. luteolus* sp. n., forming a light-yellow down on *Fucus serratus* and *vesiculosus*; *E. parasiticus* sp. n., forming small brownish spots on *Cystoclonium purpurascens*, *Gracilaria confervoides*, and *Ceramium rubrum*; *E. solitarius* sp. n., on *Dictyota dichotoma*; *Streblonemopsis irritans* on *Cystosira opuntioides*; *Ectocarpus fasciculatus* on *Laminaria flexicaulis*.

Reproductive Organs of Prasiola.§—Mr. T. H. Buffham describes structures in *Prasiola stipitata* which he regards as antherids and "spores" (fertilized oosperms). The former were seen to be discharging

* Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 139–48, 149–53.
† Journ. de Bot. (Morot), vii. (1893) pp. 87–91. Cf. this Journal, 1892, p. 825.
‡ 'Sur quelques Algues Phéosporées parasites,' 48 pp. and 35 figs. See Bot. Centralbl., liv. (1893) p. 75.
§ Grevillea, xxi. (1893) pp. 90–2 (6 figs.).

pollinoids. The male and female organs occur on different plants. He regards this discovery as a confirmation of the view that *Prasiola* is nearly related to *Porphyra*.

Giffordia, a new Genus of Ectocarpaceæ.*—Mr. E. A. Batters separates *Ectocarpus secundus* from that genus as the type of a new genus *Giffordia*, in which the male cells and the sporanges in which they are produced differ in several important particulars from the female cells and their sporanges, while the true *Ectocarpi* are isogamous. The antherozoids of *Giffordia* are much smaller than the zoospheres, and are destitute of chromatophores. In the same genus must be placed *E. fenestratus*, *E. Lebelii*, and a new species *G. Padinæ* described by Mr. T. H. Buffham.†

Chlamydomonas Kleinii sp. n.‡—Herr W. Schmidle describes a new species of this genus found in ditches and pools in the Black Forest, which differs in several respects from the species hitherto described. It occurs in both a swarming and a palmelloid condition. In the former state each individual is an oval or cylindrical body, 32–28 μ long and 12–8 μ broad, with two very slender flagels. In the anterior portion is a linear reddish-brown "stigma" or eye-spot, in which are always two well-developed pyrenoids, and there are two small contractile vacuoles which pulsate alternately. It has a striated appearance, owing to the arrangement of the chlorophyll-bodies in bands. The individuals swarm only for a short time, and then pass rapidly into the resting condition, and the cell-wall gelatinizes, the mucilage being distinctly laminated; the flagels often remain for a considerable time, retaining a slow movement. The attachment of the individuals to one another in the palmelloid condition is but slight. In this condition both microspores and megaspores are formed; the first cell-division is always transverse, differing in this respect from that of all other species known. The usual number of megaspores and microspores derived from each cell is 4 and 32 or 64 respectively. No conjugation was actually observed; but there were indications of this taking place between an active microspore and one which had already come to rest.

Rhodochytrium, a transitional form between the Protococcaceæ and the Chytridiaceæ.§—Prof. G. v. Lagerheim describes a parasitic alga found on a species of *Spilanthes* (Compositæ), which he makes the type of a new genus with the name *Rhodochytrium Spilanthidis*. It appears on the stem and leaves of the host in the form of blood-red spots which are the sporanges of the parasite. They are always in contact with a vascular bundle, and produce only one kind of zoospore, which is biciliate and may germinate either with or without conjugation. When a zoospore settles on the epiderm of the host, it does not penetrate through a stomate, but puts out a germinating tube which makes its way between two epidermal cells. The rhizoids which are put out from the germinating tube form a complete weft round the vascular bundle. Nearly the whole organism is coloured by a red pigment; both the sporanges and the spores themselves contain abundance of starch; but

* Grevillea, xxi. (1893) pp. 85–6. † Tom. cit., pp. 88–9 (3 figs.).
‡ Flora, lxxvii. (1893) pp. 16–26 (1 pl.).
§ Bot. Ztg., li. (1893) 1[te] Abtheil., pp. 43–52 (1 pl.).

the presence of chlorophyll is very doubtful. A second kind of organ of propagation, resting sporanges, was also observed. *Rhodochytrium* is most nearly allied to *Phyllobium*, but differs in the presence of two kinds of sporange, in the mode of germination, and in the absence of chlorophyll; in the last two characters it presents an approach to the Chytridiaceæ.

Tetrasporidium, a new Genus of Algæ.*—In a collection of Algæ from Java, Prof. M. Mœbius finds a freshwater species which he makes the type of a new genus allied to *Tetraspora*, and names *Tetrasporidium javanicum*. The following is the diagnosis of the genus:—Thallus spongiosus, irregulariter perforatus, structuram et multiplicationem cellularum eandem quam *Tetraspora* præbet; reproductio fit sporis (zoosporis aut gametis?) in cellula incrassata divisione succedanea senis denis evolutis, periplasmate multo in sporangio remanente; diam. cellul. veg. 6–7 μ, sporangiorum 20–25 μ. The following new species are also described:—*Cladophora fluviatilis*, *C. Beneckei*, *C. clavata*, *C. elegans*, *Siphonocladus exiguus*.

Fungi.

Germination of Parasitic Fungi.†—M. M. Büsgen has studied the mode in which the germinating filament penetrates into the tissue of the host-plant in the cases of *Botrytis cinerea*, *Fusicladium pyrinum*, and several species of Peronosporeæ, Erysipheæ, and Uredineæ. There is always the closest contact between the germinating parasite and the host, either by the apex only of the former, as in the Peronosporeæ, or along its whole length, as in the Uredineæ. The hyphæ of the parasite which are in contact with the host put out swellings or "appressoria," by means of which this intimate contact is maintained, as well as by haustoria, or branches of the hyphæ which penetrate into the tissue of the host-plant. These haustoria or "infection-filaments" are not the result of contact-irritation. The appressoria have the double function of causing intimate contact between the parasite and the host, and of indicating the direction in which the infection-filaments shall be put out. In the Peronosporeæ and Uredineæ this intimate contact is assisted by spontaneous nutations; the movement of the zoospores of *Cystopus* towards the stomates appears to be partly the result of chemotropism. *Botrytis cinerea* also displays chemotropism as well as contact-irritation.

New Parasitic Fungi.—The late Dr. C. Tubeuf ‡ found *Alnus viridis* attacked by *Valsa oxystoma*, infesting the wood, and causing the leaves to fall. This fungus had previously been known only as a saprophyte.

Prof. R. Hartig § finds a hitherto undescribed parasitic fungus, probably a *Nectria*, attacking the seedlings of a number of trees, especially conifers, destroying them in the same way as *Phytophthora omnivora*. It produces sickle-shaped usually six-celled conids; and rudiments of peritheces or pycnids were observed.

* Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 118–39 (2 pls.).
† Bot. Ztg., li. (1893) 1te Abtheil., pp. 53–72 (1 pl.).
‡ Forst-naturw. Zeitschr., i. (1892) pp. 387–90 (1 pl.). See Bot. Centralbl., liii. (1893) p. 329.
§ Tom. cit., pp. 432–6 (4 figs.). See Bot. Centralbl., liii. (1893) p. 328.

The same author * observed *Septoglœum Hartigianum*, hitherto unknown as a parasite, parasitic on the maple. The only mode of propagation observed was by light-brown conids.

Herr Behrens † describes a disease of the tobacco-plant caused by the attacks of *Alternaria tenuis*, which occurs also in a conidial form, probably belonging to a *Hormodendron*.

Herr O. Kirchner ‡ describes young plants of *Cytisus capitatus* destroyed by an undescribed parasitic fungus belonging to the Hyphomycetes, which he names *Ceratophorum setosum*.

Sig. F. Cavara § finds, on the fruit of *Citrus vulgaris*, a parasitic fungus which he makes the type of a new genus *Trichoseptoria*, with the following diagnosis :—Perithecia carpophila, innato erumpentia, maculicola, trichomatibus undique fulta, membranacea; basidia nulla; sporulæ bacillares, septatæ, hyalinæ.

Chanci, a Disease of Mushrooms.‖—M. J. Costantin, who had previously described this disease, and pointed out the existence of the mycele, has now succeeded in obtaining, by means of pure cultivations, the fructification, and has thus been able to identify the parasite as a *Clitocybe* (a species closely allied to, if not identical with *C. candicans*). The appearance of dung affected by this disease is little different from that which contains the mushroom mycele. The two, however, may be distinguished by the smell. The odour from the mushroom is delicate and agreeable, but when Chanci is present it is strong, penetrating, and disagreeable.

Relationship of Calcicolous Lichens to their Substratum.¶—Sig. E. Baroni describes the structure of the thallus of the calcicolous lichens *Aspicilia calcarea*, *Lecidea fusco-atra*, and *Verrucaria rupestris*, especially in relation to the formation of the gonidial zone and of the apotheces beneath the surface of the rock on which they grow. He considers it probable that the hyphæ penetrate the rock through the agency of an acid which they secrete.

Structure of Yeast-cells.**—Herr G. Hieronymus has undertaken a series of observations on a form of *Saccharomyces*, with the view of determining the question of the presence or absence of a nucleus in the cells. He finds the contents of the cells to present a similar fibrillar structure to that in the Phycochromaceæ. The angular granules (probably nuclein) which lie in the protoplasm are always arranged in rows intertwined into a more or less regular spiral or ball, which the author calls the central thread. He regards the protoplasm as originally structureless, the definite structure being developed only as the result of the penetration of fluids into the cell from without.

* Tom. cit., pp. 289–91 (1 pl.). See Bot. Centralbl., liii. (1893) p. 181.
† Zeitschr. f. Pflanzenkrankheiten, ii. (1892) p. 327.
‡ Tom. cit., pp. 324–7.
§ Atti R. Ist. Bot. Univ. Pavia, 8 pp. and 1 pl. See Bot. Centralbl., liv. (1893) p. 26.
‖ Bull. Soc. Mycol. France, viii. (1892) pp. 153–60 (1 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 765–6. Cf. this Journal, *ante*, p. 74.
¶ Bull. Soc. Bot. Ital., 1893, pp. 136–40.
** Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 176–86 (1 pl.). Cf. this Journal, *ante*, p. 366.

Granules and Vacuoles of Yeast-cells.*—Herr J. Raum examined ten different kinds of yeasts for cell-nuclei. The yeasts used were in pure cultivations, and they were stained and fixed in different ways. He came to the conclusion that true nuclei were not present, although he found in all the species examined those peculiar bodies known as sporogenic granules. These, when stained with methylen and Bismarck-brown, become black or dark brown, and when treated with eosin or rose-Bengale and methylen-blue became dark violet. These granules are by no means invariably present, being found only when the conditions of nutrition are favourable, and are absent in badly nourished and senile forms. With regard to number, shape, and arrangement within the cell, the granules exhibit great variation, though these remain very much the same for each species. No membrane or any definite structure could be observed; hence they are probably of fluid consistence. Though their chemical composition is not yet ascertained, their digestibility by means of pepsin suggests that they are of the nature of nuclein.

The author also found that vacuoles are of frequent occurrence in yeast-cells, but are not always present; e. g. they are absent altogether in kephir yeast, and their size is in inverse ratio to that of the granules. From observations on cells while budding the author finds that neither the vacuoles nor granules are connected with this process. Nor is there any direct connection between the granules, the vacuoles, and spore-formation.

Animals, when infected with pure cultivations of yeast, suffered from fever and dyspnœa; and it was noticed that yeast-cells from internal organs behaved differently towards stains to what they did when cultivated in fluid nutrient media.

Saccharomyces.†—Prof. E. C. Hansen defends the independence of the genus *Saccharomyces* against the attacks of H. Moeller, who advocates the extension of the term. The latter declines to believe that certain forms seen within yeast cells are true spores, inasmuch as they do not possess a spore-membrane, nor have they been observed to mature into germs; and, as there is for him no morphological difference between *Ustilago* sporids and the yeasts examined by him, the genus *Saccharomyces* should be enlarged.

According to the author, not only are these forms enclosed in a membrane, but every step in their after development can be observed under the Microscope. Hence, they are really endospores; and he goes on to say that among the Blastomycetes or yeast-fungi there exists a group embracing numerous species, which differ from the rest of the Blastomycetes in the internal development of spores. This particular group has been introduced into the system under the generic appellation of *Saccharomyces*. He holds that it is better to adhere to the old name until the conjectural original form is discovered. Then will be time enough to extend the definition of genus *Saccharomyces*.

Fermentation Differences of Wine Yeasts.‡—The experiments of Herr J. Wortmann on wine yeasts from various wine districts were

* Zeitschr. f. Hygiene, x. (1891) pp. 1–50.

† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 16–9. Cf. this Journal, *ante*, p. 220.

‡ Landwirthschaftliche Jahrbücher, xxi. (1892) pp. 901–36. See Bot. Centralbl., liii. (1893) pp. 318–9.

principally intended to discover if there were any notable differences in their ferment action, and if so, whether any practical outcome were likely. Pure cultivations were made from ferments derived from various parts, and artificial must was inoculated with equal quantities at similar stages of development. The must was composed of extract of raisins to which had been added a definite quantity of tartaric acid and sugar. Erlenmayer's flasks were used as cultivating vessels, and these were exposed to the same temperature conditions throughout. Every twelve hours the quantity of carbonic acid was estimated from the loss of weight, and at the end of fermentation the total quantity of alcohol and glycerin was determined.

When the results were tabulated it was seen that the duration of fermentation varied according to the particular yeast from 17–32 days. The differences in the amount of carbonic acid formed were very slight, the maximum formation being attained in from two to three days. With regard to the quantity of alcohol produced by various yeasts, similar differences were observed, while those yeasts which had the shortest fermentation period produced the smallest amount of alcohol, and *vice versa.* Differences in the amount of glycerin formed conclusively indicate the specific differences of the yeasts used.

Control experiments with natural must were made, the rest of the experimental conditions being the same, and quite analogous results were obtained. The author concludes from his experiments that the number of races or kinds of *Saccharomyces ellipsoideus* is so great as not to be computable.

Influence of Parasitic Uredineæ on the Host-plant.*—Herr K. Fentzling describes the changes effected in a number of host-plants by parasites belonging to the genera *Uromyces*, *Puccinia*, *Gymnosporangium*, &c. The extent of the deformations are, in general, in proportion to the early period in life at which the host-plant is attacked. In external habit the effects are seen in the diminished height and branching, the smaller amount and size, but greater thickness of the leaves, the feebler development of wood, and the shorter life. In the leaves the epidermal cells are usually longer, intercellular spaces appear in the palisade-parenchyme, the spongy parenchyme increases in size, the cells becoming larger and more numerous, with intercellular spaces between them. In the stem the epidermal cells become longer, those of the cortical parenchyme increase in number and size, there is a feebler development of wood, while the number of cells in the pith is larger.

Heterœcious Uredineæ.—Herr H. Klebahn † records the following observations on the life-history of various Uredineæ.

Gymnosporangium confusum occurs on *Juniperus Sabina*, and is genetically connected with an æcidio-form on *Cratægus oxyacantha.* Two species of *Gymnosporangium* are therefore parasitic on *J. Sabina.*

Two new species of *Peridermium* are described, *P. Stahlii* and *P. Plowrightii.* From the former uredoforms were obtained on *Alectoro-*

* 'Morph. u. anatom. Unters. d. Veränderungen welche bei einigen Pflanzen durch Rostpilze hervorgerufen werden,' Freiburg-i.-B., 1892, 52 pp. See Bot. Centralbl., 1893, Beih., p. 83. Cf. this Journal, *ante*, p. 364.

† Zeitschr. f. Pflanzenkrankheiten, ii. (1892) pp. 94–5, 258–75, 332–43.

lophus and on *Melampyrum pratense*, and it appears to be connected genetically with *Coleosporium Euphrasiæ*. The latter is connected in the same way with *Coleosporium Tussilaginis*.

It has been long known that, while the æcidiospores of *Peridermium Strobi* and *Cronartium ribicola* germinate freely on almost all species of *Ribes*, *R. Grossularia* is exempt from their attacks. The author states that this immunity ceases if the gooseberry is grafted on *Ribes aureum*.

The æcidium of *Euphorbia Esula* belongs, like that of *E. Cyparissias*, to a uredo- and teleuto-spore form parasitic on *Pisum sativum*.

Puccinia sylvatica, connected with *Æcidium Taraxaci*, was found on *Carex arenaria*. *P. Phragmitis* is connected with an æcidium on *Rumex crispus*, and *P. Magnusiana* with one on *Ranunculus repens*. *Puccinia coronata*, on *Lolium perenne*, is connected, not with *Æcidium Grossulariæ*, but with *Æ. Rhamni*. Under the name *P. coronata* two species appear to be confounded, both growing on various species of grass. The æcidiospores of *Æcidium Convallariæ* give rise, on *Phalaris arundinacea*, to the uredo- and teleuto-spore forms of *Puccinia Digraphidis*.

Herr P. Magnus * gives further particulars respecting the occurrence and parasitism of the four European species of *Gymnosporangium*, viz. *G. fuscum*, *juniperinum*, *clavariæforme*, and *confusum*.

In another communication † Herr Magnus contributes additional information on the species of *Uromyces* and *Æcidium* found on *Euphorbia*, on the genetic relationship between the various species of *Cæoma* and *Melampsora*, and on *Peronospora Cytisi*.

Development of the Spermogone of Cæoma.‡—Mr. H. M. Richards describes in detail the structure and development of the spermogone of *Cæoma nitens* on *Rubus villosus*. It originates, in the first place, as an outgrowth between and not within the epidermal cells of the host-plant, but soon breaks through and absorbs the confining walls, and makes its way into the cavities of the surrounding cells. It is more superficial than the spermogone of most other Uredineæ.

Anthracnoses of the Solanaceæ.§—Prof. B. D. Halsted states that on each of the three cultivated species of Solanaceæ, the tomato, the pepper (*Capsicum*), and the egg-plant, there is found a species of *Glœosporium* and a species of *Coleotrichum*, to which different specific names have been given. By culture experiments he has determined that the three species of *Glœosporium* have no structural differences, and that they are all identical with the bitter-rot of the apple *Glœosporium fructigenum*. It is also probable that all the three species of *Coleotrichum* are forms of *C. Lindemuthi*.

Monilia fructigena.‖—Prof. J. E. Humphrey has investigated the life-history of this fungus, which causes mummifying of the fruits of Drupaceæ and Pomeæ, and states that the chains of so-called spores are not true conids, but chlamydospores or oïdiospores of the most primitive type. There are, however, true conids produced on sporophores. It is

* Verhandl. Bot. Ver. Prov. Brandenburg, 1893, pp. xiv.–xvi.
† Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 43–53 and 212 (1 pl.).
‡ Proc. Amer. Acad. Arts and Sciences, 1893, pp. 31–6 (1 pl.).
§ Bull. Torrey Bot. Club, xx. (1893) pp. 109–12.
‖ Bot. Gazette, xviii. (1893) pp. 85–93 (1 pl.).

probable that the fungus is the persistent chlamydosporic and microconidial stages of a *Sclerotinia* allied to *S. Vaccinii*, the perfect stage of which has been partially or entirely suppressed.

Phyllogaster, a new Genus of Phalloideæ.—Under the name *Phyllogaster saccatus*, Mr. A. P. Morgan * describes the type of a new genus of Phalloideæ, with the following diagnosis:—Mycele fibrous, much branched; peridium obovoid, consisting of two concrete layers, an inner and an outer one, rupturing irregularly; glebe composed of numerous roundish irregular masses or lobes of a green colour, attached to the inner surface of the upper part of the peridium; spores minute, oblong, hyaline. The genus constitutes a bond of connection between the Phalloideæ and the Lycoperdaceæ.

Mr. R. Thaxter † gives a detailed description of the same species; and, from the absence of any volva or receptacle differentiated as such in the mature condition, suggests the establishment of a third subdivision of the Phalloideæ, to be termed PHYLLOGASTREÆ. He proposes some modifications in the generic diagnosis, especially from the fact that the peridium consists only of a single layer covered by an evanescent cortex, and coarsely reticulated through the presence of numerous irregular thin areas, which become perforate at maturity. Its nearest affinities are with the Clathreæ.

Luminosity of Pleurotus olearius.‡—A fresh series of observations by Prof. G. Arcangeli confirms him in his previous statement that the phosphorescence of this fungus, though most strongly displayed in the laminæ, is not confined to the receptacle. It is accompanied by an elevation of temperature amounting to from 0·7–1·1°, and is the result of respiration. Its function is probably to assist in the dissemination of the spores by attracting nocturnal animals.

Myxomycetes.

Labyrinthuleæ.§—Prof. W. Zopf has studied the structure of this little-known group of Mycetozoa, and adds one species, *Labyrinthula Cienkowskii*, to the two previously described by Cienkowski.

The species described carries on a partly saprophytic, partly parasitic existence on freshwater *Vaucheriæ*. The vegetative structure is composed of amœbiform bodies coalescing with one another by means of pseudopodes, which are continually extruded and retracted. These pseudopodes pierce the wall of the alga-filament, and the amœbiform structures form a network within it. They consist of granular colourless protoplasm, and contain a nucleus and a vacuole. The formation of the fructification is preceded by a contraction of the pseudopodes, and occurs both outside the alga and in its vegetative and fertile branches. The amœbiform structures become quiescent, round themselves off, invest themselves with a membrane, and pass into the spore-condition. The germination of the spores was not observed.

* Journ. Cincinnati Soc. Nat. Hist., xv. (1893) pp. 171–2 (1 pl.).
† Bot. Gazette, xviii. (1893) pp. 117–21 (1 pl.).
‡ Atti R. Accad. Lincei, vi. (1890) pp. 197–214. Cf. this Journal, 1889, p. 426.
§ Beitr. z. Phys. u. Morph. niederer Organismen (Zopf), Heft 2, pp. 36–48 (2 pls.) 1892.

With regard to the systematic position of the Labyrinthuleæ, Zopf divides the highest order of the Mycetozoa, the Sorophoreæ, into two sub-orders, the Acrasieæ and the Labyrinthuleæ. The former are characterized by having pseudoplasmodes, and by the sori being capitate, naked, and either stalked or sessile; they live on dead parts of plants, dung, fungi, &c., and are divided into two families, the Guttulineæ and the Dictyostelieæ. The Labyrinthuleæ have filiform plasmodes; the sori are naked or imbedded in solid hyaloplasm, and sessile. They are partly saprophytic, inhabiting dung or salt or fresh water, partly parasitic, and comprise only the two genera *Labyrinthula* and *Diplophrys*.

Protophyta.

α. Schizophyceæ.

Lyngbyeæ.*—M. M. Gomont now gives a monograph of the second tribe of the Oscillatoriaceæ, the Lyngbyeæ, distinguished by the sheath, when present, enclosing only a single trichome. They are divided into two sections, according as the trichome is septated or not. The first section is again divided into two sub-tribes,—Lyngbyoideæ in which the filament is simple or pseudo-ramose, the sheath firm, sometimes dusky yellow, the trichome always straight at the apex (*Plectonema* 8 species, *Symploca* 11 species, and *Lyngbya* 21 species, including *Leibleinia*); and Oscillarioideæ, in which the filament is simple, the sheath thin, always hyaline, mucous, more or less diffluent, apparently wanting in some species, the trichome often curved at the apex (*Phormidium* 29 species, *Trichodesmium* 3 species, *Borzia* 1 species, *Oscillatoria* 38 species, and *Arthrospira* 3 species). The second section consists of the sub-tribe Spirulinoideæ, characterized by the trichome being twisted into a regular spiral, and of the single genus *Spirulina* 9 species. The following new species are described:— *Plectonema purpureum*, *Symploca atlantica*, *S. læte-viridis*, *Lyngbya Rivulariarum*, *Phormidium Crouani*, *P. Setchellianum*, *Oscillatoria Aghardii*, *O. simplicissima*, *O. acuminata*, *O. numidica*, *Spirulina Nordstedtii*.

New Genera of Schizophyceæ.†—Among a number of Freshwater Algæ obtained from Algeria, M. C. Sauvageau describes several new species, and the following new genera of Schizophyceæ:— *Synechocystis*, nearly allied to *Synechococcus*, but with perfectly globular cells; *Tapinothrix*, with the following diagnosis,—Filaments without heterocysts, very slender, simple, attenuated from a slightly thickened base, not produced at the apex into an articulated hair; sheath slender, very narrow, continuous, usually open above from the escape of hormogones; near *Schizothrix* and *Amphithrix*.

Biology of Diatoms.‡—Dr. P. Miquel discusses in detail the various modes in which diatoms multiply. The diminution in the size of diatoms is not in exact proportion to the number of bipartitions, which is retarded by the constant decrease in the thickness of the connectives.

* Ann. Sci. Nat. (Bot.), xvi. (1892) pp. 91–256 (7 pls.). Cf. this Journal, 1892, p. 838.

† Bull. Soc. Bot. France, xxxix. (1892) Sess. Extraord., pp. civ.–cxxviii. (1 pl.).

‡ Ann. de Micrographie, iv. (1892) pp. 529–58 (9 figs.). Cf. this Journal, 1892, p. 655.

Möller's law with regard to the multiplication of the frustules, which prevails in *Melosira*, is certainly not true of all diatoms. In artificial cultures the propagation by means of auxospores can readily be followed out in many species of diatom, both filamentous and solitary. The restoration of form takes place habitually without the production of spores or sporanges. The protoplasm of the microfrustules escapes from the valves, and, at first enclosed in a membrane of cellulose, assumes first of all an irregular form, which gradually approaches that of the normal megafrustules. These primordial megafrustules acquire their regularity by bipartitions which immediately begin to take place in them. Whether the microfrustules are fertilized before germination must remain at present undecided.

β. Schizomycetes.

Effect of High Temperatures on Tubercle Bacilli.*—Drs. Forster and Bonhoff, though working quite independently, have examined the effect of temperatures below boiling point on tubercle bacilli. In Forster's experiments the temperatures ranged between 40° and 95°, and Bonhoff's from 50° to 80°. The object of the former was to ascertain if the pasteurization of milk effectively destroyed tubercle bacilli contained therein.

Both authors inoculated guinea-pigs in the peritoneal sac to demonstrate presence of living tubercle bacilli. Forster employed tuberculosis milk of cows, crushed tubercle and tuberculous sputum, while Bonhoff used pure cultivation of tubercle bacilli in calf's lung broth with 4 per cent. of glycerin. On this medium the growth was extremely luxuriant in 10–14 days. Forster heated the tuberculous fluids enclosed in capillary tubes on a water-bath; Bonhoff simply heated the pure cultivations in a water-bath.

The results of both authors are pretty well in accord. According to Forster, tubercle bacilli are killed when heated from 45–60 minutes at 60°, according to Bonhoff it only takes 20 minutes. At 70° they die in 5–10 minutes, while at 50° this result is not attained in 12 hours.

Bonhoff noticed that the inguinal glands of animals which had been injected with cultures heated for 20 minutes at 60° underwent a slight enlargement.

Origin and Presence of Alexins in the Organism.†—In an interesting and speculative paper Mr. E. H. Hankin suggests that the source of alexins, those substances which are the cause of the bactericidal power of the blood-plasma, is to be found in the eosinophilous granules in certain leucocytes. The hypothesis assumes a germicidal property existing in white corpuscles and blood-plasma, and the presence of special proteid substances, and endeavours to reconcile the opposing theories of Phagocytosis and Humoralism by showing that alexins are secretions from and by leucocytes.

What are those bright highly refracting granules with greenish reflex and a love for eosin? They are the source from which the defen-

* Hygien. Rundschau, ii. (1892) pp. 869 and 1009. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 293–4.

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 777–83, 809–24 (6 figs.).

sive proteids are drawn. They are the mother substances, in fact, of the alexins. Experiments to show the diminution in the number of these granules in the leucocytes following on an increase in the bactericidal power of the blood, and others to demonstrate that this germicidal action was greater before than after the excretion, would be required by the necessities of the case. Two series of such experiments are given in copious detail, and the conclusions arrived at are stated by the author to be simple but not altogether new. The cells of the body are able to resist the entrance of micro-organisms into the body in virtue of their phagocytic property, but there are other cells, "alexocysts," distinguished by the presence of eosinophilous granules, which secrete germicidal substances. Hence the eosinophilous leucocyte is a sort of wandering gland, and is comparable to the cells in the gastric mucosa, which secrete and excrete pepsin, so that the eosinophilous granules have their analogue in the zymogenic granules.

Mucoid Change in Infusions.*—It is well known that many infusions are prone to become viscid, to throw down a deposit, or to evince some other form of deterioration. According to Herr E. Ritsert, the mucoid change is not associated with a degeneration of the leaves employed, but is set up by micro-organisms present in the air or in the water used to make the infusions. Microscopical examination showed the presence of moulds, yeasts, and bacteria; from all of these cultivations were made in Digitalis infusion, and in the course of a few days it was found that bacilli had induced a viscosity, while other organisms were merely responsible for cloudiness, decoloration, or acidity. This observation was confirmed by obtaining pure cultivations through gelatin plates and inoculating infusions.

From the behaviour of the organism on various cultivation media whereon it was found to exhibit marked polymorphism, e.g. long filaments, rods like anthrax, typical streptococci and other coccus arrangements, the author calls it *Bacterium gummosum.*

The rod-like shape appeared in agar cultivations, and if these were kept at 20°–25°, endogenous oval spores were formed. By Gram's method the bacilli were unstained, but the spores retained the colour. When transferred to potato the cultivations at first resembled those of anthrax, but after a few days diplococci became predominant. The streptococcus form appeared in cultivations made in cane-sugar diluted with 1 per cent. acetate of potash.

B. gummosum is strongly aerobic, and its growth and form seem to depend largely on the composition and reaction of the nutrient medium. Thus alkaline gelatin is liquefied, and liquefaction is promoted if the plates do not contain too much gelatin, while an acid reaction and a high percentage of gelatin retard or prevent the liquefaction.

Efficiency of Disinfectants at High Temperatures.†—Dr. A. Heider finds that the disinfecting power of most disinfectants materially increases when they are used at a high temperature, and therefore all disinfectants

* Ber. Pharmaceut. Gesell., l. (1891) pp. 389–99. See Bot. Centralbl., 1892, Beih., p. 510.

† Arch. f. Hygiene, xv. pp. 341–86. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 292–3.

should be used hot. Certainly where it is a question of destroying spores, cold fluids should be replaced by hot, and indeed by boiling hot ones. Hot solutions are not only safer and shorter in their action, but are more economical, as so much of the disinfectant is not required.

For the disinfection of clothes the author states that the best procedure is to place the linen, &c., for six hours in a 1 per cent. of lysol, then boil for half an hour, and afterwards wash in the ordinary way. Lysol was found to be the best and safest disinfectant.

Escape of Bacteria with the Secretions.*—The experiments made by Prof. C. S. Sherrington as to the method of escape of bacteria from the circulation were made on mice, rabbits, and guinea-pigs which were inoculated with pure cultivations of various micro-organisms, e.g. *B. anthracis*, *B. mallei*, *B. tuberculosis*, *B. cuniculicida*, *Sp. choleræ asiaticæ*, *St. pyogenes aureus*, and others, injected intravenously or subcutaneously. The urine, bile, and sometimes aqueous humour were afterwards examined. Taken in the aggregate the experiment showed that bacteria were sometimes present in the secretions and sometimes absent; that the presence in the secretions was to be associated with a more or less damaged condition of the secreting membranes, for these when healthy appear to be impassable to bacteria.

These results seem to hold true more especially for pathogenic organisms, as these invariably appear in the secretion after a time, and their appearance is usually, though not invariably, accompanied by an escape of blood. Even if no actual blood can be detected these secreta may contain proteid when bacteria are present.

The fact that animal membranes are permeable to the non-motile as well as to motile bacteria rather suggests that their outward passage is a passive transference than an active migration.

Bactericidal Power of the Blood.†—The contribution of Dr. A. Bastin to the knowledge of the bactericidal power of the blood is essentially on the lines previously traversed by Nissen, who examined the bactericidal influence from intravenous injections of microbic emulsions. In all his experiments the author used *St. pyogenes aureus*, and dogs were the animals experimented with. Though the method of the first part was the method of Nissen the results were diametrically opposite. The author found that after the intravenous injection of considerable quantities of microbic emulsion, the bactericidal influence was abolished or at any rate considerably diminished, and that this effect was due to the action of the toxins. The difference between the results of the two observers is possibly due to the fact that Nissen supposed the toxin to be alkaloid in nature and therefore soluble in water, whereas the author assumes the toxin to be albuminous. The natural inference that there is some relation between the dose injected and the diminution in the bactericidal power was corroborated by the experiments, and these also showed that the abolition and restoration of the functions were alike very rapid.

When the bactericidal action was abolished for one microbe it was abolished for all others. After this the author enters upon the second

* Journ. Pathol. and Bacteriol., iii. (1893) pp. 258–78.
† La Cellule, viii. (1892) pp. 383–417. Cf. this Journal, *ante*, p. 372.

part of his task. In this the idea was to ascertain the bactericidal condition of the blood at different stages of infection, and especially at the moment when from being local the infection was becoming general. For this purpose local injections, e. g. into the pleural sac and into subcutaneous tissue, were made with bacillus of malignant œdema, *Bacillus aerogenes*, and *St. pyogenes aureus*. It was found that from being local the infection soon became general, and that under these circumstances the bactericidal influence was either abolished or much diminished. Secondly, that the degree of the diminution was in direct proportion to the intensity of the infection; and thirdly, that the appearance of living organisms in the blood appears to coincide with a diminution in the bactericidal influence.

Flies and the Transmission of Cholera.*—During the epidemic at Hamburg, Dr. N. Simmonds examined flies captured in the post-mortem room at the time the bodies were open. In these numerous comma-bacilli could be demonstrated. When the autopsies were over and the room washed up, the cholera bacilli were not found. In order to ascertain how long the cholera germ could be retained in flying insects, further experiments were carried on. It was found that they disappear in an hour and a half, a time sufficiently long to render their transmission to a considerable distance possible.

Sphærotilus roseus, a new red aquatic Schizomycete.†—Prof. W. Zopf found in the outfall of a sugar-refinery a new red Schizomycete belonging to the Cladotricheæ, to which he has given the name *Sphærotilus roseus*, constantly associated with two other fungi. It forms long delicate filaments which coalesce into mucous strings, and these run into longer or smaller flakes which he found clinging to dead vegetable and animal matter. The filaments branch and exhibit a delicate sheath. They are composed of elongated cells of small diameter ($0 \cdot 7$–1 μ), which apparently possess the power of swarming, and like other species of *Cladothrix* may eventually split up into small segments. The red pigment is located in the cell contents. It can be extracted with alcohol, but strips of paper soaked with the red solution lose their colour on exposure to the daylight. The red constituent is soluble in ether, chloroform, petroleum-ether, benzol, &c., and the author thinks that he has isolated it by saponifying the alcoholic solution and treating it with petroleum-ether (a yellow non-crystallizing material). With sulphuric acid the colour becomes blue, and the spectrum of the solution exhibits two bands.

Saccharobacillus Pastorianus.‡—Herr H. van Laer has studied the micro-organism, first described by Pasteur in his 'Études sur la Bière,' called *Saccharobacillus Pastorianus*. Its specific action is the turning of beer, which becomes mothery and acquires a disagreeable odour and taste. The organism did not get on well when cultivated on meat-water-gelatin, and very poorly on wort-gelatin, though if a little alcohol were added after liquefaction at 30° it did better, and similar results were

* Deutsch. Med. Wochenschr., 1892, No. 41. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 237–8. Cf. this Journal, *ante*, p. 376.

† Beitr. z. Morph. u. Phys. niederer Organismen (Zopf), Heft ii. (1892) pp. 32–5.

‡ Zeitschr. f. gesammte Brauwesen, xv. (1892) pp. 340 *et seq.* See Bot. Centralbl., lii. (1892) pp. 330–1.

obtained from pasteurized beer-gelatin. Yet on neither of these media did this organism thrive like yeast or other beer bacteria, the growth being only slow and the colonies of small size.

Inoculations on fish-water-gelatin, milk-gelatin, wort-agar, and potato, failed to take. In mineral nutritive solutions the growth was very poor. Infection experiments showed distinctly that *Saccharobacillus Pastorianus* is the actual and efficient cause of the souring of beer; on unhopped beer the schizomycete grows better than on beer. The microbe is an acid-former, it decomposes carbohydrates, ferments cane-sugar, without previous inversion, into lactic acid, acetic acid, and alcohol. It also forms small quantities of formic acid and its homologues and homologues of ethyl-alcohol.

The relative quantity of the fixed and volatile acids appears to depend on the composition of the nutrient medium.

Saccharobacillus Pastorianus lives in the presence and absence of air. Ten minutes' exposure to a temperature of 55°–60° C. suffices to sterilize a slightly acid beer wort which has not been hopped and has been infected with the bacillus.

Hereditary Transmission of Immunity to Rabies.*—Prof. G. Tizzoni and Dr. Eug. Centanni record experiments made on three different litters with virus of rabies. Only the fathers were immunized, two to fixed virus, the third to street virus. The mothers were unprotected, although all three were vaccinated to tetanus.

The authors conclude from these experiments, (1) that the father can transmit through the semen immunity to rabies; (2) the transmission does not require any special properties in the mother; (3) it is transmitted to all children alike; (4) it is less than that possessed by the father; (5) the immunity transmitted through the semen is more lasting than that acquired through the blood or milk.

The authors go on to say that these experiments of theirs are in agreement with our present embryological knowledge, according to which the head of the spermatozoon, as male pronucleus, becomes fused with the female pronucleus of the ovule at the time of fertilization. Consequently, each new element which arises from the fission of the fertilized ovum must always possess a share, both of the maternal and paternal plasma, and of the properties inherent in them. With regard to the practical importance of these experiments, it is suggested that by carefully selecting dogs which have acquired immunity to rabies, this disease might eventually be extirpated.

Chemotaxis of Leucocytes and Immunity.†—M. J. Massart found that when virulent cultivations were enclosed in capillary glass tubes, and inserted in the abdominal cavity, the less virulent possessed a stronger chemotactic action than the more virulent of the same species. Fowl-cholera, *V. Metschnikovi*, hog-cholera, *Bac. pyocyaneus*, diphtheria, were used for these experiments, and the cultivations were both fresh and sterilized. The same results were obtained when virulent cultivations were diluted. No conclusion could be drawn as to the virulence of a cultivation from the strength of its harmful influence on leucocytes, and

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 81–7.
† Ann. Inst. Pasteur, 1892, p. 321.

the most important deduction is that the chemotactic substances in cultivations are not identical with the toxines.

Structure and Spore-formation of Green Tadpole Bacilli.*—Dr. J. Frenzel reports on a bacillus which he observed in the end-gut of larvæ of Anura, especially if these were in bad condition; he then describes their morphological characters, and discusses the central body which in this large bacterium offers favourable opportunity for satisfactory study. The view maintained by Bütschli that the central body is to be regarded as the nucleus is confirmed. Spore-formation, which shows many peculiarities, is thoroughly described. The spores arise endogenously, as nucleoid forms in the central body; amitotic division is the usual course; but it is not unfrequent to find two spores without observing a division into two cells. The finer structural relations of the plasma and of the membrane are also discussed, and a peculiar filamentous body is described; this is found in bacilli containing spores, but at the opposite extremity; its signification is quite unknown.

Variability of Cholera Bacilli.†—Prof. Finkelnburg compared cholera vibrios obtained from different sources,—Paris and Hamburg epidemics and laboratory cultivations which originally were derived from India and from the outbreak at Genoa in 1884, for the purpose of ascertaining if there were any differences in the rapidity of their growth on gelatin plates: at what time liquefaction occurred in puncture cultivations; what influence low temperatures had on their growth and viability; whether lactose were fermented, milk coagulated, and cholera red formed; how far they were dependent on the free access of oxygen; their action on red corpuscles, and the slight differences of shape. Only slight differences were found between the Parisian and Hamburg bacilli as regards rapidity of growth, while both were more resistant to lower temperatures and to the absence of oxygen than laboratory vibrios. They possessed, besides, greater power of inducing acid fermentation of lactose; they were more poisonous to red corpuscles, and showed a greater tendency to form spirilla than the older species, which were also thinner and less prone to central bulgings.

Bacteriology of Swine-plague.‡—The bacteriological researches of Dr. B. Bang on swine-plague in Denmark date back to 1887, when the author isolated a bacterium pathogenic to mice and rabbits and fatal to a sucking pig in four days. This micro-organism grew very well on the usual substrata, and the cultures showed their identity with the American hog-cholera. The disease was at first very virulent, no less than 600 to 700 dying in a few weeks in one district. Later the disease became chronic and less virulent, so that only a comparatively small number of pigs died, though profound and extensive diphtheritic processes were found in the intestine. Often too a characteristic pneumonia was met with, the hepatized portions being firm and white, a yellowish demarcation line showing that the inflammation had ended in necrosis. No definite result was at first obtained from the examina-

* Zeitschr. f. Hygiene, xi. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 239.

† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 113–7.

‡ Maanedskrift for Dyrlaeger, iv. (1892–3) p. 194. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 203–5.

tion of this chronic form, but afterwards the author was able to confirm the results of Salmon and Smith. Inoculations from the organs, especially the diseased intestines and mesenteric glands, disclosed a bacterium resembling that of 1887, but which was not pathogenic to mice or rabbits. It became evident from feeding pigs that it was a less virulent variety of swine-plague. The pigs sickened, and if killed after nine days croupous inflammation of intestines was found; if killed later, small wounds and scars, close to the croupous membranes. When mice and rabbits were inoculated from pigs which were sick or dead of swine-plague, they usually died, but the swine plague bacterium was not found; but in the exudation from serous membranes, in the blood and in the spleen, a bacterium, called by the author "Vakuolebacillus," was present. In the blood these bacilli showed as oval corpuscles, the poles only staining. In the exudation from serous membranes they were seen as plump little bodies, at one end of which was a vesicle. Experiments with the vacuole bacillus showed that its pathogenic action set up a fatal pleuro-pneumonia, but there was no affection of the intestinal tract. The vacuole bacillus is therefore undoubtedly identical with the swine-plague bacillus of Salmon and Smith, and certain forms of swine-plague are to be regarded as cases of mixed infection; that is to say, hog-cholera and swine-plague may be simultaneously present in the same animal. Besides the specific organism of swine-plague another micro-organism, the necrosis bacillus, is very constant in the chronic form of this disease. It would appear that this exists in the intestine of healthy swine, but after the intestinal wall is weakened by the croupous inflammation it invades the deeper lying parts, producing there profound necrotic processes. The author maintains that, (1) swine-plague is caused by a specific micro-organism; (2) the pneumonias occurring in the chronic form of this disease are set up by another bacterium which apparently inhabits the nasal secretion of healthy pigs; (3) the profound necrotic changes in the intestinal canal, as well as the necrotic foci in the pneumonic lungs, are due to the invasion of the necrosis bacillus.

Pathogenic Action of Bacillus lactis.*—MM. R. Wurtz and R. Leudet, during some experiments relative to the pathogenic action of *Bacillus lactis*, established the fact that the characteristic claimed by Escherich as being distinctive of *B. lactis aerogenes*—fermentation in absence of air—was shared by *Bacillus lactis*. The two bacilli were therefore possibly identical. Guinea-pigs and rabbits inoculated with this bacillus died in a short time from severe diarrhœa with emaciation. On post mortem examination, well-marked ulcerative gastro-enteritis was discovered. The same, though less severe, changes were produced by the injection of sterilized cultivations. The toxic action appears to be dependent on the presence of proteids in the nutrient media, as bacilli cultivated on non-albuminous media exerted a much less pathogenic action, and this action is much diminished by heating. The toxin was not isolated. Cultivations in peptonized bouillon or alkaline pepton-solutions always became strongly alkaline, ammonia and other fœtid substances being formed. The indol reaction was negative.

* Arch. Méd. Exp. et d'Anat. Pathol., iii. No. 4. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 275–6.

Tuberculosis and Leprosy.*—Dr. B. Rake records some experiments which seem to settle the long disputed question whether certain pathological lesions and morbid products found in cases of leprosy are tuberculous or leprous. Guinea-pigs were inoculated with pulmonary tubercles from three cases of mixed leprosy. The usual appearances of guinea-pig tuberculosis were found. Cover-glass preparations showed bacilli indistinguishable from tubercle bacilli. Cultivations in glycerin-agar failed.

As attempts to inoculate guinea-pigs with leprosy have always failed, it seems justifiable to conclude that the guinea-pigs became tuberculous from the infection derived from the pulmonary tubercles of the lepers.

The author points out that the present position as to the relation of leprosy to tuberculosis is as follows:—Inoculation experiments have shown that the visceral nodules in lepers are tuberculous and not leprous. It is quite possible that leprosy and tuberculosis may be caused by the same bacillus, but this has not yet been proved.

Morphology and Biology of the Tubercle Bacillus.†—According to Dr. F. Fischel the exciting cause of tuberculosis is a pleomorphous and variable micro-organism. The author bases his proposition partly on the observations of Metschnikoff and Mafucci, and partly on his own. He succeeded in demonstrating in the marginal zones of tubercle cultivations on agar and serum at 40°, long filaments, which were usually vertical, though occasionally short branches going off at an acute angle were observed. Occasionally forked and felt-like appearances were observed. In some cultivations of fowl-tubercle the author found drumstick-like forms, the pyriform expansions of which contained small, bright, round or oval forms, somewhat resembling anthrax spores, and these possibly are the representatives of gonidia.

The form of the bacillus was found to be considerably influenced by the composition of the cultivation medium, e. g. blood-serum, agar, &c., containing different amounts of pepton, and charged with boric acid and thymol.

Bacillus of Influenza.‡—Dr. L. Letzerich has constantly found in the blood of influenza patients very small free bacilli, which stained with hot methyl-violet, showing a tendency to red with darkly stained ends. Only potato cultivations succeeded. The author convinced himself that these bacilli were identical with those described by Pfeiffer and Canon. The number of bacilli found in the blood at the beginning of the disease is very great, but they gradually diminish as the disease passes away, and at the same time always stain more faintly.

Bacterium pyogenes and B. coli commune.§—Dr. Th. Reblaud, in the course of examinations of a case of cystitis, was struck with the resemblance exhibited by the micro-organisms so frequently found in infected urine, and so carefully studied by Clado, Halle, and Albarran,

* Lancet, i. (1893) pp. 719–20.

† Fortschr. d. Med., x. No. 22. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 124–5.

‡ Zeitschr. f. Klin. Med., xx. No. 3. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 284–5.

§ Bull. Med., 1891, p. 1180. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 285.

to *B. coli*. Comparative researches confirmed the identity of the micro-organisms. Cultivation differences were referred to the influence of the natural nutrient medium.

Parasites of Typhus Fever.*—Prof. S. W. Lewascheff availed himself of the presence of an epidemic of typhus fever at Kasan to examine blood from the finger and from the spleen. Under a magnification of 2000–2500 small highly refracting cocci in active movement can be seen mixed up with the red discs. The motion is imparted by a long, thin, slightly curved flagellum or tail. The illustrations show red discs, tailed and tailless cocci. The former resemble spermatozoa in appearance, and their length is about the diameter of a red disc. Cultivations in serum hominis with 1 per cent. agar at 36°–37° were successful, but not under other conditions. The cocci developed only at the lower part of the puncture, and were therefore anaerobes. Under the Microscope the cocci thus bred were for the most part without a tail, with a green reflex, usually single, but occasionally in pairs, or even in chains. In young cultures the flagellated cocci, if transferred to bouillon in physiological NaCl solution, are extremely mobile. They are stained by Loeffler's method, and with phenol-fuchsin.

The quantity of these microbes (*Micrococcus exanthematicus*) circulating in the blood appears to increase with the progress of the disease. Before the crisis involution forms appear. *M. exanthematicus* is very difficult to stain, as the reagents seem to destroy it. Preparations treated with 2–3 per cent. osmic acid succeeded best.

Streptococcus isolated from Scarlatina-blood.†—MM. D'Espine and de Marignac isolated a microbe from the blood of a patient who was attacked with "surgical scarlet fever" after an operation on the leg. The disease ran its usual course, followed by typical desquamation, and the wound healed quickly. The authors compare this streptococcus with ten others isolated from cases of erysipelas, abscess, diphtheria, pleuritis, broncho-pneumonia, angina catarrhalis, and healthy saliva.

The three last belong to the group *Streptococcus brevis*; the rest are long streptococci. The authors are, however, disinclined to draw a sharp line of demarcation between the two groups, though they succeeded in differentiating the scarlatina cocci from other cocci. They took no account of the degree of virulence, but laid most stress on cultural characters, which on the whole accord with those of the scarlet fever coccus described by Klein. On blood-serum chain-formation is less marked, the cocci are smaller, $0 \cdot 7\ \mu$, and never bisected as in *Str. longus*. On bouillon the scarlatina *Streptococcus* behaves like *Str. longus*; yet even in this case the individual joints are small, round, and the chains greatly contorted. On potato it forms long, twisted chains, without there being any naked-eye evidence of growth. Involution forms are common. Milk is coagulated in 2–3 days with acid-formation.

On gelatin the growth has no special characters. The authors do not suggest any special connection with scarlet fever.

* Wratsch, 1892, Nos. 11 and 17. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 728–9 (1 fig.).

† Arch. de Méd. Exp., 1892, No. 4. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 762–3.

MICROSCOPY.

Handbook of Microscopy.*—It would be almost impossible to put into a smaller compass the instructions needed by beginners in Microscopy than we find them to be presented in the pages of this book. But efficiency has not been sacrificed to brevity. The field covered is greatly narrowed by the wise omission from so purely elementary a treatise of the history and evolution of the Microscope, and of all attempts to epitomize the optical principles on which the instrument is built. The book introduces the amateur to his Microscope in a simple form, and explains competently, but in few words, the nature and use of apparatus. The plain and at the same time very practical and modern instructions given (pp. 50–6) on centering and illuminating with substage condenser will be welcome to many a tyro, and will prevent much needless waste of time. If the portion of this small volume devoted to the nature and use of the instrument be read with care by any one of ordinary intelligence, the initial work involved in the use of the Microscope will be done with far less trouble and disappointment than is usually the case.

Nor is the feature of absolute utility a whit less lost sight of by Mr. Cole in the second part of the volume. Every line has its value, and he will have but little ingenuity and perseverance who will work honestly with this book before him and not succeed in making fair microscopic preparations and mounts in a short time.

We cannot unconditionally subscribe to all that is laid down in this book; but the divergencies have no great moment in anything appertaining to the work of the beginner; and even when we differ, and our differences are carried over to higher power work, we feel assured that the judgment of the authors is a judgment and not a mere opinion, and is therefore deserving of respect.

This book will have the success it deserves.

α. Instruments, Accessories, &c.†

(1) Stands.

Reichert's Travelling Microscope.‡—In this Microscope, shown in fig. 60, the coarse-adjustment is by sliding in a socket, and the fine by a micrometer screw. It is very solidly built, can be put together very easily and occupies a very small space. It is provided with diaphragm and mirror, plane and concave.

* 'Modern Microscopy. A handbook for beginners, in two parts. 1. The Microscope, with instructions for its use by M. I. Cross. 2. Microscopical Objects: how prepared and mounted, by Martin J. Cole.' Ballière, Tindall, & Cox, London, 1893.

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

‡ Reichert's Catalogue No. 18 (1892).

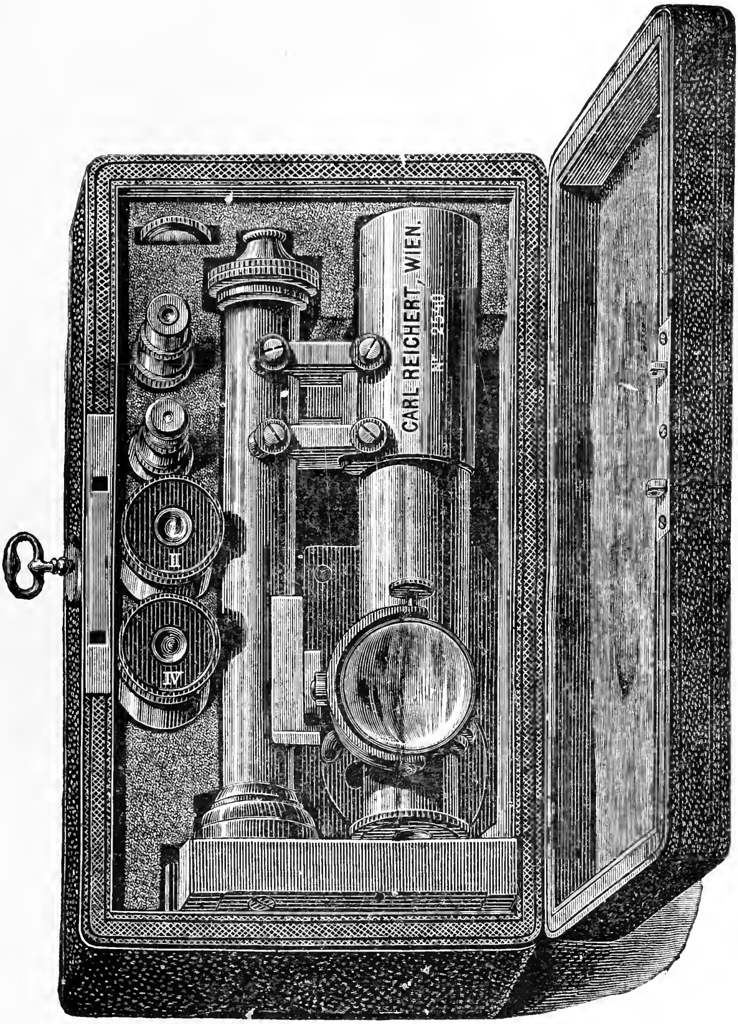


Fig. 60.

Reichert's Preparation Microscope.*—This instrument, fig. 61, is provided with an adjustment by rack and pinion, large brass stage,

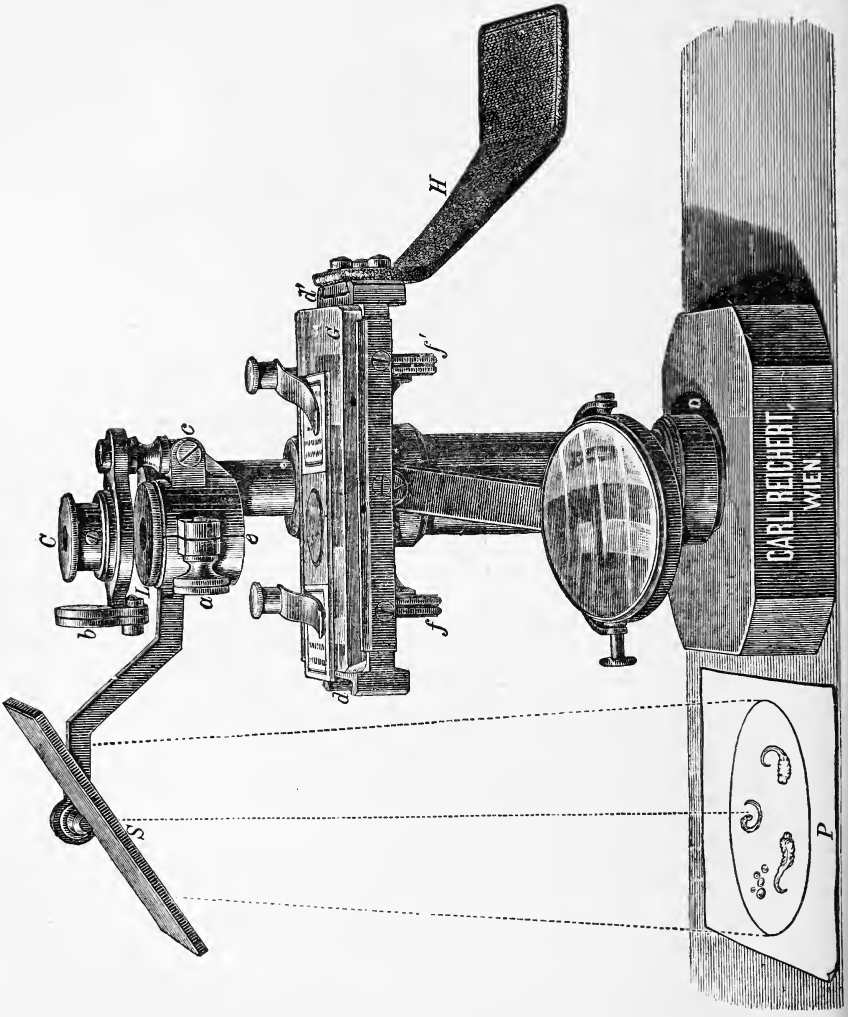


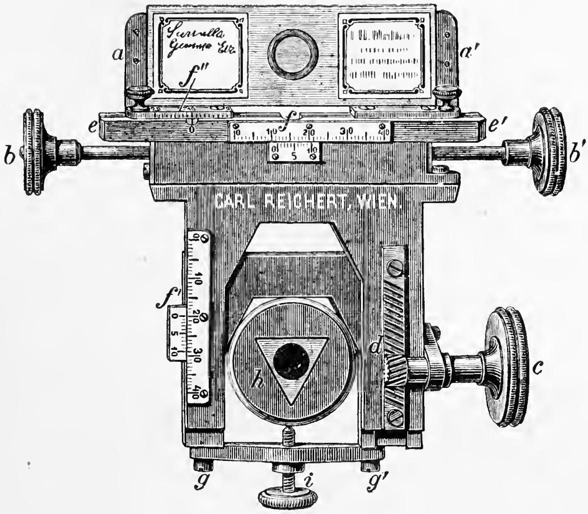
Fig. 61.

plane mirror adjustable on both sides, two leather covered hand-rests, and a doublet which magnifies 10 times.

* Reichert's Catalogue No. 18 (1892).

Reichert's Movable Stage.*—In this stage, represented in fig. 62, the object can be displaced in two rectangular directions by means of the two screw-heads *b* and *c*. It can be readily attached to and removed

Fig. 62.



from the ordinary stage. This stage is intended for the Reichert model No. II., but it can also be fitted by means of the screw *i* to any larger stage of the Continental type.

A Sliding Carriage and Stage for the Microscope.†—Mr. G. W. Brown, jun., says, "The following description and drawing of plan and section of an improved sliding carriage and stage for the Microscope may be of interest. If put into actual use it will, I hope, bring as much comfort and satisfaction as it has brought to me.

After considering the qualities useful in a good stage, Dr. Dallinger concludes ‡ that an efficient substitute may be found for a mechanical stage in what he terms a 'super-stage,' so arranged that the bearings shall be glass, and friction reduced to a minimum. He says that 'against its employment is the fact, first, that the slide is clipped into a rigid position; and, second, that the aperture is too small to admit of the employment of the finger in moving the slide to assist in rapid focusing.' He adds, 'But these are defects which might certainly be overcome.'

The improved 'super-stage' now described is believed to obviate these objections, and is not only 'an efficient substitute' for a

* Reichert's Catalogue No. 18 (1892).

† Amer. Mon. Micr. Journ. xiv. pp. 100–3.

‡ Carpenter, 7th ed., p. 169.

mechanical stage, but a most desirable substitute for usual work with the Microscope; permitting, as it does, absolute freedom of movements about a field for full two inches horizontally and one inch vertically, thus allowing ample room for even serial sections; and possessing, as it does, exquisitely smooth sliding movements, over the stage proper of the Microscope, of almost absolute precision. My carriage and stage, made for me a year ago by Zentmayer of Philadelphia, after my own specifications, is of such excellent workmanship as to give perfectly level and precise movements under a power of 2250 diameters (Zeiss 1/12 homo. immers., 18 compens. ocular).

The drawing shows in fig. 63 a plan of the sliding carriage, and in fig. 64 a cross-section on a vertical central line. The stage should have

Fig. 63.

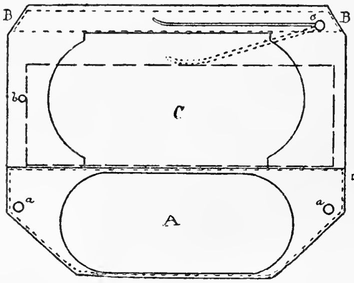
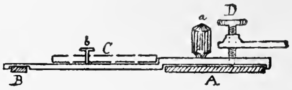


Fig. 64.



two flat rails, one on each side of its aperture, slightly raised above the surrounding surface, on which the carriage slides; and the stage may be square or round in shape, as preferred. The outlines of the carriage are shown by the full lines of the figures. Affixed to the bottom of the carriage are glass rails, A and B, of which the outlines and positions are indicated by dotted lines. These glass rails of the carriage slide on and over the metal rails of the stage. The circles *a a* and *b* show respectively knobs for holdfasts and a centering stop for object slide C, indicated by the broken lines of the figures. A spring clip *c* is provided, which can be swung against the upper side of the slide, as indicated by the dotted lines in fig. 63, to hold it securely in place when the stage is perpendicular or while it is rotated, or swung aside out of the way as shown by full lines. The slide rests with sufficient security against the ledge of the carriage when the stage is level or inclined, free from being clipped in a rigid position, justly criticized as objectionable by Dr. Dallinger. The carriage is kept in contact on the rails of the stage by the spring and ivory-pointed thumb-screw D, and the pressure thereby regulated. It will be observed that there is ample room in the opening of the sliding carriage, above the object-slides, to insert the end of the forefinger in quick focusing as recommended by Dr. Dallinger and practised by many microscopists; and also that the object-slide is not slipped in a rigid position, but can be when desired. This opening also permits the use of wide angle, short focus or immersion substage condensers. By placing the forefinger on the holdfast *a*, the middle finger on the post of the spring clip *c*, and the thumb against the lowest corner of the sliding carriage, an object can be moved around and about the whole field of view, with the greatest facility and precision, and perfect control, while the other hand is constantly used at the same time in adjusting the focus as desired. Personally, I think such a carriage should be as light as possible, consistent with sufficient rigidity in construction. My own weighs only a little over one ounce; the brass part, supporting the object slides C, being 1/25 in. thick, and that holding the broad glass rail A, double that thickness. The ledge against which the object slides lie, should, I think, be lower than their average thickness, to permit passing under high-power objectives so as to allow examination, even to the extreme edges. The ledge of my own carriage is 1/25 in. high, and I find this ample to securely support ordinary object-slides, and low enough to pass under the highest power objectives.'

The Society of Arts Microscope.*—The following is an account of the discussion on this subject which took place before a meeting of the American Microscopical Society last year.

"Prof. Claypole then read a paper on 'The Society of Arts Microscope as a cheap Microscope.' This instrument was designed and made forty years ago, and is still sold in England for about fifteen dollars.

Mr. G. S. Woolman: What does Prof. Claypole consider cheap?

Prof. Claypole: Twenty to twenty-five dollars.

Mr. C. L. Griffith: What wages are paid by these Microscope-makers?

Prof. Claypole: I do not know; we have no instrument made on the same plan.

Mr. G. S. Woolman: I sold this instrument for many years at 22·50 dollars. It is a miserable instrument. The American makers make much better ones for 30 dollars.

Dr. Blackham: When I first commenced to use a Microscope I used one of these instruments. It is a little better than the Craig Microscope, or a drop of balsam in a pinhole. The lenses are not as good as a 1·50 dollar pocket magnifier—it is beneath contempt. The value of a stand is to hold the tube steady, and I would rather have a Jackson model and sliding-tube than that. The curious system of leverage it possesses magnifies every error of workmanship. The large model known as the Ross, which is similar to it, has been abandoned. The instrument I worked with was so badly made as to be worthless. Such traps are more likely to disgust a student with microscopy than to lead him on.

Prof. Rogers: We have here two opinions—one that of an instructor who has successfully used the instrument in the class-room; the other that of a dealer who formerly sold the instrument. It is only fair that both opinions should have their due weight. In regard to the choice between an instrument simple in form but of good mechanical construction, as compared with a high-priced stand, I prefer the former. I use for most purposes a Bausch and Lomb stand costing about 12 dollars. It is well to keep in mind that nearly all the valuable work—e. g. in

* Proc. Amer. Micr. Soc., xiv. (1892) pp. 32–3.

astronomy—has been done with instruments of comparatively small size. We may go further and say that a large part of the discoveries made in this science have been made with telescopes of moderate power. Dawes made his famous discoveries of double stars with a telescope having an aperture of only $8\frac{1}{2}$ inches. The most of Herschel's discoveries were made with a telescope of small aperture. It often occurs that solidity in mechanical construction more than compensates for increased magnifying power.

Mr. G. S. Woolman: The American makers furnish a better low-priced stand than the European.

President Ewell: All Microscopes are good, but some are better than others. I would not select the Society of Arts instrument, but let us be tolerant. Some English authorities favour that stand. I would buy a model such as Brother Blackham has, but let us encourage every one to get a Microscope of some sort.

Mr. Turner: I look at this matter from the standpoint of the manufacturer. Men will accept, use, and pay for European work of a worse character than they will take from American manufacturers, and then criticize the latter.

President Ewell: I want to say that the best work in the world is made in the United States.

Professor Claypole: I agree with the President, but this instrument was made forty years ago; Dr. Carpenter was the leading man in getting it made, and advocated it. I maintain that it is better the student should get such an instrument as this, and keep up to his work, than to drop it."

(3) Illuminating and other Apparatus.

Three new Accessories for the Microscope.*—Mr. E. H. Griffiths describes three accessories that are easily made by additions to the Griffith focus-indicator, which has already been described to the American Society of Microscopists.

Fig. 65 is a rough sketch of the focus-indicator as now in use.

Fig. 66 represents the same device attached direct to the nose-piece of the Microscope or to an adapter, and figs. 65 and 66 are introduced here simply to show that the indicator is a portion of the new accessories to be described.

Fig. 67 is an object-holder to be used as an excellent substitute for stage-forceps, and for many objects it is much more convenient than the forceps. Near the bottom of the spindle-dropper of the indicator a small hole is drilled for the introduction of a pin, as illustrated in the sketch. The insect or other object for examination may be placed in focus by raising or lowering the dropper, and it may be turned over or placed in any position desired.

This device may be used as a mechanical finger for arranging diatoms, &c. The pin in fig. 67 must be removed, and a cat's whisker or other finger put in its place. It may be thrown into focus and out of focus by means of the Microscope adjustments.

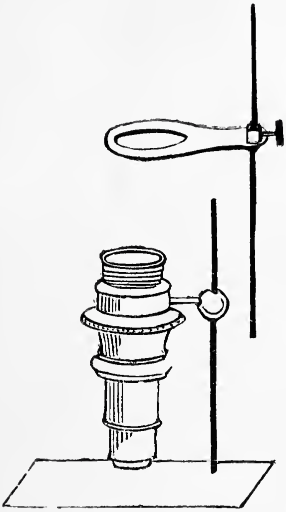
Fig. 68 represents a revolving diaphragm with as many apertures as

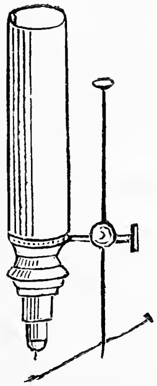
* Proc. Amer. Soc. Micr., xiii. (1891) pp. 47–8.

may be desired. It is made of thin metal, and may be quickly attached to the bottom of the indicator-dropper and quickly placed in any position where desired.

Other accessories made by additions to the focus-indicator will be described later.

Fig. 65.





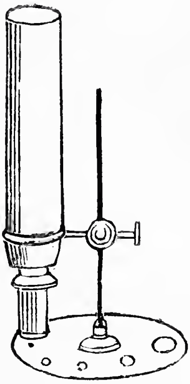


Fig. 66. Fig. 67. Fig. 68.

Filar Micrometers.*—Prof. W. A. Rogers considers that there are two requirements in the construction of a good filar micrometer to which manufacturers have given too little attention, viz. equality in the diameters of the fixed and movable threads, and ease and uniformity in the movement of the measuring screw.

The author considers that as regards uniformity in diameter, quartz fibres are far superior to spider lines. They appear to be truly circular and any required diameter can be easily obtained.

The second difficulty may be met by the use of a long spring instead of the usual short stiff one for keeping the slide in contact with the end of the screw. For this purpose nearly the whole length of the frame can be utilized by the use of guide-pulleys at one end, thus allowing the spring to lie parallel with the sliding plate.

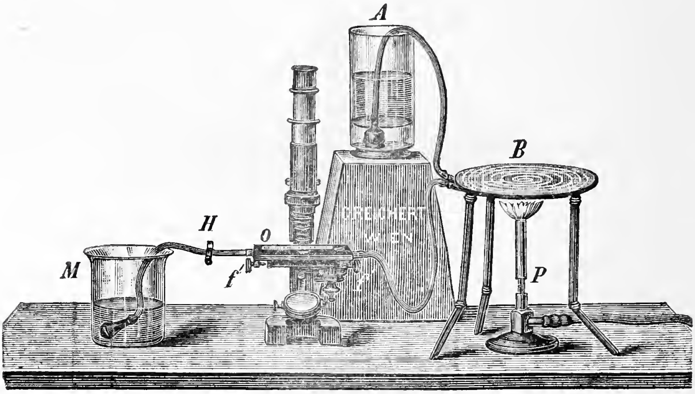
Micrometers made for the author on this plan by Bausch and Lomb have given very satisfactory results.

Reichert's New Heating Apparatus.†—This apparatus, fig. 69, is used for the stage described on p. 383. It was designed by Dr. Spietschka in order to obtain a uniform heating of the hot stage during the course of prolonged investigations. A is a large vessel containing

* Proc. Amer. Soc. Micr., xiv. (1893) p. 132.
† Reichert's Catalogue No. 18 (1892).

water which passes into the spiral B, where it is heated to a given temperature by a Bunsen burner provided with an automatic regulation of the

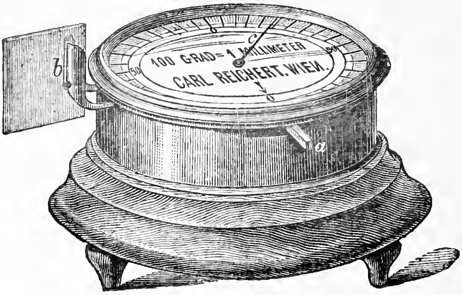
Fig. 69.



gas supply. By means of the stop-cock H the rate of passage of the hot water to the hot stage, and consequently the temperature of the latter, can be conveniently regulated.

Reichert's new Cover-glass Measurer.* — With this instrument, represented of half its natural size in fig. 70, the most exact measure-

Fig. 70.



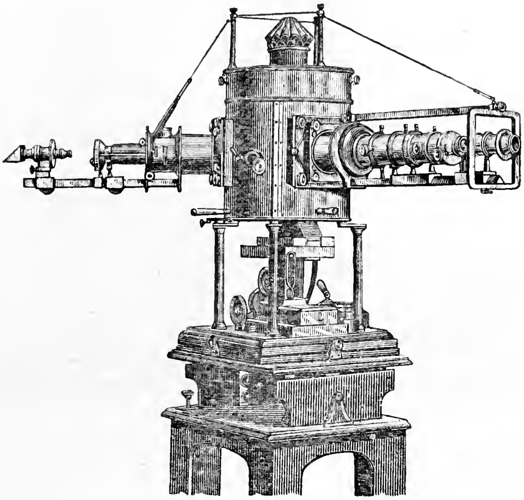
ments of 0·01 to 8 mm. can be quickly and conveniently made. The clamp *b*, in which the cover-glass to be measured is fixed, is opened by a slight pressure upon the lever *a*.

Sir David Salomons' Electric Lantern.—The following figures† represent this lantern as shown by Sir David Salomons at the May Meeting of this Society (see *ante*, pp. 383–4, 424–6). Fig. 71 shows the instrument with the polariscope on the right and the Microscope on the left. Fig. 72 gives another view with the Microscope on the right, and also showing the third front.

* Reichert's Catalogue No. 18 (1892).
† We are indebted to the Camera Club for the use of the clichés.

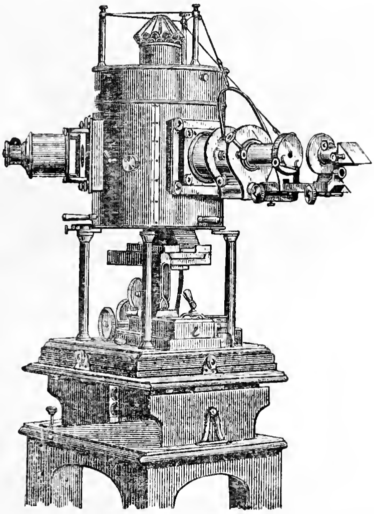
The lantern with its apparatus can be rapidly erected. All parts are interchangeable, and only attached with one screw. No support is

Fig. 71.



required for any apparatus outside the lantern. Support is obtained by straining-rods from portions which project far beyond the lantern case

Fig. 72.

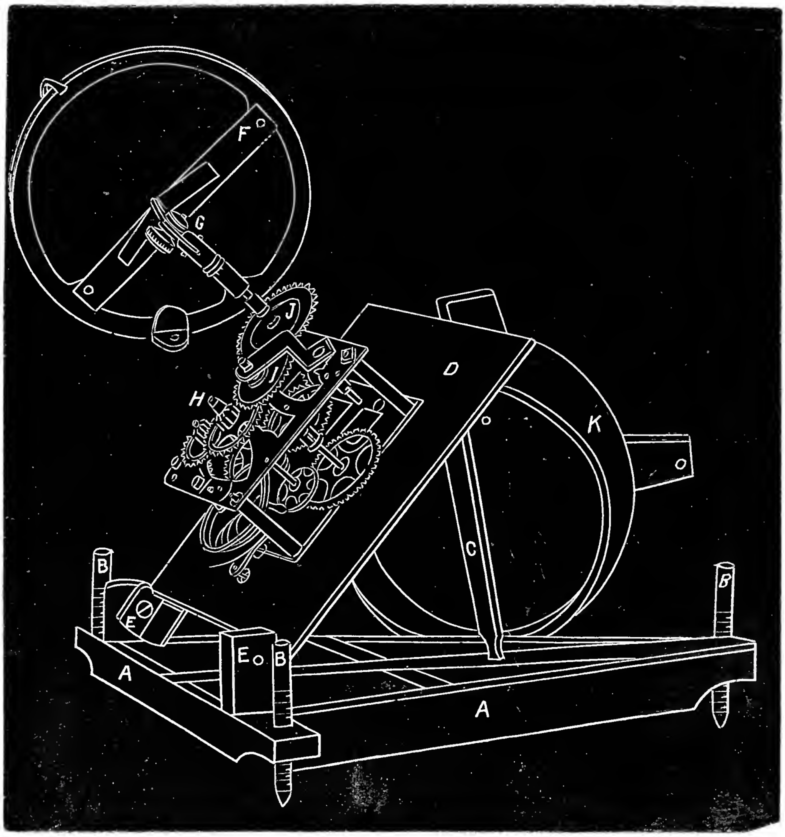


to pillars attached at the top of the lantern. In other words, the same principle is employed which is now so much in vogue with bridges, i. e. the cantilever principle.

(4) Photomicrography.

New Heliostat.*—Dr. Lyman S. Deck writes as follows:—"This simple and inexpensive form of heliostat, some idea of which can be gained from the accompanying illustration, is designed more especially

Fig. 73.



A, Triangular frame on levelling screws B. D, Plate of clock movement. C, Brace for inclining movement at proper angle. E, Posts on which clock-plate turns. F, Mirror frame on joint G. H, Hour spindle carrying wheel with 10 cogs. I, Wheel for reversing the motion of the mirror. J, Wheel having 40 cogs on spindle carrying the mirror. K, Brass case to protect the clockwork from dust.

for use in photomicrography and with projection apparatus. It is constructed on a principle similar to the equatorial telescope, and consists essentially of a mirror revolving on an axis parallel to the axis of the

* Proc. Amer. Soc. Micr., xiii. (1892) pp. 49 and 50.

earth and in an opposite direction to the earth and with one-half its velocity, or making a complete revolution once in 48 hours. It may be made from the works of a common clock, having a balance, in the following manner:—

First remove the striking parts of the clock and procure three cog-wheels,* one having 10 cogs, one 40 cogs, and the third wheel any convenient number. Now fasten the one having 10 cogs to the spindle of the hour-hand and in its place. Next, to carry the mirror, make a spindle about three inches in length and fasten the wheel of 40 cogs to it at such a place that when it is in its place in the framework of the clock it will be on a level with the wheel of 10 cogs, and then drill holes to receive it in the framework of the clock, taking great care to have it sit perpendicular to the frame when in place. Now attach the third wheel to the framework so that its cogs will match with the other two wheels and cause the spindle carrying the mirror to revolve in the same direction as the hands of the clock.

A plane mirror may be attached to the spindle by a ball-and-socket joint or any convenient means.

Now make a flat tripod base of iron with three levelling screws, and attach the clockwork to it by means of a hinge so that it can be elevated to correspond to the latitude of the place.

To use the instrument, set it up with great care exactly north and south and elevate the axis carrying the mirror by means of a protractor and plumb to correspond to the co-latitude of the place, so that the axis points directly to the north star, and then adjust the mirror so as to reflect the light to the desired place.

This simple apparatus, if well made, will answer every purpose of the more expensive heliostats and will practically keep a beam of sunlight in a constant direction for hours at a time.

As reflection from a glass mirror is not perfect, it is better in practice to not reflect the light at an angle too acute to the surface of the mirror."

Photomicrographs by Gas-light.†—Dr. G. M. Sternberg advocates the use of gas-light as a satisfactory artificial light for photomicrographic work. The objections to the use of the oxy-hydrogen lime-light are the considerable expense attending it and the inconvenience resulting from the necessity of frequently renewing the gas-supply when much work has to be done. The electric light is also very expensive unless an electric plant is at hand, and even then it may not be available during the day. Admirable results have been obtained by the use of an oil-lamp; but to photograph bacteria, &c., which have been stained, coloured screens must be used, and then, owing to the loss of light, the time of exposure must be considerably increased.

Under these circumstances the author was induced in 1889, when preparing a report of the investigations which he had made on yellow fever in Cuba, to experiment with gas-light, and obtained very satisfactory results.

The objective used was the 3 mm. oil-immersion apochromatic of

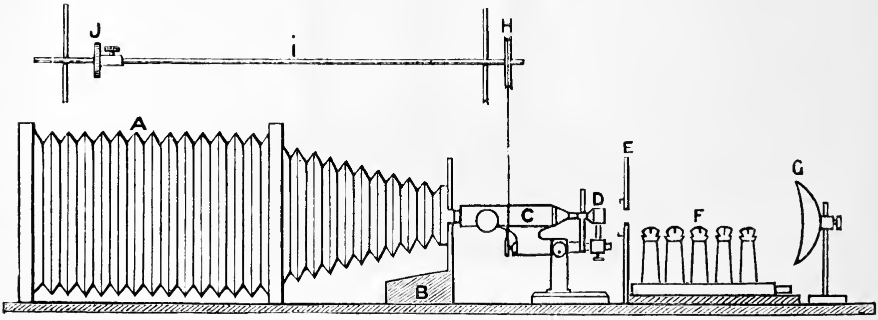
* "Grooved band-wheels may also be used."
† Proc. Amer. Micr. Soc., xiv. (1893) pp. 85-90.

Zeiss, and the eye-piece his projection No. 3. An amplification of 1000 times was employed.

Most of the photographs were made from preparations stained with a simple aqueous solution of fuchsin. A yellow screen, prepared by coating a plate of glass with a film of negative varnish in which tropæolin had been dissolved, was placed at the back of the achromatic condenser. Orthochromatic plates manufactured by Carbutt of Philadelphia were used.

The arrangement of the apparatus is seen in fig. 74. A is the camera, with pyramidal bellows front supported by the heavy wooden

Fig. 74.



block B, which can be pushed back so as to enable the observer to place his eye at the eye-piece of the Microscope; C is the large Powell and Lealand stand, and D the Abbe condenser supported upon the substage; E is a thick asbestos screen for protecting the Microscope from the heat of the gas-battery F.

The gas-burners are arranged in a series with the flat portion of the flame facing the aperture in the asbestos screen. The light is reflected in the right direction by the concave mirror G. The focusing is effected by means of the rod I, which carries at one extremity a grooved wheel H, connected by a cord with the fine-adjustment screw of the Microscope. The focusing-wheel J may be slipped along the rod I and retained in any required position by a set-screw.

To avoid oscillations, soft rubber cushions were placed under the whole apparatus.

Reichert's New Photomicrographic Apparatus.*—This apparatus can be used with the highest magnifications either in the vertical (figs. 75 and 76) or horizontal (fig. 77) position. For use in the horizontal position with very high magnification, the object is first adjusted in the Microscope as in fig. 76, and then the apparatus is reversed as seen in fig. 77. The light-proof connection between Microscope and camera is effected by the socket V and the adjustable connecting piece F. The final correction of the fine-adjustment is effected by means of the string,

* Reichert's Catalogue No. 18 (1892).

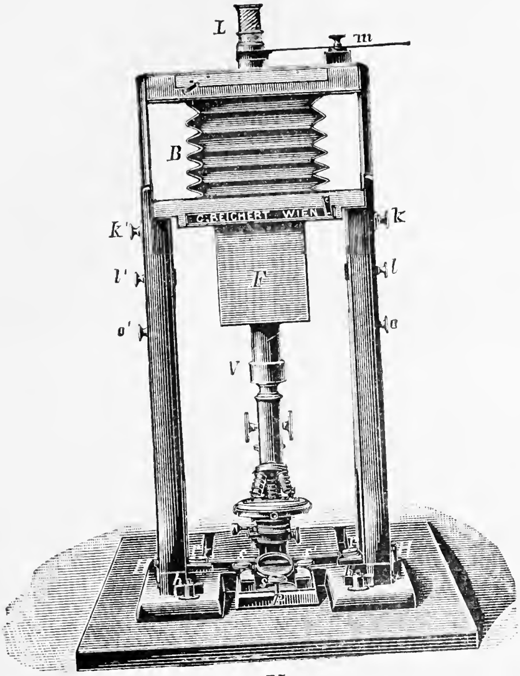

L
m
B
C. REICHERT WIEN
k
k'
l'
l
o'
o
F
V

FIG. 75.

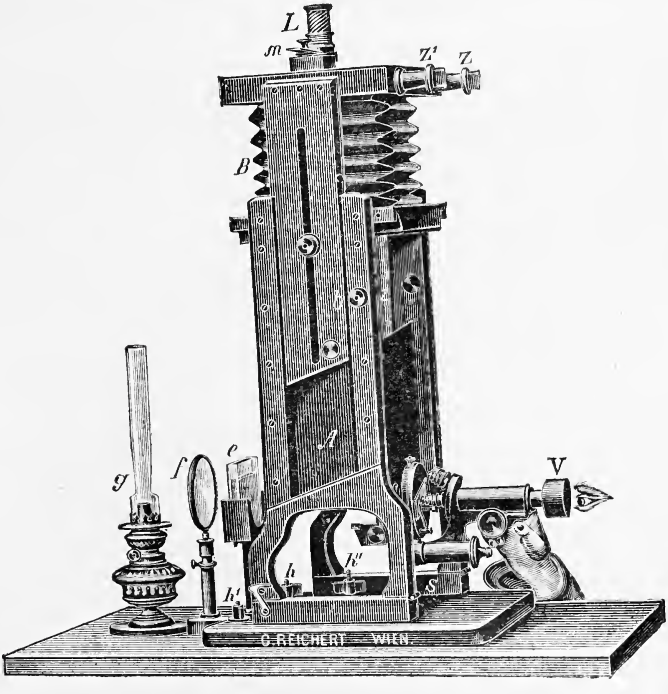

L
m
Z'
Z
B
A
V
g
f
e
h
h''
h'
S
C. REICHERT WIEN.

FIG. 76.

seen in fig. 77, which acts upon the lever *a* fitted to the micrometer screw. On the glass plate of the camera four squares are etched, so that it can be simultaneously used as a transparent and as a ground glass plate. The total length of extension of the camera from Microscope stage to glass plate amounts to about 85 cm.

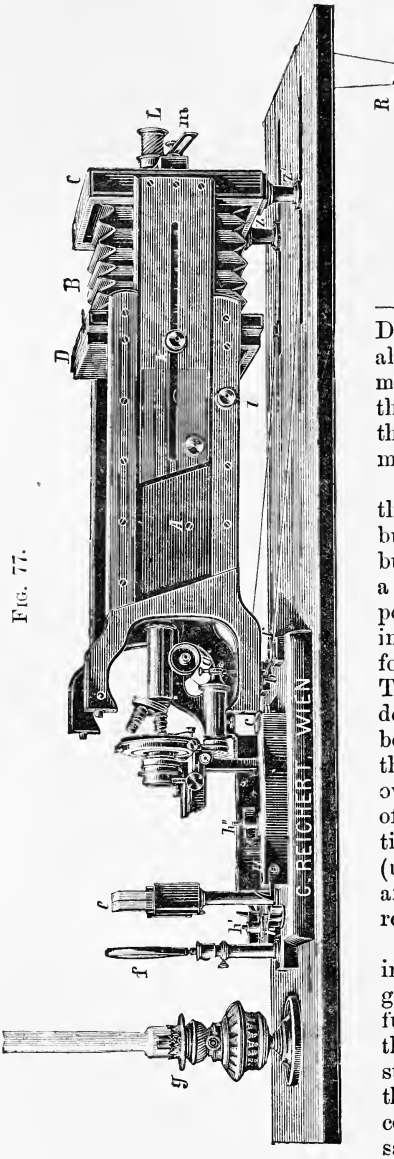


Fig. 77.

(5) Microscopical Optics and Manipulation.

Theory of Optical Instruments.*—The appearance of this book by Dr. S. Czapski will be welcomed by all microscopists who possess the mathematical knowledge necessary for the due appreciation of Prof. Abbe's theories on the formation of the microscopic image.

The book is really an abstract of the articles which the author contributed to Prof. Winkelmann's 'Handbuch der Physik.' It is not, however, a text-book of optics, as only those points are dealt with at length which, in the author's opinion, are not to be found adequately treated elsewhere. The main object of the book is to demonstrate the advances which have been made in our understanding of the behaviour of optical instruments owing to the observations and theories of Abbe. The phenomena of diffraction and the famous diffraction theory (the "Abbe theory" proper), however, are not discussed in this book, but are reserved for a subsequent work.

After a preliminary chapter dealing with the general principles of geometrical optics, there follows a full discussion of the Abbe theory of the formation of images. This is succeeded by a chapter treating of the theory of spherical aberration and the conditions necessary for its compensation (achromatism). Prisms and

* 'Theorie der Optischen Instrumente nach Abbe,' Breslau, 1893, 8vo, 292 pp., 94 figs.

systems of prisms are next considered. Then under the head of limitation of the rays and the properties of optical instruments dependent upon it, the questions of perspective, magnification, penetrating power, brightness of images, the aperture and limits to the resolving power of optical instruments are passed in review.

These general theories form the foundation for the special theory of optical instruments, the most important of which, viz. the eye, projecting systems, lens, Microscope and telescope, are then discussed in detail; for each of them the dioptric effect and the factors on which it depends are determined, and, in the case of the artificial instruments, a critical and historical review is given of the most important types of construction.

The concluding chapter of the book is devoted to a description of the methods employed in the determination of the constants of optical instruments.

At the end of each chapter is a list of the literature bearing upon the subject which has been discussed.

On the Subjective Magnitude of the Monocular and Binocular Images in the Hand-lens.*—Dr. Yves Delage gives an explanation of the increased magnification which results when both eyes instead of one only are used in examining an object through a hand-lens of large diameter.

This increase in magnification must evidently be a subjective phenomenon, since the retinal image of the second eye is equal to that of the first.

In such a question of magnification, then, there are two things to be distinguished: the real magnitude of the retinal image and the subjective sensation of the magnification.

As regards the first point. According to the text-books the lens should be placed so that the image is formed at the minimum distance of distinct vision. This may be an advantage, but is not a necessity, for between eye and object there is a considerable range of distance in which the lens will furnish sharp images; and this is also the case if the eye is displaced with respect to the lens. Similarly for each fixed distance of lens from the eye, there is a series of positions of the object giving sharp images and different magnifications; and finally there is a series of positions of the head giving distinct images. The real magnification, then, depends on the relative positions of three factors: object, lens, and eye.

Now for a given position of the lens L L′ (fig. 78) with its foci F F and of the object O O′, the image I I′ has a position and magnitude fixed and independent of the eye which perceives it.

This image can be considered as a real object seen by the eye without the lens. It is such that any ray I C passing from any one of its points to the eye and meeting the lens in K is real in its part K C which represents the refracted ray corresponding to the incident ray O K. This image I I′ can be seen by the normal eye from an infinite distance up to the punctum proximum.

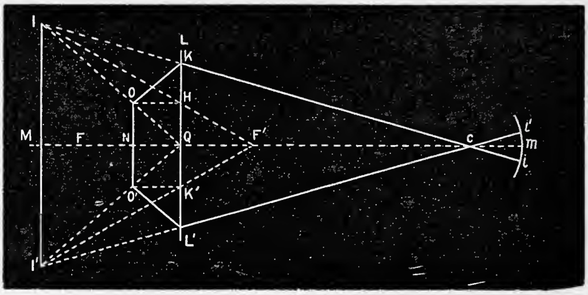
As the distance of the eye increases, the angle beneath which it sees

* Arch. d. Zool. Exp., i. (1893) pp. vi.–xiii.

I I′, i.e. the retinal image, diminishes. Thus in order to obtain images as large as possible, the eye must be placed as close as possible to the lens.

Now let the distance of the lens from the object be varied. The more the lens is separated from the object, the nearer is the latter to the

FIG. 78.



focus and the greater is the image. But the retinal image diminishes as I I′ recedes, and in fact I I′ recedes more rapidly than it increases, for the formula $\frac{I}{O} = \frac{p'}{p}$ put in the form $I = O\frac{p'}{p}$ shows that, O being constant, in order that I may vary uniformly with p', p must be constant. This is not the case, however; p varies much less rapidly than p', but in the same direction as it. In order to obtain the largest retinal image, then, the lens must be approached to the object. But in this direction there is a limit, for as p diminishes, so does p', until it becomes equal to Δ, the minimum distance of distinct vision.

To put this in a more mathematical form, let λ be the distance C Q of the lens to the nodal point of the eye, and consider only the half of the figure situated above or below the optic axis M m. The retinal image is measured by the tangent of the angle α of the extreme rays. But $\tan \alpha = \frac{I}{p' + \lambda}$. The retinal image will therefore be so much greater as λ is smaller; which shows that the eye must be placed as near as possible to the lens.

On the other hand, from the similar triangles F′ Q H, in which H Q = O and Q F′ = f, and F′ M I: we have

$$\frac{I}{O} = \frac{p' + f}{f}.$$

$$\therefore \quad \tan \alpha = \frac{O}{f} \times \frac{p' + f}{p' + \lambda} = \text{constant} \times \frac{p' + f}{p' + \lambda}.$$

Now by varying p', the fraction $\frac{p' + f}{p' + \lambda}$ will vary in the same direction or in the opposite, according as it is less or greater than unity. Thus $\tan \alpha$ will be a maximum when p' is a minimum, so long as λ is less than

f, and this will be the case unless the lens is very thick. It follows from this that the myope can see with the lens more details than the emmetrope, since he is able to make p' less.

On the other hand, however, the magnification defined by $\frac{I}{O}$ is less for him than for the emmetrope, for $\frac{I}{O} = \frac{p'}{p} = \frac{p'(p'+f)}{p'f} = \frac{p'+f}{f}$, which shows that $\frac{I}{O}$ is a maximum when p' is. This is only an apparent contradiction, for the service rendered to the emmetrope by the instrument can be greater than that rendered to the myope, without the latter ceasing to keep the advantage over the former.

Now to consider the second point, viz. the subjective sensation of the magnification of images. Besides the magnitude of the retinal image we have as another element the distance. All objects seen under the same visual angle ought to appear equal, but we *feel* them more or less great because we refer them more or less far in the angle. Thus a doll of 15 cm. seen at 1 metre appears smaller than a woman of 1 m. 50 seen at 10 metres, although they furnish equal retinal images. So inversely a man appears as large at 5 metres as at 10. To what distance then are the images furnished by the lens referred?

In monocular vision the images furnish no direct indication as to their situation on the visual ray. Indirectly we are guided by comparison with other objects in the field of view and also by the effect of accommodation, but this element of judgment is not very precise. In the case of the lens, if it alone influenced us, we should refer the image to its true distance, but other effects intervene which cause us to modify our impression. According to the author's experience we refer the image nearly to the position occupied by the object which furnishes it. Thus in examining with a lens an object on a table, the field of the lens does not appear to be sunk into the table as would be the case if the retinal image was referred to the distance of the virtual image. The feeling of the continuity of the parts seen in the lens with their prolongation beyond the field dominates the less intense impression of the effect of accommodation. The resultant sensation is doubtless a compromise between the organic sensation and the corrected sensation, but much nearer the latter than the former, at least with persons who frequently make use of the lens.

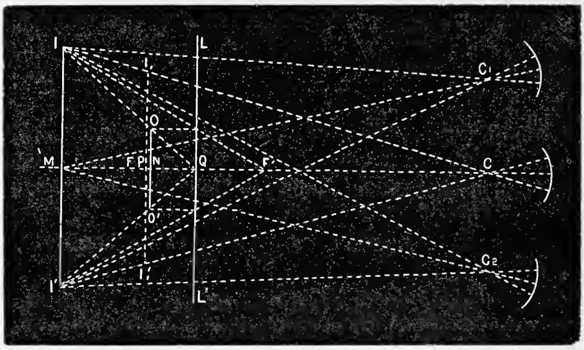
Thus the image seen with the single eye is always estimated below its true dimensions. When, however, both eyes are opened, the convergence of the optic axes furnishes instantly a precise and intense indication which dominates all the preceding vague approximations; the image is referred to its true distance and consequently appears greater. Thus in fig. 79 the rays starting from the point N which, without the lens, would make an angle C_1 N C_2, form after refraction the smaller angle C_1 M C_2. The eyes have the same direction as if O O′ were at I I′. With a single eye C the image is referred in the angle α to the distance C P, and I_1 P measures its apparent magnitude; while with two eyes C_1 and C_2 it is seen beneath the same angle at a distance C M, and its apparent magnitude is represented by I M.

From fig. 79 we have $\frac{\mathrm{I\,M}}{\mathrm{I_1\,P}} = \frac{\lambda + p'}{\lambda + p}$, for C P does not differ sensibly from C N.

Replacing p by its value $\frac{p'f}{p'+f}$ drawn from the equation $\frac{1}{p} - \frac{1}{p'} = \frac{1}{f}$

$$\frac{\mathrm{I\,M}}{\mathrm{I_1\,P}} = \frac{\lambda + p'}{\lambda + \frac{p'f}{p'+f}} = 1 + \frac{p'^2}{\lambda p' + \lambda f + p'f} = 1 + \frac{1}{\frac{\lambda}{p'} + \frac{f}{p'} + \frac{\lambda f}{p'^2}}.$$

Fig. 79.



This shows that the binocular image I I′ appears so much greater with respect to the monocular image $\mathrm{I_1\,I_1'}$ as λ and f will be smaller and p' greater. To see the phenomenon under the most favourable conditions therefore, it would be necessary to take a lens of short focus, separate the object as far as possible from the lens, and place the eye close to the lens.

For the normal eye, since p' is without limit $\frac{\mathrm{I\,I'}}{\mathrm{I_1\,I_1'}}$ can become equal to $+\infty$; but actually the binocular image never appears more than double the monocular, for when the virtual image is very far from the eye, the sentiment of the reality of things is opposed to the idea that the subjective image which represents it is very far from it.

Numerical Aperture.—Dr. M. D. Ewell writes as follows on this subject:*—

"It is not proposed in this paper to enter upon any theoretical discussion, but to give the results of actual measurements of the aperture of such objectives of different makers as I have been able to procure for that purpose. The measurements were made with an Abbe apertometer, which will be found figured and described on p. 24 of Zeiss's English Catalogue, 1891, as 'No. 2.' †

I intended to repeat the measurements on another apertometer of

* Proc. Amer. Micr. Soc., xiv. (1892) pp. 44–7 (2 figs.).
† See also Journ. Roy. Micr. Soc., Jan. 1878, p. 19; 1880, p. 20.

my own construction, and to include the results of this paper, but the pressure of professional duties has prevented the completion of this work in time for this meeting. A description of this piece of apparatus may, however, not be inappropriate. See fig. 80.

FIG. 80.

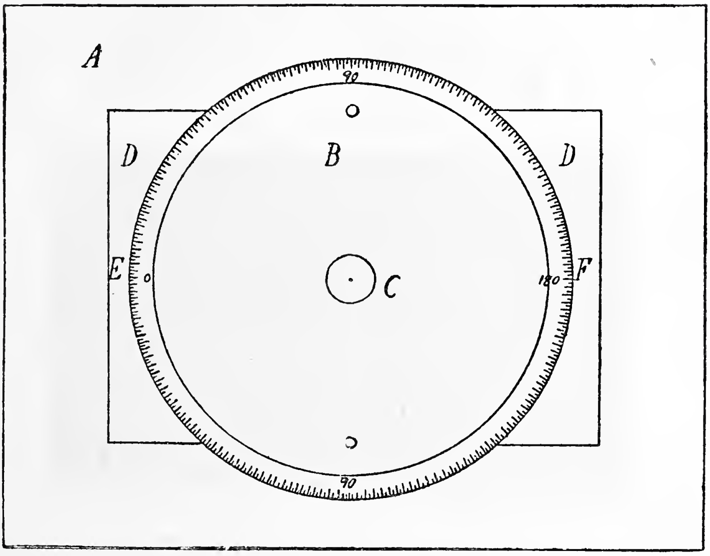
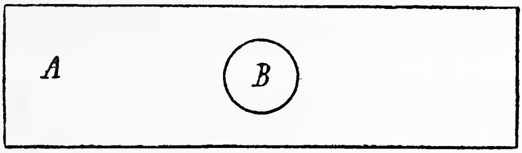


FIG. 81.



A represents an iron plate, 20 in. square and 1/2 in. in thickness, planed as flat as possible on its upper surface; B represents a brass circle 13 in. in diameter, graduated to one-half degrees, and turning around its centre C; D represent two opposite verniers, reading to single minutes of arc.

In practice, however, these are entirely unnecessary, as the unavoidable errors of measurement must exceed the least count of the verniers. The centre is read, therefore, simply to one-half degrees or, if desired, by estimation to three minutes of arc.

In fig. 81, A represents a brass slide with a small hemispherical lens B, burnished into an opening in its centre. The centre of this lens is indicated by a very small circle marked on its plane surface with a diamond while in the chuck on which it was turned up. This portion of the apparatus was made for me by Spencer and Smith, of Buffalo, New York.

TABLE DESCRIBING OBJECTIVES.

Maker.	No.	Description.	Aperture claimed by Maker.	Aperture as Measured.	No. of Readings.	Owner of Objective.
Bausch & Lomb Optical Co.	None	Professional 1 in.	36°	30°	4	M. D. Ewell, Chicago.
" "	"	1/2 in. opaque illuminator	60°	61°	3	" "
" "	"	2 in. First Class	22°	21°	4	" "
" "	"	1/4 in. Student's Catalogue No. 608	75°	70°	3	Mrs. W. H. Bulloch, Chicago.
" "	"	1/5 in. Student's Catalogue No. 611	110°	95½°	3	" "
" "	"	1/4 in. opaque illuminator	115° *	88°	1	M. D. Ewell, Chicago.
" "	"	First Class 1/6 in.	140°	114°	3	" "
" "	"	First Class 4/10 in.	110°	111°	3	W. H. Summers, Chicago.
" "	"	1/8 in. hom. im.	1·43 N.A.	1·28 N.A.†	3	" "
Beck	"	First Class 1/5 in.	100°	98°	1	" "
Crouch	"	1 in.	25°	24°	1	" "
Grunow	"	1/6 in.	140°	150° closed 147° open	2	Dr. H. M. Farr, Mt. Pleasant, Iowa.
Gundlach	"	1/8 in. hom. im. "E"	136° B.A. = 1·41 N.A.‡	1·39 N.A. = 132° 16	3	Prof. E. S. Bastin, Chicago.
Hartnack	"	1/2 in.	40°	47°	1	W. H. Summers, Chicago.
Leitz	"	No. 3 dry (18 mm.)	N.A. 0·28	N.A. 0·28	4	Richards & Co., Ltd., Chicago.
"	"	No. 7 dry (32 mm.)	N.A. 0·85	N.A. 0·88	3	" "

* So stated by Prof. W. A. Rogers, who purchased it for me. † Collar at 1°, best point of adjustment.
‡ Approximately.

Table describing Objectives—*continued.*

Maker.	No.	Description.	Aperture claimed by Maker.	Aperture as Measured.	No. of Readings.	Owner of Objective.
Leitz	5141	1/12 in. oil im.	N.A. 1·30	N.A. 1·28	3	Richards & Co., Ltd., Chicago.
Spencer & Co.	637	1/4 in. Student's	..	94°	3	M. D. Ewell, Chicago.
"	654	1/10 in. hom. im.	130° B.A.	1·36 N.A.	4	" "
"	None	1/25 in. hom. im.	125° B.A.	1·32 N.A.	3	" "
Spencer & Smith	856	New Dry First Class 4/10 in.	130°	126°	4	" "
"	862	New Dry First Class 1/8 in.	150°	167°	3	" "
"	884	1/10 in. hom. im. (New formula)	138° B.A.	N.A. 1·41	3	
"	886	1 in.	33°	33½°	3	
"	893	1/2 in.	70°	71°	3	
"	907	1/12 in. hom. im. New Professional	1·00 N.A.	0·97 N.A.	3	" "
Tolles	None	1/6 in. hom. im.	B.A. 120° = N.A. 1·32	N.A. 1·31	3	" "
"	"	2 in. solid	Unknown	12½°	1	W. H. Summers, Chicago.
"	"	1/12 in. water im.	"	0·99 closed 0·90 open	2	Jno. H. Choate, Salem, Mass.
Wales	"	1½ in.	20°	20°	1	Preston, Chicago.
"	"	1/2 in.	60°	51°	1	" "
"	"	1/5 in.	100°	97°	1	" "
Zeiss	710	A A 3/5 in.	36°	31°	4	M. D. Ewell, Chicago.
"	282	C C 1/4 in.	90°	102°	3	" "
"	194	1/18 in. hom. im.	N.A. 1·27	1·27 N.A.	3	" "

To use this instrument, the stand with the slide figured above in position on its stage is placed on the circular disc B, with the centre of the hemispherical lens as nearly over the centre C as possible. The objective whose aperture is to be measured is focused on the centre of the hemispherical lens, the Microscope being in a horizontal position. A light—e.g. a small incandescent lamp—is then placed at a convenient distance in front of the Microscope, and the Microscope and disc revolved, and the angle of aperture in crown glass read off, as with other apertometres. The eccentricity is eliminated by taking the mean of the two readings at E and F.

I should have been glad to include more objectives in this table, but have been unable to procure them, some dealers apparently being unwilling to submit their objectives to the test proposed, since no attention was paid to my letter requesting the loan of objectives for said purpose. The table needs no explanation. No tests of the objectives were made other than to determine their aperture."

(6) Miscellaneous.

Solution of the Dust Problem in Microscopy.*—Mr. A. H. Cole says:—"The statement of the dust problem is this: Given a stock of cleaned micro-slips and cover-glasses, to keep them clean and ready for use at any moment, without the necessity of brushing or wiping them. The following solution is the result of a laboratory study of the problem, and is now announced after having received the approval of leading microscopists.

The objects to be accomplished are:—

(1) To secure a dust-proof magazine for storing the cleaned micro-slips and cover-glasses in separate compartments for the different sizes of squares, circles, and oblongs.

(2) To provide simple mechanical appliances for removing a single slip or cover without exposing those remaining in the case.

(3) To provide an automatic device for warning the operator of the approaching exhaustion of his stock of any of the shapes of covers and of slips, thus avoiding the necessity of opening the case, except to replenish stock.

(4) To provide against the breaking or disarrangement of the covers in case of the accidental overturning of the case.

(5) Incidentally to provide a mounting-table, with guides for centering the objects and cover-glasses, the whole apparatus being so constructed that the glasses are not touched by the fingers, and only once by the forceps until the slide is completed and labelled.

The dust-proof slip and cover-glass case fully meet these requirements. The case is $4\frac{1}{2}$ in. square on the base, and 6 in. high. The slips and mounting-table are contained in the lower half, and the cover-glasses in the upper portion. The mounting-table has concentric lines for guidance in properly centering the objects. Four dust-excluders are hinged to the front of the grooved table to protect the slots through which the cover-glasses pass out upon the grooved table. The milled head of the roller which pushes the cover-glasses out of the slots is at

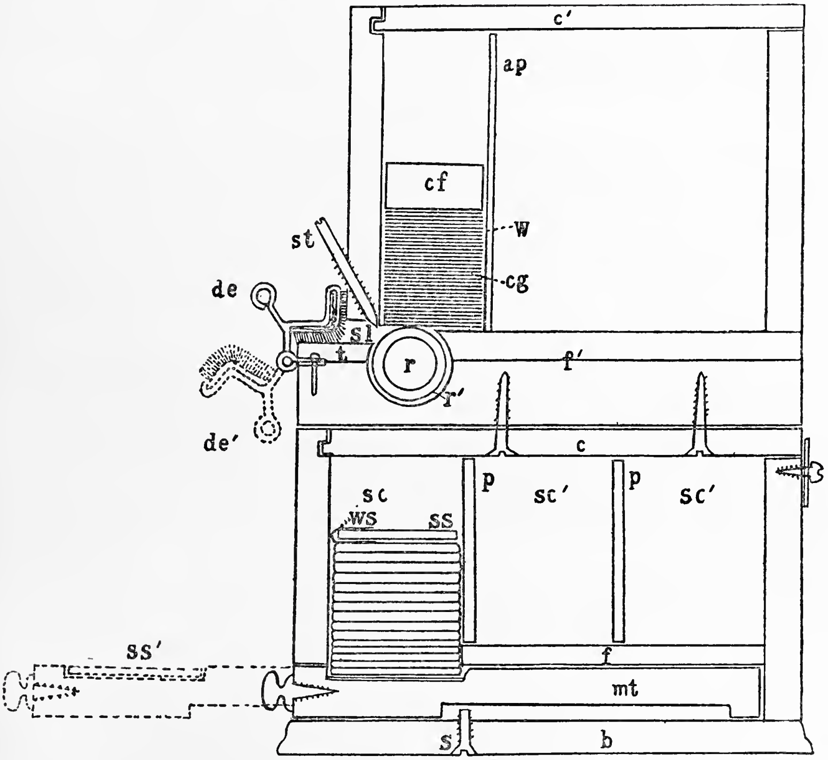
* Amer. Naturalist, xxvii. (1893) pp. 405–7 (3 pls.).

the side of the case. A screw stop is inserted in the front of the case above each slot.

The case is fitted for 3 in. by 1 in. glass slips of any thickness, and has a capacity of six to twelve dozen. It has four compartments for the cover-glasses of the sizes 1/2 in., 3/4 in., 7/8 in, or 12–24 mm., either circles or squares or oblongs of the above widths, and any lengths up to $2\frac{3}{4}$ in. The screw stops regulate the depth of the slots for either No. 1, 2, or 3 thickness of cover-glasses.

Fig. 82 is a vertical section from front to back showing the plan of the case. The section of the lower half is made in the median plane,

Fig. 82.



that of the upper half in the plane of the screw stop. Through the base *b* projects the stop *s* into a narrow groove in the mounting-table *mt*, which slides in and out between the base and the floor *f* of the stock compartments *sc*′. The service compartment *sc* is deepened by a shallow cavity cut into the upper surface of the mounting-table, and in the bottom of this cavity is fitted a sheet of celluloid bearing a series of concentric lines. The slips *ss* are stacked in the service compartment, the lowest slip fitting the shallow cavity in the mounting-table, as shown at *ss*′. A warning slip of paper *ws* is folded around the front edge of the top slip. The loose partitions *p* running in the grooves in the sides of the case can be removed after sliding back the cover *c*. In the base f' of the cover-glass case is the groove r' for the roller *r*, which is made of brass and covered with chamois. To the front of the base is hinged the brass dust-excluder *de*, whose lining of silk plush protects the grooved table *t* and the slot *sl* from dust. The dust-excluder also prevents the delivery of a cover-glass by the roller, except when the slot is opened. Into the slot projects the point of the screw-stop *st*, which is so adjusted as to permit the passage into the slot and out upon the grooved table of only one cover-glass at a time. Above the roller are stacked the cover-glasses *cg*. Near the top of the stack is placed a warning disc *w*, and upon the top cover-glass rests the loosely fitting follower *c f*, which prevents displacement and breaking of the covers if the case is accidentally overturned. The adjustable partition *a p* may be moved backward or forward to fit any length of cover-glass from 1/2 in. to $2\frac{3}{4}$ in. The cover c' is so constructed as to exclude dust.

Method of operation:—Thoroughly dust the inside of the case, and partly, or completely, fill the compartments with clean slips and cover-glasses of the proper sizes, and place the warnings in position. The apparatus is then ready for immediate use, or at any time during successive weeks or months until the stock of slips and covers is exhausted.

The slips are withdrawn from the case singly by pulling forward the mounting-table, and from this they are removed, either before or after an object is mounted, by inserting a finger into the notches cut into the sides of the table. The warning slip having been withdrawn, the service compartment is again filled by removing the sliding cover which carries with it the cover-glass case, withdrawing a loose partition and sliding the cleaned slips from a stock compartment into a service compartment.

Whenever a cover-glass is needed, the dust-excluder in front of the proper slot is opened by a touch of the finger, the milled wheel is rotated and the chamois-covered roller pushes the bottom cover-glass through the slot and out upon the grooved table, where it is readily grasped by the forceps. This action is positive, because the friction between chamois and glass is greater than between two clean glass surfaces. The table being grooved, only the extreme margins of the cover-glass touch it. A touch of the finger closes the dust-excluder.

It will be noted (*a*) that the slips and covers are doubly protected from atmospheric impurities by the dust-proof case and the constant contact of clean glass surfaces with each other; and (*b*) that in the process of removal for use they do not come in contact with any surface from which they receive dust. They come out as clean as when, weeks or months before, they were put into the case. Thns the dust problem is solved."

Visit to Messrs. Bausch and Lomb's Factory.*—The following is the description of a visit of the members of the American Microscopical Society to the works of the Bausch and Lomb Optical Company. These works "are situated on North St. Paul Street, No. 515, near the Genessee

* Proc. Amer. Micr. Soc., xiv. (1892) pp. 27–9.

river, which, however, does not give them any power, that being furnished by a steam engine.

The establishment was begun in 1859 as a spectacle factory, and has gradually increased until it is now one of the largest in the world devoted to making optical goods. There are at the present time 44,500 square feet of floor space, and about 500 hands are employed, and an addition is in process of construction which will add about 62,000 feet in area, and about 200 hands to the present plant. The new part will contain a Harris-Corliss engine of 500 horse-power that will furnish power for the entire establishment. Spectacle glasses, Microscopes, and photographic goods are the principal lines of work.

Until this year optical glass was all imported, but its manufacture has now begun in this country, and the first exhibit of American made optical glass was opened at this meeting in the hall of the Rochester University. Discs were shown 30 cm. in diameter and 4 cm. thick, free from striæ and perfectly annealed, made by the firm of Geo. A. Macbeth and Co., of Pittsburg, Penn. These discs are first ground on opposite sides so that they can be looked through to see if they are perfect, and are then stored till wanted. For some lenses the glass is pressed into nearly the shape required. A pair of small scales were shown with a piece of flint-glass on one side and a piece of crown three times as large on the other, and yet the scales balanced, that being nearly their relative specific gravities.

The general methods of making lenses are nearly the same for all kinds. It consists of making a pair of metal patterns or shells having the shape of the surface of each side of the lens, and then cementing the rough lens to one with pitch, while the other is rubbed over it with the aid of grinding powders of different degrees of fineness. First coarse emery is used, then fine emery, then rouge. The latter is merely a particular kind of iron oxide, some forms of which are also known as venetian red. Every particle of a coarser powder must be carefully washed off before a finer is applied, or scratches would result.

The finer Microscope lenses have to be made by hand, one by one, the laps or shells being on the end of little handles not larger than lead pencils, and the opposite lap being kept wet with ice-water, and rapidly turned by a spindle in the bench before the workman. Sets of finished glasses lying in the boxes look like gems. The metal-work of Microscope stands is made very largely by milling machines and turret lathes. The first are run with high speed and slow feed, to finish with one cut instead of two, the single cut leaving the work finished. The turret lathes carry all the tools required to finish a given piece, say an adapter, on a revolving tail stock, whereby a slight turn brings each one successively into action.

Arrangements are now being made to cut the racks on the better class of Microscopes with a spiral tooth, similar to that used for some time on the Zeiss instruments.

This brief description is not intended to be complete, but only to touch on those points likely to be of interest to the members of our Society."

β. Technique.*

(1) Collecting Objects, including Culture Processes.

Culture of Diatoms.†—In his concluding paper on this subject, Dr. P. Miquel describes several forms of cells which he has found convenient for preserving diatoms alive, and for propagating, observing, and photographing them. He has succeeded in keeping some species alive for as long as ten months, watching all the various stages of propagation as far as the production of auxospores.

Cultivating Ascospores on Clay Cubes.‡—Dr. H. Elion recommends cubes of clay 2 by 2 by 2 cm. for cultivating ascospores. These cubes are easily sterilized, and the ascospore formation which takes place on them is very satisfactory. The author finds they are superior to the gypsum blocks.

Growing Tubercle Bacilli on Vegetable Nutrient Media.§—Dr. Sander finds that the tubercle bacilli of mammals will grow, not only on potato, as was first pointed out by Pawlowsky, but in various other vegetable media, such as carrot, turnip, radish, and macaroni. On the three first media the growth presented the appearance of chalky white nodules, while on macaroni it was almost invisible. Hence it is possible that baker's bread, &c., may sometimes be the source of infection. The reaction of these media is not so restricted as it is for those of animal origin; indeed a slight degree of acidity appears to be not only beneficial but requisite. Access of air to the cultivation appears to be necessary. The most favourable temperature is rather high, viz. from 38°–39°. At 22°–23° no growth took place. The carrot, turnip, and radish were used as solid cultivation media after the manner of potato cultures in tubes, while the macaroni was soaked and then stuck on slips of glass, which were dropped into the test-tubes. The tubercle bacilli were found to grow also in fluid media made from potato. The juice obtained from mashed potatoes was decanted, and then placed in a water-bath for one hour. From this experiments were made showing that an acid reaction was necessary. One part was neutralized with soda, and after filtration, both were sterilized. Further, to another portion of each was added 4 per cent. of glycerin. The growth was strongest in the acid glycerin potato soup.

The author also states that under some circumstances the tubercle bacillus thrives in sterilized tap-water, and that the presence of mould does not prevent this development. In vegetable media the growth will usually be found to be more luxuriant and more rapid than in animal media, these properties becoming still more marked in the second and third generation.

Certain spheroidal bright bulgings occurring at the end of the bacilli

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

† Diatomiste, i. (1893) pp. 165–72 (3 figs.). Cf. this Journal, *ante*, p. 111.

‡ Centralbl. f. Bakteriol. u. Parasitenk,, xiii. (1893) p. 749.

§ Arch. f. Hygiene, xvi. No. 3. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 732–3.

are believed by the author to be an early stage of spore-formation. The author regards potato as being a superior cultivation medium for tubercle bacilli to glycerin agar, and in conclusion expresses the hope that, through vegetable cultivations, an attenuated virus, suitable for vaccination purposes, may eventually be procured. He states that the virulence of the tubercle is altered when cultivated on potato, and that this alteration increases with age.

Impervious Self-acting Self-regulating Stopper for Sterilizing Purposes.*—Dr. Pannwitz says that the rubber caps used for bacteriological purposes may also be used as stoppers for vessels when they are being sterilized. It is suggested that the lip of the tube, &c., should be broad. The rubber cap is perforated with a red-hot platinum wire at some part where it rests against the edge. The wire-made opening is of course under these circumstances quite impassable, but when the tubes or vessels are incubated, the pressure inside rises and causes the rubber cap to bulge outwards and so to open up the aperture. The author states that this device is quite effective, and that he has used it for some time for all kinds of sterilizing purposes. It certainly has the merit of extreme simplicity.

Improvising Bacteriological Apparatus.†—Prof. von Esmarch calls attention to the fact that bacteriological apparatus is often not at hand when most needed for diagnostic purposes, e. g. in an out-of-the-way place where cholera is suspected to have broken out, and under these circumstances makeshifts must be accepted. Yet nothing can supply the place of a Microscope and suitable accessories, and if these be absent almost all is lost. But other orthodox appliances can be done without and their place supplied by some temporary arrangement; for example, an incubator may be made of a saucepan in which is placed one kilo of acetate of soda dissolved in a little water, and then heated up to 60°. If the saucepan be covered up the vessel will retain sufficient heat for incubation purposes for 24 hours. Or if the vessel be filled with water at 37° a night-light placed underneath will maintain the temperature for practical purposes at the proper level.

Rapid Demonstration of Cholera Bacilli in Water and Fæces.‡—Dr. Schill says that old bouillon cultivations of cholera bacilli, which have been sterilized by boiling, form a most suitable basis for starting cholera cultures for diagnostic purposes. If the culture be some months old then 2–3 hours in the incubator after inoculation with fæces or water is quite sufficient for the purpose; if, however, the cholera bouillon be young then it may be necessary to incubate for 24 hours. Plate cultivations are next to be made of meat-pepton-gelatin and agar, the former kept at 20°, the latter incubated at 37°. At the same time it is advisable to make gelatin puncture cultures to see the characteristic liquefaction. A few loopfuls of the first tubes should be transferred to alkaline pepton water (1 per cent. pepton, 0·5 per cent. sodium chloride, 1 per cent. crystallized soda) to test for cholera red reaction which will,

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 754–5.
† Hygienische Rundschau, 1892, p. 653. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 628.
‡ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 750–2.

if the quantity of the virus inoculated be sufficiently large, be evident in three hours. This reaction is much better obtained if a few loopfuls of a cholera cultivation be placed on a white porcelain dish and then a loopful of sulphuric acid added, than in the usual way of pouring acid over a cultivation.

Present Position of the Bacteriological Diagnosis of Cholera.* — Prof. R. Koch discusses the diagnosis of cholera under several heads, viz. microscopical examination, cultures in pepton solution, on gelatin and agar plates, cholera red reaction, experiments on animals.

The author regards a microscopical examination of the alvine discharge as most important. Some of the mucoid secretion found in the motions or in the intestinal canal after death should be used for making cover-glass preparations, and these stained with dilute Ziehl's fuchsin solution. In cases of cholera such preparations are nearly always successful and frequently show the characteristic arrangement in clusters of the cholera bacilli.

The diagnosis is then to be confirmed by cultivating the organism simultaneously in pepton and gelatin. The tubes are incubated at 22° and 37° respectively. In 8 hours the pepton cultivation will have sufficiently developed to give the cholera red reaction if the cholera vibrio be present. In 20–24 hours the gelatin plates show the cholera colonies. Where there is considerable doubt at the first, agar plates should also be employed, and these inoculated from the pepton cultures after they have incubated for 6 hours, and 10 hours later the diagnosis may be confirmed by the red indol test.

Sometimes the cholera organisms develope slowly and in small numbers, both in pepton and gelatin. If in these there be none, but on agar some suspicious looking colonies, then a completely new set of cultures on all three media must be started and when ready submitted to the sulphuric acid test and experiments made on animals.

Cultures in pepton solutions are made by adding a few drops of the choleraic dejecta or a small quantity of mucus from the stools with a platinum loop to a sterilized 1 per cent. solution of pepton mixed with 0·5-1 per cent. of sodium chloride, and the reaction of the solution must be alkaline. The cultures are incubated at 37°. The pepton cultivations should be confirmed by gelatin plate cultivations. These are made of 10 per cent. gelatin and incubated at 22°. In 15–24 hours characteristic colonies will be apparent. On agar plates the colonies are of medium size and of a brownish-grey colour.

The cholera red reaction is regarded by the author as extremely important since the cholera vibrio is the only comma-shaped organism which gives the reaction. The reaction consists in the formation of a red colour when pure H_2SO_4 is added to a cultivation, and is due to the presence of indol and nitrous acid.

Experiments on animals are of importance since the cholera spirillum is the only one known which when injected into the peritoneal sac produces toxic effects. About 15 decimilligrammes—about as much as can be picked up on a platinum loop—is removed from an agar cultivation, mixed with a cubic centimetre of broth, and injected into the

* Zeitschr. f. Hygiene, xiv. No. 2. See Medical Week, 1893, pp. 265-9.

peritoneal cavity. Toxic symptoms appear soon after the operation, the temperature soon falls, and the animal dies.

Bacteriological Examination of Water for Cholera Bacilli.* — Prof. R. Koch finds that the following method is the most reliable for detecting cholera organisms in water. To 100 ccm. of the water to be examined, 1 per cent. of pepton and 1 per cent. of sodium chloride are added, the mixture being kept at 37°. At the end of 10, 15, or 20 hours a number of pepton tubes and agar plates are inoculated with this culture. The microscopical examination is so far of unimportance as all sorts of comma-shaped organisms are always to be found in water, but the colonies on the agar plate should be carefully examined under the Microscope in order to see if they consist of comma organisms. If so they should be transferred to fresh culture media for the cholera red test and for experiments on animals.

Cultivation of Leprosy Bacillus.†—Dr. A. Ducrey made numerous cultivations from leprous persons and succeeded in obtaining in grape-sugar-agar a growth which became evident to the naked eye six days after inoculation as a thin coating with indented edges. Cultivated *in vacuo* in bouillon the organism showed itself in 48 hours as a thin overlay on the side of the tube. A culture one year old in grape-sugar-agar and kept at 20° would, when transferred to bouillon and cultivated in the absence of air, still develope freely. The cultivations consisted of bacilli, which when stained with anilin-water-fuchsin and afterwards treated with alcohol were quite like leprosy bacilli in tissues. They are thin, straight, or slightly bent rods with rounded ends, of various lengths, but on the average somewhat shorter than leprosy bacilli. They are quite motionless. Many stain quite regularly, others show bright spots in their interior. Very short forms are also present and the chain or rosary form is not infrequent. They also stain well with gentian-violet methyl-violet, methylen-blue, by Gram's and the Koch-Ehrlich methods, but not by those of Ziehl-Neelsen, Gabbet, and Baumgarten. Inoculations on rabbits entirely failed.

The author identified his *in vacuo* cultivation with a cultivation obtained by Campana and de Amicis, and he finally succeeded in obtaining pure cultivations from his eight cases in simple bouillon cultures *in vacuo*.

Cultivating Gonococcus.‡—Dr. C. Gebhard cultivated gonococcus in blood obtained by catching this fluid, as it flowed from the vulva after expulsion of the placenta, in sterilized Erlenmeyer's flasks. The flasks were placed for 24 or 48 hours in a refrigerator, and then 1–3 ccm. of the serum were removed to so many sterilized test-tubes. After this the tubes were sterilized by heating them on 7 consecutive days for 1½ hours at 58°. The absence of germs was then tested by incubating the tubes for several days at 37°. Those tubes which contained the clearest serum were then mixed with 2 parts of meat-pepton-agar and allowed

* Zeitschr. f. Hygiene, xiv. 2. See Medical Week, 1893, pp. 265–9.

† Giorn. Ital. delle Mal. Vener. e della Pelle, xxvii. (1892) p. 76. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 627–8.

‡ Berl. Klin. Wochenschr., xxix. No. 14. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 565–6.

to set obliquely. In order to avoid entrance of germs when the fluids were mixed, the author mixed them before sterilizing the serum. The serum, which is stained brown from the hæmoglobin, can be used very well for plate cultures, and for this purpose it is recommended to use equal parts of blood-serum and meat-pepton-agar. The plates inoculated with some loopfuls of gonococcus pus show, when kept at the body temperature, in 24 hours, in addition to many other colonies, very small whitish-yellow points, which by the third day after inoculation have become so great that their characteristic irregular form can be descried with the naked eye. Magnified fifteen times, the deep-lying colonies are seen to be sharply defined, of irregular shape, and with many prolongations. The colour of the colonies is brownish and is due to optical causes and not the result of the presence of pigment. The growth of the deep-lying colonies is slow and ceases at the beginning of the second week when they have attained the size of a pin's head. The superficial colonies form pretty regular glassy scums with sharp irregular margins. On oblique media the colonies look like glassy drops 12 hours after inoculation.

Permeability of the Chamberland Filter to Bacteria.*—M. E. de Freudenreich records his observations on the permeability of the Chamberland porcelain bougie filter to bacteria. The same subject has been dealt with by other observers, notably Kitasato, Kübler, Giltay, Aberson, and Miquel. The author's apparatus was very simple, and consisted in placing the bougie inside a vessel filled with the infected fluid and filling the exhaust pipe close to the filter with cotton wool. The experiments were of two classes, those in which the fluid was bouillon infected with enteric fever bacteria, and water. Several experiments with the typhoid cultures showed that no bacilli passed through; cultivations made with the fluid drawn through remained quite sterile. In the second series water was filtered through at 35°, at 22°, and at the ordinary temperature of the room. In the first instance bacteria were cultivated from the filtered water passing through on the sixth day; in the second on the tenth day; while in the third it was sterile on the twenty-first. It is obvious therefore that germs do pass through, and that temperature plays an important part. For practical purposes therefore it is necessary that the filter should be sterilized once a week.

Plate Method for cultivating Micro-organisms in Fluid Media.†—Dr. P. Drossbach has devised a method for obtaining pure cultures. The principle consists in having a number of patches of nutrient material on one plate and infecting each plot with a very dilute solution of the fluid to be examined. The plates are made of stout glass in which are pressed or ground out a number of depressions from 2–3 mm. deep. The plates are about 100 sq. cm. in size and it is convenient to have plates with 3, 5, 9, and 16 depressions to the sq. cm. Plates which are not to be exposed to a high temperature are easily made by pouring paraffin in Petri's capsules to form a layer 3 mm. thick and when the paraffin has become cold making the necessary depression with a cork-borer or other tool.

* Ann. de Microgr., iv. (1892) pp. 559–68 (1 fig.).
† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 455–7.

The material containing the bacteria is to be diluted with bouillon until 2–3 ccm. of the fluid contains less than 1000 viable germs if each depression is to contain representatives of one species only. Excess of fluid should be removed from the surface with strips of stiff, smooth, sterilized paper. The plates are then incubated at any temperature and in a few days characteristic changes may be observed in the bouillon. If the fluid inoculated has been sufficiently diluted the number of pure cultivations will predominate. Special care is to be taken that the droplets do not run together.

Dr. K. Holten * states that he has used a similar method of cultivation for some time. A number of separate compartments are made in a glass plate by means of asphalt or the like substance. Each square space receives, by means of a fine pipette, a droplet of fluid; the fluid fills but does not exceed the whole space. To prevent contamination each plate should be covered with another, the two being about 2 mm. apart and separated by means of strips of asbestos fixed with some adhesive or by plaster of Paris.

The author uses plates 12 by 9 cm. divided into seventy compartments and finds that the larger the plate the better the result; the breadth, however, should not be too great to prevent every part from being examined under the Microscope. The plates may be dry or steam sterilized.

The material to be examined should be so diluted with the nutrient solution that not more than 1/4 of the drops are infected, and if the approximate number of germs in a definite quantity be unknown then plates of different dilutions must be made. If, however, it be important that the composition of the nutrient fluid should not be altered, then the nutrient medium must be correspondingly concentrated. The plates should be incubated in a moist chamber in order to compensate for evaporation. For a day or two the infected drops begin to get cloudy, and then they may be examined macroscopically and microscopically.

Action of Disinfectants on dry and wet germs.†—MM. Ch. Chamberland and E. Fernbach give the results of numerous experiments with eau de Javelle, chloride of lime, peroxide of hydrogen, and sublimate on *Bacillus subtilis*. This particular organism was selected on account of its great resisting power, and the action of the disinfectants was tested against the germs in the moist and dry condition. In the moist condition a definite quantity of a liquid culture was mixed with a definite quantity of the disinfectant, and the two well shaken up together. From the mixture cultivations were made at various intervals, some of the undisinfected cultivation being kept for control. The experiments on the germs in the dry condition were made in the usual manner, that is to say, they were dried on pieces of glass or silk threads. The authors conclude from their experiments that commercial eau de Javelle (hypochlorite of soda), chloride of lime (a solution of 100 grm. in 1200 grm. of water, diluted with ten times the volume of water), commercial oxygenated water (H_2O_2) are more active than an acid solution of sublimate (1–1000). These disinfectants do not, or only after several

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 753.
† Ann. Inst. Pasteur, vii. (1893) pp. 433–80.

hours, act on moist germs, if they be used at ordinary temperature, but if they be heated to 40°–50°, or even higher, moist germs are destroyed much more rapidly—a few minutes suffice. Hence it follows that whatever the disinfectant used, it should be made as hot as possible.

Dry germs are more resistant than moist germs ; while the latter are killed in a few minutes, the former may resist for several hours, even at a temperature of 40°–50°. Hence it follows that the germs must be moistened before the disinfectant can act. It was found that when dry germs were damped, especially with warm water, they were attacked after an hour's soaking, just as rapidly as if they had been wet. The necessity of spraying the walls of a room with water before using a disinfectant is therefore of paramount importance. The authors call especial attention to the fact that a saturated solution of calcium chloride is far less active than when this solution is diluted with 10 or even 20 times its volume of water; and that too on moist or dry germs at ordinary temperatures or at 50°.

The disinfectants used on *Bacillus subtilis* destroy very rapidly, in several minutes, and even when used cold, anthrax spores, *Aspergillus niger*, beer yeast, and the microbe of enteric fever.

For practical disinfecting purposes, the authors recommend the chloride of lime solution, as it is effective, economical, and not dangerous.

Method of using Thor Stenbeck's Centrifuge for detecting Tubercle Bacilli.*—Dr. L. Kamen first treats the sputum suspected of containing tubercle bacilli by Biedert's methods, and then with absolute alcohol, until the mixture has the same specific gravity as water. By this means the tubercle bacilli will be found to collect in the sediment, which, as their specific weight is only 1023, they will not do in the much heavier fluid, the gravity of which is never less than 1035.

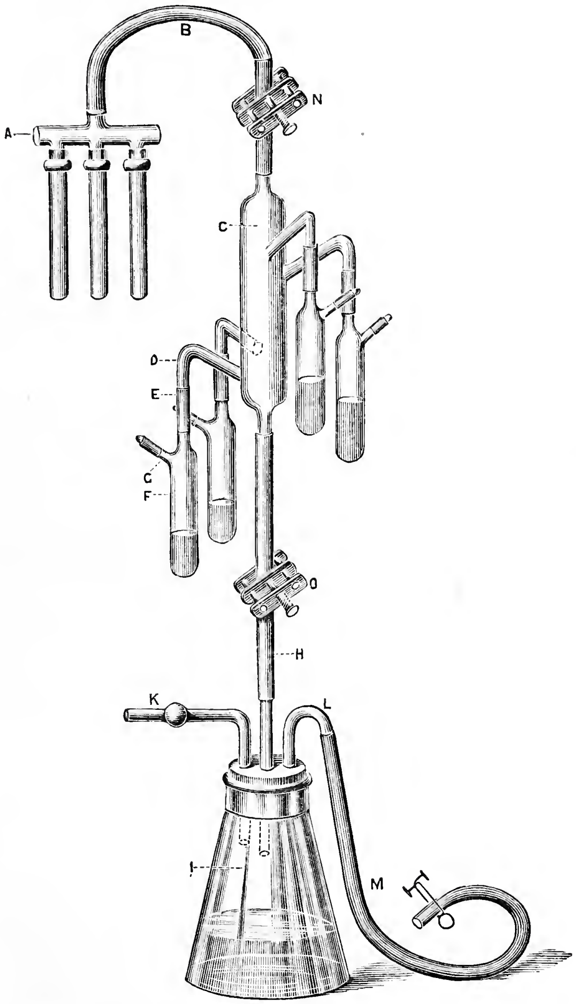
Method for Testing Filtering Apparatus.†—The opinions as to the value of Chamberland's bougies are, say Dr. E. Giltay and M. J. H. Aberson, extremely divergent, some persons regarding them as indispensable, and others as perfectly useless. It seemed desirable, therefore, to devise some method for accurately testing their value, and the authors have constructed an apparatus, by means of which samples of the water can be tested from time to time during the process of filtration.

A is a collector to which three bougies are connected on one side, while on the other it is connected by means of a rubber tube with a cylindrical glass vessel C, from which four elbow-pipes D come off. The elbow-pipes are, in their turn, connected with test-tubes containing nutrient gelatin, and the test-tubes, in addition to the inlet opening, have another tube at the side, the opening of which is plugged with cotton-wool. The vessel is connected below by means of a caoutchouc tube H with a receiver I, through the stopper of which three tubes pass, viz. K, L, and M ; K is plugged with cotton, and L-M is for drawing off the water ; it is kept closed by a pinch-cock. The bougies are tested

* Intern. Klin. Rundschau, 1892, No. 16. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 733–4.
† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 92–5 (1 fig.).

by plunging them in water, and fitting on a suction-pump to the tube K; the water then flows into the receiver I. When the latter is full the tubes B and H are closed by screw-clamps, and air of normal tension allowed to enter at K; the water can run out at M. A sample of water

FIG. 83.



can at any time be obtained by clamping the tube H, and fixing on the air-pump to the side tube G one of the four test-tubes, and when sufficient quantity has flowed into the tube F, the tube B must be clamped, and the suction-pump replaced on K. Of course E must be clamped before the test-tube is removed for incubation. In a similar way any of the test-tubes may be filled at any time during the filtering process.

The results obtained from filtering impure water by means of the Chamberland bougie were not at all satisfactory, for though the water which flowed through at first was germ-free, it soon showed contamination, and that therefore the porcelain filter is unable to deprive dirty water of its germs.

(2) Preparing Objects.

Eserin in Protistological Technique.*—Sig. P. Longhi finds that a mixture of 1·10 per cent. of eserin sulphate to 10 ccm. of which one drop of a 1 per cent. sublimate solution is added, is of excellent service for all Protista and especially for Rhizopoda. The general form is retained, the separate parts of the organism remain clearly apparent, the pseudopodia and cilia are fixed in their natural position, and there is no interference with hardening or staining.

Preserving Achlorophyllous Phaneragamous Parasites and Saprophytes.†—Prof. E. Heinricher finds that the troublesome blackening of certain plants, e.g. *Lathræa*, which occurs when preserved in spirit, or by pressure, may be avoided by steeping them in boiling water and continuing the boiling for about a quarter of an hour. After this they are transferred to spirit or pressed, when it will be found that there is scarcely any blackening at all.

Nor are these the only advantages offered by this simpler procedure, for it is well known that boiling water acts as a fixative, and hence the method is advantageous for anatomical purposes.

Preparation of Vegetable Objects.‡—Herr W. Bieliajew recommends the following mode of treatment of microtome-preparations. The fixing is effected by Perenyi's fluid, 3 pts. 0·5 p.c. CrO_3, 4 pts. 10 p.c. HNO_3, 3 pts. alcohol. After fixing and staining, the object is gradually transferred to absolute alcohol and pure xylol, and then placed for a day in a saturated solution of paraffin in xylol at a temperature of 35°; finally warmed to 47°, and then placed in paraffin melting at 45°. The object is simply placed on the slide which has been moistened with distilled water, and the water allowed to evaporate.

Objects which contain no vacuoles, such as spermatozoids and their mother-cells, are first stained on the slide, and some gum arabic added and allowed to dry; and the object becomes then so firmly attached that both the fixing material and the gum can be washed away without disturbing it.

Isolation of Living Protoplasts.§—Herr J. af Klercker isolates protoplasts by first plasmolysing pieces of leaf or sections of larger organs to such an extent that the protoplasts become detached on all sides from the cell-wall. The sections are next cut to pieces in the plasmolysing solution, when some of the contracted protoplasts escape

* Boll. dei Musei Zool. e Anat. Comp. della R. Univ. Genova, 1892, No. 4. See Zeitschr. f. wiss. Mikr., ix. (1893) p. 483.
† Zeitschr. f. wiss. Mikr., ix. (1893) pp. 321–3.
‡ Scripta Botanica, 1892, 12 pp. See Bot. Centralbl., liv. (1893) pp. 105 and 6.
§ Ofvers. K. Vetensk. Akad. Förh. Stockholm, 1892, pp. 463–74 (8 figs.).

into the fluid. They are then observed either in a capillary space formed by a combination of cover-glasses, or in the culture-apparatus for running water described by the author. The chromoplasts have the appearance of being compressed by an outer elastic layer. The isolated protoplasts were found to be surrounded by a clear margin which is in active motion, and is composed of cilium-like threads. The inner side of the wall of the vacuoles was in places clothed by streams of granular protoplasm. The observations were made chiefly on *Stratiotes aloides*.

Histological Observations on Hydromedusæ.*—Dr. M. Chapeaux, in using the teasing method, fixed the polyps with a mixture of ·1 per cent. osmic acid and ·2 per cent. acetic acid, in which they were left for some time; they were then placed for twenty-four hours in 1 per cent. acetic acid. Maceration being finished, the tissues were teased, and various carmines or hæmatoxylin were used for staining; this was effected with difficulty. If maceration was effected with 1 per cent. osmic acid for from twelve to twenty-four hours, it was impossible to stain the elements, but teasing was easy, and the cells did not really require to be stained.

If it is proposed to make sections, the best method for fixing the polyps in a state of extension is to treat them with 1 per cent. osmic acid for fifteen hours, or 2 per cent. for a less time; the protoplasm of the cells is stained yellowish brown, while the contained granulations are of a dark hue. Flemming's solution may be used, and although concentrated sublimate does not give equally good results, tissues that have been treated with it can be stained.

Graafian Follicle.†—Dr. J. Schottlaender in his study of Graafian follicles used Flemming's chromo-osmic-acetic mixture, Rabl's platinum chloride and chromo-formic acid method, &c. Safranin, gentian-violet, alizarin, &c., were used as stains; celloidin and photoxylin for imbedding.

Methods of Decalcification.‡ — Prof. S. H. Gage discusses the methods of decalcification in which the structural elements are preserved. He points out the necessity of a "restrainer" or chemical substance, which will restrain the decalcifier from injuring the soft parts. In 1888 it was discovered that the gelatinizing and softening action of nitric acid—the great decalcifier—was almost wholly obviated by the use of a saturated aqueous solution of alum to every 100 ccm. of which 2 grm. of chloral hydrate are added. As a satisfactory fixer and hardener, the author recommends a mixture of 500 ccm. water, 500 ccm. 95 per cent. alcohol, and 2 grm. of picric acid. The tissue is left one to three days in the picric alcohol, one to three days in 67 per cent. alcohol, and then put in 82 per cent. alcohol. For decalcification 67 per cent. alcohol and 3 ccm. strong nitric acid may be used, when the alcohol acts on the restrainer; or use is made of a saturated aqueous solution of alum diluted with an equal volume of water, to every 100 ccm. of which 5 ccm.

* Arch. de Biol., xii. (1892) pp. 661 and 665.
† Arch. f. Mikr. Anat., xli. (1893) pp. 219–91 (2 pls.).
‡ Proc. Amer. Micr. Soc., xiv. (1893) pp. 121–4.

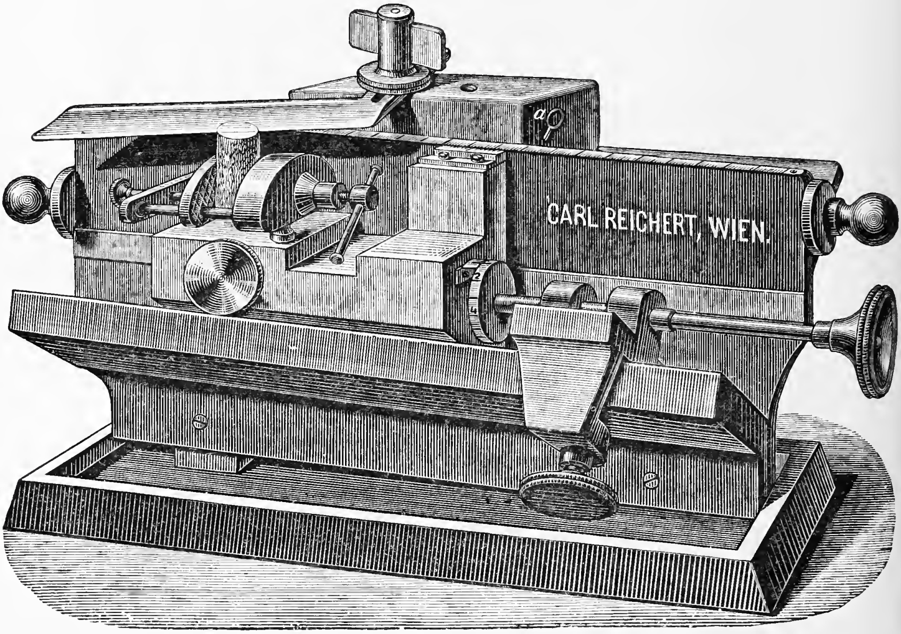
of strong nitric acid is added. After, in either case, remaining in 67 per cent. alcohol for a day, the tissue is kept in 82 per cent. alcohol till it can be cut.

Sections may be made free-hand or the collodion method may be used; details of the method are given. For staining, nothing has been found superior to the author's hæmatoxylin (see p. 564) and eosin or picric acid.

(3) Cutting, including Imbedding and Microtomes.

Reichert's Microtomes with Oblique Planes.*—In the smaller instrument, represented of half its natural size in fig. 84, the object slide is moved forward on the oblique plane either by hand or by means of a micrometer screw which is provided with a snap-arrangement. The knife-slide and also the object-slide rest on fine points. The object-

Fig. 84.

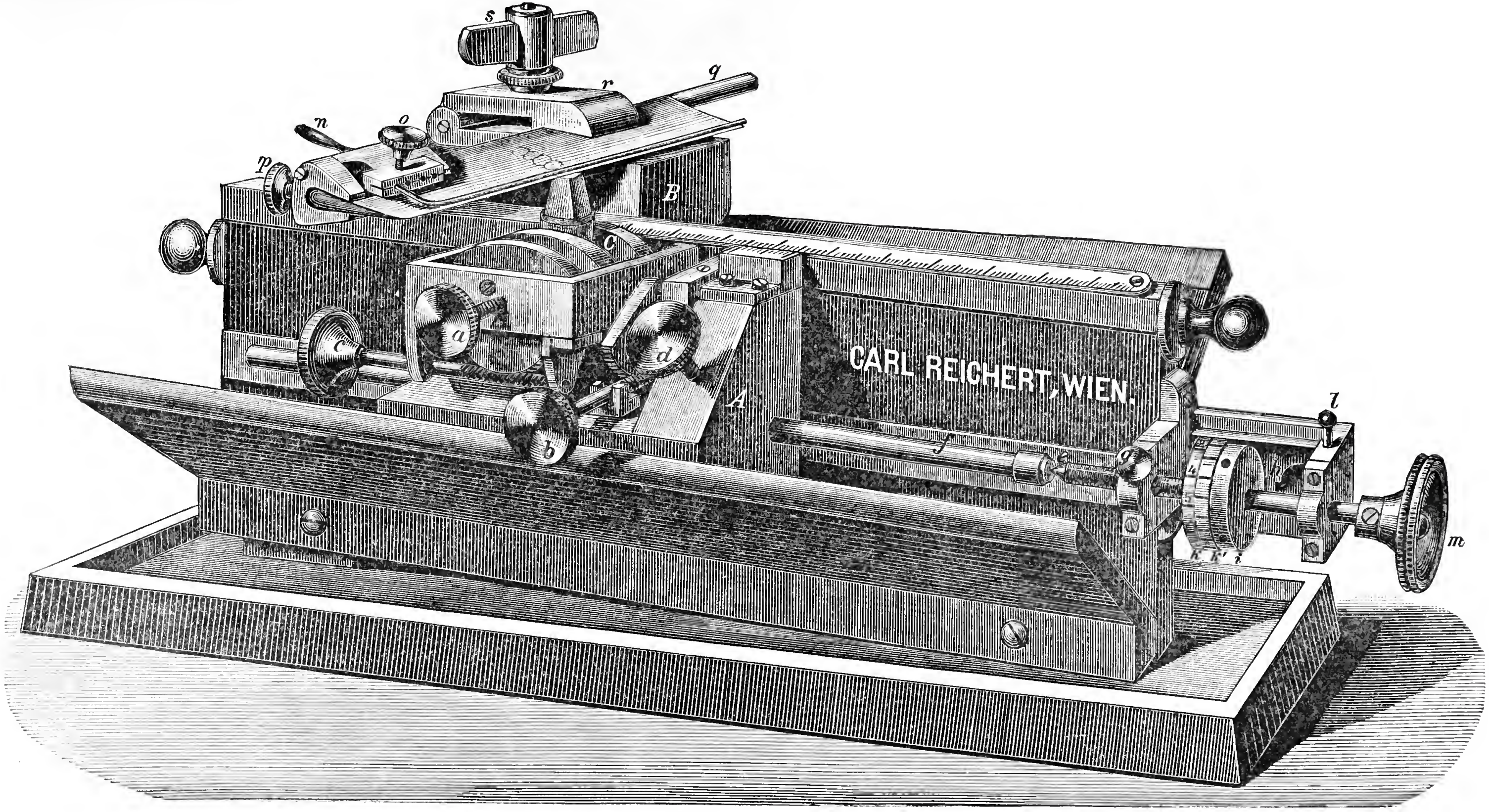


clamp has a ball-and-socket joint to enable the object to be easily brought into any desired position. The length of the slide-way for the knife = 25 cm. The slide-ways and the body of the microtome are made of cast iron, the guiding points of the knife and object-slides of steel or ivory. The apparatus is nickeled to protect from rust.

The second instrument, of larger size, represented in fig. 85, has a length of slide-way of 30 cm. The forward movement of the slide is effected by a micrometer screw which allows the object-slide to be

* Reichert's Catalogue No. 18 (1892).

FIG. 85.



raised by 0·001 mm. and upwards. The instrument is provided with an adjustable snap-arrangement to enable any given thickness of section, within certain limits, to be obtained. It also possesses a clamp by which the knife may be adjusted square for the production of series of sections.

(4) Staining and Injecting.

Double-Staining for Distinguishing Living and Dead Substances after their Preservation.*—Dr. L. Rhumbler recommends a mixture of 50 parts of a 1 per cent. watery solution of methyl-green, 50 parts of a solution of 0·8 grm. eosin in 50 per cent. alcohol, and 50 parts of absolute alcohol. With material preserved in picro-sulphuric acid or alcohol the stain acts, on sections and small pieces, in half an hour. After washing with water the material should be placed in alcohol of increasing strengths. Clearing and imbedding materials may be used as desired.

This mixture has the property of staining brilliant red all the substances which were alive when the material was preserved, while all dead organic or inorganic substances are stained bright green. In other words, the eosin acts on living substances as though there were no methyl-green in the mixture, and methyl-green acts as if there were no eosin.

Organic substances which were beginning to break up at the time of preservation, or which consist of a mixture of organic and inorganic masses, as well as most of the secreted products of protoplasm, such as certain cell-membranes, the fresh secreted cementing substances of Rhizopod shells, and glandular secretions take both stains, and are reddish-violet, violet, blue or blueish-green, according to the proportion of dead or living material. The author recommends the mixture for the study of small organisms, especially Protozoa.

It is particularly useful for finding minute organic bodies in mud or masses of detritus; it is hardly possible to imagine a greater contrast than there is between the small living things and their surroundings. It is good also for distinguishing ingested food particles from other protoplasmic constituents in the bodies of Protozoa. The method is said to afford an absolutely certain means of distinguishing between living and dead substances, and it gives a good clue as to the age of secreted substances.

The author concludes with notes on some of his results, a fuller account of which will be given when he deals separately with the organisms investigated.

Staining of Protoplasts and Cell-wall.†—Herr J. af Klercker recommends the following process for the staining of protoplasts in microtome-material. If the object examined is an aerial part of a plant, the oily substances are first removed by ether or dilute ammonia, and, after washing out the fixing material, the object is allowed somewhat to dry in order to promote the entrance of the staining substance. But if it is only the membrane which is to be stained, the object is brought, directly or after washing out the fixing material, into eau de Javelle or eau de Labarracque, and left there till all the protoplasm is dissolved. After

* Zool. Anzeig., xvi. (1893) pp. 47, 57–62.

† Verhandl. Biol. Ver. Stockholm, iv. (1892) No. 14, 4 pp. See Bot. Centralbl., liv. (1893) p. 41.

careful washing, it is then stained with a moderately concentrated solution of congo-red, and finally, after careful washing, placed in paraffin. A good staining of membranes may also be effected by successive treatment with iron salts and potassium ferrocyanide, or with tannin and ferric chloride.

Metachromatism of Parasitic Sporozoa and Carcinoma Cells.*— Dr. J. Ssudakewitsch states that in 150 cases of cancer the number of sporozoa was very variable, but only in six cases were they absent altogether. Associated with undoubted Sporozoa were forms simulating nuclei, and white blood-corpuscles, and from the appearances it became sometimes difficult to discriminate between the parasite, alterations of the nuclei, invaginated cancer cells and leucocytes. The author here gives the result of observations on the colour assumed by the Protozoa as contrasted with the tissue cells.

(1) The preparations stained with Ranvier's hæmatoxylin were fixed with 1 per cent. osmic acid, and after having been washed in water were placed in Müller's fluid for 3, 4, to 6 days, and afterwards hardened in alcohol increased in strength from 70° or 96°. The preparations had a grey look.

The nuclei of the connective tissue cells, leucocytes, and cancer cells are stained a dirty violet, while all but a few of the Sporozoa were a pure violet (metachromatism).

(2) Objects stained with safranin were fixed in Flemming's fluid, and after soaking in water for 1, 2, 3, or 4 days were immersed in a saturated watery solution of safranin and having been differentiated with alcohol acidulated with HCl or HNO_3, mounted in the usual way. The preparations were brownish, and the resting as well as the mitotic nuclei of the cancer cells were of the usual red colour. The amœboid Sporozoa, the inter- as well as intracellular, had a brownish-yellow hue; while all the capsulated forms were violet (not a pure but a dirty tone).

(3) Methylen-blue preparations were taken from Flemming's fluid or from alcohol and immersed for 24 hours in a saturated anilin-water solution of methylen-blue. Thus prepared the tissue cells were of an olive-green colour and the Sporozoa blue. In one case, by after-staining with eosin, some of the Sporozoa were stained violet, the tissues being of a pale rose tint.

The illustrations given are extremely effective.

Protozooid Appearances in Carcinoma and Paget's Disease.† — Dr. L. Török considers that the appearances observed in carcinoma cells and Paget's disease are those of degeneration affecting the cell-plasma and nucleus, and giving rise to very complicated figures. Only by numerous methods of staining can the deceptive appearances be properly distinguished. The tissue should be fixed in absolute alcohol, 5 per cent. sublimate alcohol, Flemming and Demarbaix's fluid, and stained with different solutions of carmine, hæmatoxylin, and safranin.

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 451–5 (1 pl., colrd.).

† Monatsbl. f. Prakt. Dermatol., March 1, 1893. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 496.

Safranin Nuclear Reaction and its Relation to Carcinoma Coccidia.*—Prof. A. P. Ohlmacher, while disclaiming any intention of disputing the existence of Sporozoa in cancer, or of throwing discredit on safranin as a stain, shows that many of the appearances depicted by some observers, e. g. Podwyssozki, Sawtschenko, are artificial crystalline products, the result of a safranin and iodine reaction. The author's results as summarized by himself are as follows:—A precipitation of deep red material may be produced when solutions of safranin and iodine or safranin and picric acid are mixed, directly. A similar precipitation is produced in tissues and sections when safranin and iodine or safranin and picric acid are used for staining. The precipitate occurs in any of the elements, either of normal or pathological tissue, and may occur either in the nucleus or in the cytoplasm. This artificial product occurs in the cells of sections of carcinoma tissue, prepared as directed by Podwyssozki and Sawtschenko. Therefore, the multiform red particles occurring in the cells of carcinoma tissue prepared by the safranin picric acid method are artificial products; and since Podwyssozki and Sawtschenko base their arguments on the presence of these red formations in their "coccidia," such conclusions must be valueless.

Nerve-endings in Muscle.†—Prof. L. v. Thanhoffer recommends a modification of previous methods. Let the sartorius of frog or lizard be stretched on cork with porcupine spines, split longitudinally, and subjected to a modification of Löwit's gold method. The preparation is placed, till it swells, in a mixture of 1 part formic acid and 2 parts water; it is then transferred to the gold bath, but this is arranged in such a way that osmic acid (in an adjacent vessel) acts along with the gold. After being washed in water, it is left for 24 hours in the original mixture in a dry place. Then it is washed and laid in glycerin. A new treatment recommended is as follows:—The muscle is placed for 10 minutes in 1 per cent. hyperosmic acid, washed, left for 20–30 minutes (in a dark place) in Höllenstein solution, washed, and exposed to sunlight for 10–30 minutes in water with some acetic acid. The author hints at some of the good results he has reached by means of both methods.

Restoration of Osmic Acid Solutions.‡—Mr. C. L. Bristol recommends the addition of 10 to 20 drops of fresh peroxide of hydrogen to 100 ccm. of a 10 per cent. solution of osmium tetroxide, when the latter has been reduced and turned black. The chemical reaction shows there are no injurious changes, for we have OsO_4 + organic substances converted into OsO_2 + oxidized organic substance; and $OsO_2 + 2\,H_2O_2$ converted into $OsO_4 + 2\,H_2O$. Peroxide of hydrogen may also be used to bleach tissue which has been overblackened by osmic acid.

Trustworthy Solution of Hæmatoxylin.§—Prof. S. H. Gage describes an aqueous solution of hæmatoxylin which does not readily deteriorate. As he suspected that the dark precipitate which so soon

* Journ. Amer. Med. Assoc., xx. (1893) pp. 111–7 (1 pl., colrd.).
† Math. Nat. Ber. Ungarn, viii. (1891) pp. 433–40.
‡ Amer. Natural., xxvii. (1893) pp. 175 and 6.
§ Proc. Amer. Micr. Soc., xiv. (1893) pp. 125–7.

appears might be due to the presence of living forments he prepared a solution of the following composition:—Distilled water 200 ccm.; potash or ammonia alum $7\frac{1}{2}$ grm.; chloral hydrate 4 grm.; hæmatoxylin crystals 1/10 grm. This aqueous solution had, at the time of writing, been treated for nearly a year, and there was not then any deposit, while the action of the stain was as good as at first. In preparing the solution the water and alum should be boiled in an agate or porcelain vessel for from 5 to 20 minutes, to destroy any germs in the water or alum. As hæmatoxylin is almost a pure nuclear dye it is recommended that a counter stain be used with it; eosin is very good, and for many objects picric acid is suitable.

Ruthenium-red as a Staining Reagent.*—M. L. Mangin recommends the use of the ammoniacal oxychloride of ruthenium or ruthenium-red discovered by M. Joly, as a staining reagent for vegetable tissues. It is soluble in water, concentrated calcium chloride, and solution of alum; insoluble in glycerin, alcohol, and essence of cloves. It belongs to the group of basic pigments, inert to cellulose and callose, but taken up eagerly by pectic substances. It is, in fact, the best staining reagent for the analysis of vegetable membranes; the staining resisting powerfully the influence of alcohol and glycerin. It is also permanently fixed by gums and mucilages derived from pectic compounds, but does not stain mucilages derived from cellulose, or from the products of the liquefaction of callose. Illustrations of these reactions are given in the cases of various tissues and organs.

Staining Properties of Oxychloride of Ammoniacal Ruthenium.†—The staining properties of this substance, the formula for which is $Ru_2(OH)_2Cl_4(A_5H_3)7 + 3H_20$ have been examined by MM. M. Nicolle and J. Cantazucène. It exists as brownish crystals, and is soluble in water and glycerin, but not in alcohol. It appears to be easily acted on by acids and alkalies. The authors used an aqueous 1 per thousand solution in which the sections were immersed for one to two minutes, after which they were dehydrated and mounted in balsam. It imparts a beautiful red hue and has special affinity for the nuclear chromatin. It may be used after most fixatives, and while it is stated to give brilliant results after osmic acid, it is inert after Flemming's solution or after osmic acid plus bichromate. Its potentialities are not confined to sections as it stains cover-glass preparations and all micro-organisms, except the tubercle and leprosy bacilli. Its chief merits seem to be that it picks out the nuclear chromatin very well, and that it is insoluble in alcohol.

A new Staining Method for Neuroglia.‡—Prof. N. Kultschitzky has discovered in *Patentsaures Rubin*, prepared by the "Berliner Anilinfarben-Actiengesellschaft," a very successful stain for neuroglia, which renders the cells and the fibres a beautiful red-violet colour.

For fixing and hardening, the following mixture is used:—50 per cent. methylated spirit, plus so much bichromate of potassium and sulphate of copper as will dissolve in the spirit to which 1/2 to 1 per cent.

* Comptes Rendus, cxvi. (1893) pp. 653–6.
† Ann. Inst. Pasteur, vii. (1893) pp. 331–4.
‡ Anat. Anzeig., viii. (1893) pp. 357–61.

acetic acid has been added. The exclusion of light during the fixing is essential. From the mixture the tissue is transferred direct to strong alcohol. The hardening may require to be prolonged for 2 to 3 months.

The staining mixture consists of 2 per cent. acetic acid solution 100 parts, "patentsaures Rubin" 125 parts, and saturated picric acid solution in water 100 parts. In a few seconds the staining is sufficient. Thereafter the preparation is washed in 96 per cent. alcohol. The rubin stain is almost insoluble in alcohol.

Negative Staining Method for Finding Tubercle Bacilli.*—M. Solles' method consists in cutting up the tissue to be examined into small cubes, placing these in absolute alcohol for 12 hours, then in ether for 12 hours, and finally for an equal time in collodion. Sections, when made, are placed in the following fluid composed of two solutions, which are to be mixed just before using. (1) Aq. destill. 100·0; Berlin blue, 1·0; oxalic acid, 0·2. (2) Aq. destill. 100·0; gelatin, 1·0. All the anatomical elements of the tissues pick up the pigment, the micro-organisms remaining unstained. The author applied this method to the study of the morphology of the tubercle bacillus, and thinks he has determined the presence of spores by it. This negative staining method could also be applied to detect the presence of micro-organisms in carcinoma.

(5) Mounting, including Slides, Preservative Fluids, &c.

Mounting Medium for Algæ and Fungi.†—Dr. A. A. Julien recommends the following solution, an indirect outcome of Ripart and Petit's formula, for mounting organisms with endoplasm of ordinary density, e. g. most of the filamentous Algæ:—Copper chloride, 0·1 grm.; copper nitrate, 0·1 grm.; chloral hydrate, 0·5 grm.; distilled water, just boiled, 100·0 ccm. The trace of acidity is removed from the solution in the following manner. Another solution is prepared of a few grams of any soluble copper salt; to this a weak solution of caustic potash is added in slight excess; the hydrated copper oxide is then washed thoroughly, first by decantation and then upon a filter. The purified residue is then thrown into 100 ccm. of the preservative fluid already prepared, and the mixture frequently shaken at intervals until a neutral reaction is shown by test papers, when it is filtered.

Spiral Springs for Manipulating Cover-glass Preparations.‡—Dr. A. A. Julien uses the spiral brass spring suggested by F. L. James,§ for carrying cover-glass impressions. A cork encircled by the spring is wired to the bottom of a small round pasteboard box, and a little tuft of soft tissue paper or cotton wool between the edge of the inserted cover-slips and the side of the box prevents any dislodgment.

The author also applies the spiral spring to staining cover-glass preparations. Here the spring is a straight one and made of brass or platinum wire. Between the coils cover-glasses, which have been

* Le Bulletin Méd., 1892, p. 865. See Centralbl. f. Bakteriol. u Parasitenk., xiii. (1893) p. 670.
† Journ. New York Micr. Soc., ix. (1893) p. 39.
‡ Tom. cit., pp. 24 and 6 (2 figs.).
§ This Journal, 1887, p. 693.

previously prepared, are inserted; one end of the spring is attached to a cork stopper and then lowered into a broad-necked bottle containing the solution. Of course several bottles with different reagents may be used; for example, in staining flagella of bacteria, one bottle may hold the mordant, another the stain, and so on.

Mounting large Sections of Vegetable Preparations.*—Dr. H. Schenck mounts large sections in the following simple manner. The sections are placed for 24 hours in a mixture of equal parts of spirit and glycerin. They are then transferred to pure glycerin until they are perfectly saturated therewith. This takes at least some hours, and it is well to let the preparations soak for a whole day. The sections are then removed and carefully dried between folds of blotting-paper, so that all the superfluous glycerin is removed. The next step is to pour some thin flowing xylol-balsam on the slide. In this the preparation is placed and carefully smoothed down with a brush, and any air-bubbles removed with a needle and blotting-paper. The surface of the section is then covered with balsam, after which the cover-glass is put on. The preparation must now be placed on a perfectly flat surface and allowed to dry in this position. When dry the excess of balsam on the slide may be easily removed with a knife or with some solvent.

For lecture purposes the foregoing method gives very satisfactory results as the outlines of the tissues and cells are quite clear, and easily made out with a hand-lens or low powers.

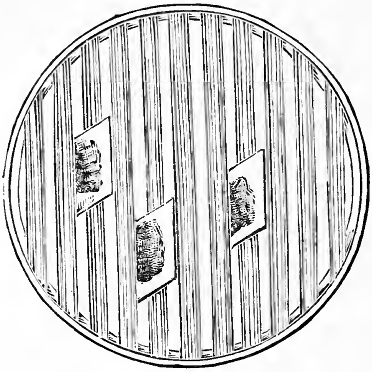
Balsam-paraffin for Cells.†—Dr. A. A. Julien observes that the mixture of balsam and paraffin for making cells deserves to be better known. Balsam-cement is first prepared by slow evaporation of commercial Canada balsam in a shallow tin pan over a low flame until the point is reached of wax-like consistence on cooling, as tested on drops removed and cooled from time to time. About a quarter of a pound of the hardest commercial paraffin, melting point above 45° C., is heated over a low flame to the melting point, a piece of balsam-cement, size of a nut, is then added, and the mass digested with frequent stirring for about an hour until all the paraffin has a slight yellowish tinge. The stock is preserved in a shallow porcelain capsule, so that when required it can be readily warmed up. A cell made with this paraffin-balsam is ready for use directly after it is spun.

Apparatus for Holding Cover-glasses.‡ — Dr. Veranus A. Moore writes as follows:—"When sections of animal tissue are fastened to cover-glasses § in order to transfer them from one bath to another during

* Bot. Centralbl., liv. (1893) pp. 1-4.
† Journ. New York Micr. Soc., ix. (1893) pp. 39-43.
‡ Proc. Amer. Soc. Micr., xiii. (1892) pp. 51-3.
§ "In fastening sections to cover-glasses care must be exercised in the choice of some method of fixation which will not leave a film on the cover that will be tinted to any degree by the stain used. I have had some trouble in this respect with the gelatin, albumen, and collodion processes when certain anilin dyes were subsequently employed.

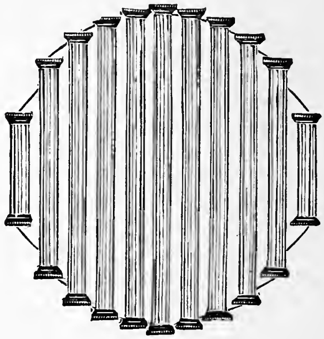
A method which seems admirably adapted to this process of handling sections is the *paraffin-alcohol method* described by Dr. A. Canini in the Archiv f. Anat. u. Phys., Phys. Abth., 1883, p. 147. It consists simply in placing the section on a cover-glass directly from the section knife and adding a few drops of dilute alcohol the process of their preparation for mounting, there seems to be no reservoir in the list of histological apparatus that is well suited to their use. The ordinary solid watch-glass, crystallizing dish, &c., is objectionable, as the cover-glass falls at once to the bottom, from which it is removed with difficulty, and, again, when several specimens are being prepared at the same time they almost invariably run together in the form of *rouleaux*, the separation of which is attended with great danger to the

Fig. 86.



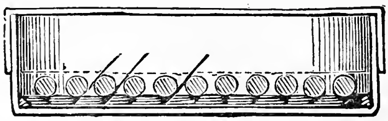
The bottom of the reservoir as seen from above, with cover-glasses in position.

Fig. 88.



A mat of glass rods.

Fig. 87.



Cross-section of reservoir.

sections. These difficulties have rendered this otherwise very convenient method of handling sections, when from their nature a support is necessary, so objectionable that the cover-glass is seldom used by histologists for this purpose. In order to eliminate these difficulties I have devised the following apparatus for holding the cover-glass during the hydration, staining, dehydration, &c., of the sections, which I have found to work admirably.

The apparatus consists simply of a 'double dish' 15 cm. in diameter and 2·5 cm. in depth, in which glass rods are arranged parallel to each

(60 to 70 per cent.). The cover is then placed in a paraffin oven at a temperature of about 50° C., where it remains until the alcohol is evaporated. This method was also highly recommended by Ogata in his work on the pancreas cell. It is applicable only to sections cut by the paraffin method.

I am indebted to Dr. Theobald Smith, of the Bureau of Animal Industry, Department of Agriculture, and Prof. W. H. Welch, of Johns Hopkins University, for valuable information concerning this method."

other and separated by a distance of about 4 mm. The rods are about 5 mm. in diameter. They are raised about 2 mm. from the bottom of the dish and fastened only at the extremities, thus permitting of a free circulation of the liquids. The cover-glasses are placed on edge between the rods, against which they rest (fig. 86). A reservoir of this size will hold, without crowding, thirty preparations on 3/4-in. covers. It is desirable to have a reservoir for each of the liquids used. The cheapness with which they can be made does not render this objectionable.

The construction consists in procuring the desired number of 'double dishes,' a few feet of glass rod, and an ounce or two of liquid glass (silicate of soda), or a few feet of fine copper wire. The glass rod is easily broken, by the aid of a file, into pieces of the required length, which are fastened in their respective places by means of a few drops of the liquid glass. In order to raise them from the bottom of the dish a ring composed of the liquid glass is built up around the edge, upon which the ends of the rods can rest and upon which they are fastened. As the silicate of soda is soluble in water and dilute alcohol, it is necessary to dehydrate it after the rods are fixed, so as to render it insoluble. This can be done by heating the reservoir in an oven or hot-air chamber at a temperature of about 98° C. If the reservoir is to be used only for turpentine, absolute alcohol, &c., the drying of the silicate of soda in the air is sufficient.

Instead of fastening the rods in the dish they can be bound together by means of fine wire, preferably copper, in the form of mats, which answer every purpose, and which can be removed at will if the dish is desired for other purposes. This is easily accomplished by running the wire around the ends of the rods after they have been cut the desired lengths. A shoulder-like projection can be procured on the ends of the rods by heating them until soft and pressing them against a firm surface. These prevent the wire from slipping off, and also raise the rods from the bottom of the dish (fig. 87).

With a full set of these reservoirs thirty cover-glasses can be carried from the first to the last liquid quite as quickly as a single preparation, for the time necessarily required for the action of the various reagents on a single specimen can be profitably employed in transferring other preparations. The cover-glasses can be handled very quickly, neatly, and with perfect safety with a pair of fine forceps."

(6) Miscellaneous.

Demonstration of Heliotropism.*—Herr F. Noll has constructed a heliotropic chamber for the growth of *Pilobolus crystallinus*. Light is admitted to the chamber only through a round pane of glass on one side. When the fungus was grown on a suitable substratum within the chamber, it was found that the sporanges had all discharged their spores on to the pane of glass, many of them striking it almost in the centre.

Demonstrating the Pigment of the Florideæ.†—Herr F. Noll describes a contrivance for exhibiting in the lecture-room the mode in which the green colour of the chlorophyll is completely masked by the

* Flora, lxxvii. (1893) pp. 32–7 (1 fig.). † Tom. cit., pp. 27–31.

red pigment in the Florideæ. This is effected by filling a flask made of green glass with a solution of potassium permanganate, when the green colour is completely absorbed, and the glass appears as if colourless.

Detection of "Masked Iron" in Plants.*—Dr. H. Molisch withdraws his previous statement as to the invariable presence of "masked iron" in plants, on the ground that the reagent employed, potassium hydrate, invariably contains traces of iron. Even when the amount of iron employed is so small as not to be detected by the most delicate chemical tests, vegetable tissues have the remarkable property of withdrawing it entirely from solution.

* Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 73–5. Cf. this Journal, 1892, p. 632.

PROCEEDINGS OF THE SOCIETY.

Meeting of 21st June, 1893, at 20 Hanover Square, W., The Rev. Edmund Carr, M.A., in the Chair.

The Minutes of the Meeting of 17th May last 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 submitted, and the thanks of the Society were given to the donors.

	From
M. I. Cross and M. J. Cole, Modern Microscopy. (8vo, London, 1893)	*The Publishers.*
O. Janson, Versuch einer Übersicht über die Rotatorien-Familie der Philodinaeen. (8vo, Bremen, 1893)	*Mr. C. Rousselet.*
Crystals and a Slab of Selenite from Utah	*Dr. J. E. Talmage.*

Dr. W. H. Dallinger called attention to a thoroughly practical and extremely useful little book which was one of the donations. It was entitled 'Modern Microscopy,' and consisted of two parts, the first of which, by Mr. Cross, dealt with the instrument and the manner of using it, and the second, by Mr. Martin J. Cole, was devoted to the preparation and mounting of objects. Although consisting only of 104 pages, it dealt with the various questions in a masterly way, and was a book which he should certainly commend to the attention of those who were beginners in the use of the Microscope.

Prof. F. Jeffrey Bell said that at the preceding meeting it had been proposed to fill the vacancy caused in their list of Honorary Fellows by the disappearance of Prof. Fol, by the election of Dr. Robert Hertwig. It had since been discovered that a mistake had been made in the Christian name of the gentleman who had been proposed, and it was desired, therefore, to rectify the error by submitting a fresh nomination paper in favour of Dr. Oscar Hertwig.

Dr. J. E. Talmage, of Salt Lake City, Utah, exhibited and described some specimens of selenite. He said that he was by no means sure that the presentation of such [large] specimens as were on the table, before a Microscopical Society, was strictly appropriate. Certainly, at first glance it would appear that the Microscope was hardly called for in the examination. However, as selenite possesses some peculiar optical properties, there might be a shadow of propriety, enough at least to serve all needed purposes of excuse, in his taking their time that night in offering such an exhibition.

In the spring of 1892, while prosecuting a journey along the course of the Colorado river for the purpose of visiting some of the numerous cliff dwellings in the canyons which give passage to the tributaries of that mighty stream, he was fortunate enough to come across a very remarkable formation of crystallized gypsum, situated in the southern part of Utah Territory. He felt justified in pronouncing the formation remarkable, from the wonderful purity of the material, and from the perfection of crystalline form, but particularly from the enormous size of the crystals. The prevailing formation in the neighbourhood is sandstone and argillite, very soft, and consequently easily subject to the violent weathering agencies of the locality. Denudation has been carried on there on a stupendous scale, and it is probably due to such forces that the discovery of this strange deposit of gypsum was rendered possible. The gypsum formation stands in bold relief on the side of a sandhill, as was to be seen from the photographs presented. The crystals occur in a cavern which is enclosed by a thick shell of the same material as the crystals. The external appearance of the formation is that of a mound, rudely egg-shaped, having a length of 35 ft., an average width of 10 ft., and a height, in the middle, of 20 ft. The outside, though rough and weather-worn, presents many brilliant crystal faces, and the whole glistens in the sunlight with indescribable beauty. The mammoth crystals project laterally inward from either wall of the cavern, and prisms of wonderful regularity and size rise through the compacted sand which forms the floor of the chamber. The stereoscopic view of the interior, taken by natural light and prolonged exposure, conveyed a better idea of the structure than words could do.

Finding many dire results of the insuppressible spirit of vandalism exhibited by the Indians and cattle men who occasionally visited the remote spot, it was resolved by the Directors of the Desert Museum, a scientific establishment in Salt Lake City, to remove the best crystals to a place of safety. About 25 tons of excellent specimens have been taken out. Many single prisms, seemingly of perfect form, have been removed. One of the finest is 48 in. long, and of its faces one is 6 in. across. Another regular prism is 52 in. long, and has 19 smaller crystals attached to one of its faces. Crystal groups of great weight are common —indeed, the entire mass is to be regarded as one group. The largest group removed whole is over 600 pounds weight [a photograph of which was exhibited].

Inclusions of sand, clay, and liquid bubbles add beauty and interest to many of the crystals, and phantom crystals within the larger masses are prettily shown. The cleavage slab shown, 24 by 13 in., demonstrated the great purity and consequent perfect transparency of many of the crystals, and the prevailing perfection of angle is shown in the crystal presented. The occurrence of the crystals would suggest a true geodic formation. Most geodes, however, are small, such are usually measured in inches, and their weight is expressed in ounces or pounds. Here, however, was a formation of the kind, with dimensions reckonable by the tens of feet, and weight by hundreds of tons.

He trusted the specimens and photographs, as also the smaller slabs for the use of individual Fellows, would prove acceptable to the Society, serving as they did to demonstrate the operations of the crystallizing forces on a colossal scale.

The Chairman said that the Society was greatly indebted to Dr. Talmage for his extremely interesting communication, as well as for the beautiful specimens he had presented. A hearty vote of thanks was unanimously given.

Mr. J. E. Ingpen said that not very long ago they were threatened with a selenite famine because Montmartre, from which their supplies had hitherto been chiefly obtained, was being built over. It was therefore very gratifying to know that there was such a large supply available as would suffice to meet the wants of microscopists for several generations.

Mr. G. C. Karop said it would be remembered that at their last meeting a note was read from Mr. W. H. Youdale as to some diseased beard-hairs, specimens of which accompanied the communication. He had not at that time seen the specimens, but hazarded a guess from the description given that it might be a case of *Sycosis*. Since that time Dr. Hebb had examined the hairs and pronounced them to be an example of *Trichoclasis*, a well-known disorder usually occurring on the hair of the face. Apparently the disease was one of nutrition.

Prof. Bell said that Mr. Lewis's communications upon the Natal Ticks had excited the interest of their humorous correspondent Capt. Montgomery, who had sent a letter, extracts from which he read, on the subject of chicken lice, ticks from grass, and other parasites.

Dr. J. B. Nias then read his paper "On the Development of the Continental form of Microscope Foot," the subject being illustrated by diagrams, and by the exhibition of a number of instruments constructed as described.

Dr. Dallinger regretted that Mr. Nelson had been obliged to leave the meeting, as his judgment would have been of value, and also that the evening was so far advanced as to preclude the possibility of any lengthened discussion upon the subject before them. If the reader of the paper had closed the subject of the paper after tracing his view of the process of evolution in the particular form of "foot" which he advocated, he should have had nothing to say; as a matter of history it would have been possibly interesting and profitable, but as he had gone further and had impeached not only the superior design but even the utility of the English stand, and as the English model had now for half a century maintained its high position, it was clearly needful that in that meeting something should be said as to its claims.

No doubt it might be held that the question was one which had two sides, and it was quite proper that as one side had been stated the other should also be heard. But because they heard both sides they should endeavour to attach the true weight to what each brought forward. They had heard that evening of a Microscope made accurately to measurements and created for anatomical purposes to suit the length of the human arm and the breadth of the human hand, and if this had no other bearing or application than that of showing them an illustration of what was considered sufficient to meet the requirements of that period, it would have had its uses. But what, he asked, had happened since that time? Were the requirements of the modern investigator with the Microscope the same now as they were a century ago? had there been no advances in optical powers and mechanical adaptations? If we look only at the modern objective as compared with that which existed at the time determined by Dr. Nias as the period at which the "Continental stand" originated, do we perceive no need of modification? are the conditions for general or special microscopic investigation the same now as they were then? And even supposing that they were the same and that we are content to treat them as the same, what shall we say in regard to the use of the indispensable condenser? Had no improvement taken place in it? Condensers were very generally used now, but Continental microscopists and even the Germans had only risen to the perception of their indispensable nature, and indeed of their necessity at all during the last eight or nine years, and had now accomplished what the English had been doing with increasing success for the last 200 years. It could therefore hardly be said that the evolution of that Microscope covered all the requirements of the modern microscopist. Supposing that it was absolutely sufficient for all purposes at the time it was produced, could it be affirmed that it was also sufficient at the present time? He understood that a biological student working in a laboratory with only limited ends to accomplish might be said to have only limited requirements, which might be met in an instrument of the form described, but on the other hand he apprehended that as regarded their own medical schools it would be most desirable that a student should first know what were the general optical principles upon which a proper use of his instrument depended, so that he might be able to distinguish between good and bad results, and next that he should have an instrument which would also serve him when he got into practice and wanted to do the best that could be done. He might have a severe struggle in life, and therefore they should give him at the outset of his career the best thing at the price which would enable him to do the largest amount of work that was really good.

If they wanted to know where the Continental Microscope was now made in its best form it would no doubt be conceded that the firm of Zeiss held the first place, and what did they find there? What had Messrs. Zeiss done towards meeting what they felt to be the necessities of modern research? First of all they inclined their Microscope, then they devised a means of rotating it, then they introduced, with great reluctance, a substage, then slowly—very slowly—they introduced a condenser, but a chromatic condenser, from which they gradually advanced to an achromatic one, and now they had a rivalry attempted to be set up between the German and the English manufacturers. He had no objection to competition, to which many of their advances were due, and it was one of his delights to get the earliest knowledge of the newest and best pieces of apparatus from time to time produced in this way, although it often meant throwing aside others which had been good and costly at a not very remote preceding period. Then, quite recently, the Germans had actually introduced a mechanical stage, so that, as additions to their original pattern, they now had a rack-and-pinion adjustment, a fine-adjustment, an inclining body, a substage, a condenser, and a mechanical stage, all of which were absolutely English in their origin. The main question concerning these matters, of course, was, were they needful for the highest class of even ordinary histological and general work, or not; or were they the outcome of a want of knowledge as to what was essential? If the former, then the further question might be asked, was the Continental form of Microscope the best form in which they could exist? At that late period of the evening it was not possible for him to go fully into the answer to this question, but he would just take up one point by way of illustration—the introduction of the condenser—and he carried with him the experience that without a good condenser good results could not be obtained from the best objectives. It had been found to be absolutely necessary that the condenser should be accurately centered with the other optical arrangements. This being so, it was most important to see that the form of substage introduced on the Continent was bound by certain limitations of size and length of the hand, as they had been told, which entirely crippled its usefulness as a means of research, and they found that the German substage had no centering apparatus fitted to it because there was no room for it, and yet it was a peculiarity of the Microscope made by Zeiss ten years ago that a sort of substage arrangement was made to receive *diaphragms*, and this was provided with a centering arrangement! The diaphragms were so minute that the makers could afford to make a light centering apparatus, and they did; but the condenser was still utterly incapable of being centered; that is to say, the delicate centre of an optical combination was allowed to take care of itself, but a diaphragm aperture was mechanically centered—yes! and provided with rack and pinion besides—which was also wanting for the condenser.

When Zeiss introduced their first (chromatic) condenser, it did not so much matter about centering it, but with the achromatic condenser the need was at once apparent. What can be the use of a delicately achromatized combination without an accurate use of its optical centre? Hence we find that, unable to provide a proper centering socket in the substage of the Continental stand, because the space was so small, they provided their achromatic condenser with a separate and *independent* centering arrangement; so that to get this condenser for the Continental stand we had to pay the additional cost of mechanical centering arrangements attached to it. But how does this work in practice? It will be readily seen. The meeting will remember that Zeiss subsequently produced that remarkable objective which has a N.A. of 1·60. Now it was bound to have a condenser with an equal aperture; to employ this then, it must of course have centering arrangements; now I possessed their achromatic condenser and its special centering arrangements; but these, not being in the substage, could only be of use when *it* was employed. The result was that to centre the new 1·60 N.A. condenser, it was needful to mount it also with a *separate centering* arrangement! Thus there was the cost and inconvenience of a distinct arrangement for as many condensers, or other pieces of substage optical combination, as required centering. But in the English model the one centering substage received and centered *every* piece of substage apparatus; this one expense covered all, and the collimation of the optical axis was more definitely and accurately secured. But in the Continental stand, from the very "hand-breadth" limits of its mode of genesis, this was impossible. It was too cramped to admit of a large centering substage.

Now if it be admitted that the condenser is a necessity of modern optical combination then it must be admitted that the condenser must be centered; and if so, which is the better, to have a stand that will not admit of a centering substage, but requires that each piece of apparatus needing its axis brought into incidence with the axis of the optical combination of the objective and eye-piece must be separately and by great additional expense endowed with it, or to have a stand with a substage that would admit of the centering of every condenser and other optical apparatus that might be employed?

There may, however, be those who would still affirm that with histological and pathological mounts, for the study of which they were told the German instrument was adapted, it was not needful to obtain a critical image, or use a delicate condenser; but he was convinced that there was a consensus of judgment amounting to unanimity amongst thoroughly skilled and experienced microscopists, that even students should employ high class and well corrected objectives, and it was simply absurd to suppose that they could get the best results with these without the employment of a suitable condenser. If this was so, he asked, was the Continental form the best adapted for its use? This was only one point in connection with the subject, whereas he might have gone into ten points had time permitted. The author of the paper had spoken to them about the Continental form in which the body could be inclined; true, in its modern and modified form it could be inclined, but they had only to try it in the horizontal position to find how uncertain was its equilibrium, and imperfect its lateral stability when so placed, if compared with that which he had before him, which was a tripod stand, and arranged with the best appliances for modern work. It was the simple Nelson model made in London, and could be produced as inexpensively as a Continental form of stand; and while it was equally firm and steady in any position and at any inclination, it would admit of a finely finished substage with centering screws and all the essentials of a modern Microscope. Steadiness could be obtained in two ways, both of which they have illustrated in the two forms before them, one being by putting a great mass of lead into it and the other by ingenuity. If they looked to the stage of Continental form they saw it fitted with clips under which the slide was to be fixed, a plan entirely fatal to all accuracy of focusing when high powers were used. Why not leave it free as in this excellent arrangement of Mr. Nelson, enabling the slide or object to be manipulated as modern focusing requires? He was not going to regret, however, that this paper had been read, and would only further add that he thought the Society was indebted to the author for giving them so fully what there was to be stated on the historic side of the question.

Dr. P. M. Braidwood thought they had a most excellent appendage to the paper in the remarks they had just heard from Dr. Dallinger. The mention of the year 1824 reminded him of a Microscope which he had of about that date, and it struck him that they had been talking a great deal about the focusing and other arrangements, but had said very little about the lenses, which he thought were as good then as they were nowadays. With regard to Chevalier's Microscopes, they were excellently good, especially as to the lenses, and it struck him that there was wonderfully little progress made in them since then. There might be a difference in the combination of the lenses, but there was no doubt that Chevalier's lenses were uncommonly good.

Mr. Karop said there were several other points which suggested themselves, but it was too late then to go into the subject.

Mr. Washington Teasdale said he chanced to have worked up through every one of the series which had been mentioned, but he considered them practically obsolete from about the time that the Society of Arts brought out their 3-guinea Microscope. The Continental Microscopes became so popular because at that time medical men could not get a good English Microscope under about 25*l.*, but one of the German instruments was supplied with four powers of really good quality for about 8*l.* Of course the question was too large to go into at that late hour, or he could have shown how it was that these Microscopes continued to be used, although he considered them to have been thoroughly and entirely superseded by the modern English forms.

The Chairman said there was no doubt that many other points might be brought out if only time permitted.

Dr. Nias said he was unwilling to occupy more time at that period of the evening, but he did not think that after all there was any substantial difference between them on the questions raised. For his own part he should never attempt to say that the Continental form was better in all respects than the English model; what he had wished to do was to bring out some facts as to the history of the development of the Continental form, because, though much had been written about it, nobody seemed to have shown how it came to be adopted.

Mr. Ingpen said the rotating stage was adapted from the Oberhauser model.

Dr. Dallinger said that a very important consideration would come out of this if it were looked at from a practical standpoint. By this process of revolution the whole of the body was made to rotate about the centre of the object, and if the whole of the parts were made with absolute accuracy there might not be any very great objection, but in cheap instruments they could not of necessity afford to make them accurate, and, therefore, if they attempted to rotate the upper portion they very speedily got it out of centre and most serious optical errors were in this way introduced.

Mr. Ingpen said no doubt the Continental form had its purpose but that was frequently overlooked because nobody ever seemed to look into the subject if he could help it, and because here we were accustomed to attack the whole subject from an entirely different standpoint. He thought it would be a great pity to ignore the value of these old models or to pass over their history, which was in itself extremely interesting and instructive.

The thanks of the meeting were then voted to Dr. Nias for his paper.

Mr. C. Rousselet said that he felt he could not at that late hour trouble the meeting with his paper "On *Floscularia pelagica* and other Rotifers" (see *ante*, p. 444); he would therefore content himself by merely mentioning the names of the species described and would hand the paper over to the Society for publication.

Prof. Bell said their thanks were due to Mr. Rousselet for this communication, and he felt sure that all would sympathize with him in being again unable to read it, remembering that it was similarly edged out at their last meeting.

Prof. Bell reminded the Fellows of the Society that after Wednesday the 28th inst., the Library would not be open on Wednesday evenings until after the vacation. Also that the rooms would be entirely closed from the 14th August until the 11th September. With regard to the opening of the Library on Wednesday evenings, he had caused a return to be prepared showing the attendance, so that they might see to what extent the arrangement had been appreciated. From this return it appeared that during the first quarter the total attendance was thirteen, and that there were four nights on which nobody came. From April 5th to June 7th the number who came was also thirteen, none being present on three nights. During the whole period the greatest number in attendance on any evening was four, whilst the average was rather less than one and a half. He thought if these statistics were reported and published with their Proceedings perhaps the Fellows might understand more clearly what success the arrangement had met with.

The next Ordinary Meeting of the Society would take place on October 18th.

The following Instruments, Objects, &c., were exhibited:—

Messrs. R. and J. Beck:—Different forms of the "Continental Model" Microscope. "Pathological" Microscope. Vertical Photomicrographic Apparatus.

Dr. W. H. Dallinger:—"Nelson" Model Microscope.

Mr. J. G. Grenfell:—*Paramœcium bursaria* which has thrown out a cloud of trichocysts.

Dr. J. B. Nias:—Two forms of Oberhäuser's Microscope and drawings illustrating his paper.

The Society:—Chevalier's "Microscope Achromatique Universel," and Dollond's Microscope, illustrating Dr. Nias's paper.

Mr. C. Rousselet:—*Notops pygmæus*, the coloured Rotifer.

Dr. J. E. Talmage:—Selenite and Photographs of the Selenite Mound in Utah, U.S.A.

New Fellow:—The following was elected an *Ordinary* Fellow:—Mr. Thomas Comber.

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JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

F. JEFFREY BELL, M.A.,

One of the Secretaries of the Society
and Professor of Comparative Anatomy and Zoology in King's College;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

A. W. BENNETT, M.A., B.Sc., F.L.S.,
Lecturer on Botany at St. Thomas's Hospital,
R. G. HEBB, M.A., M.D. (*Cantab.*), AND

J. ARTHUR THOMSON, M.A.,
Lecturer on Zoology in the School of Medicine, Edinburgh,

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α. Embryology.

β. Histology.

γ. General.

B. INVERTEBRATA.

Mollusca.

α. Cephalopoda.

γ. Gastropoda.

δ. Lamellibranchiata.

Molluscoida.

α. Tunicata.

γ. Brachiopoda.

Arthropoda.

Vermes.

β. Physiology.

(1) Reproduction and Embryology.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

(3) Irritability.

(4) Chemical Changes (including Respiration and Fermentation).

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Characeæ.

Algæ.

Fungi.

Mycetozoa.

Protophyta.

α. Schizophyceæ.

β. Schizomycetes.

MICROSCOPY.

α. Instruments, Accessories, &c.

(1) Stands.

(3) Illuminating and other Apparatus.

(4) Photomicrography.

(5) Microscopical Optics and Manipulation.

(6) Miscellaneous.

β. Technique.

(1) Collecting Objects, including Culture Processes.

(2) Preparing Objects.

(3) Cutting, including Imbedding and Microtomes.

(4) Staining and Injecting.

(5) Mounting, including Slides, Preservative Fluids, &c.

(6) Miscellaneous.

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JOURNAL

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ROYAL MICROSCOPICAL SOCIETY.

OCTOBER 1893.

TRANSACTIONS OF THE SOCIETY.

XI.—*The Foraminifera of the Gault of Folkestone.*—IV.

By Frederick Chapman, F.R.M.S.

(*Read* 19*th April*, 1893.)

Plates VIII. and IX.

Family LAGENIDÆ.

Sub-family LAGENINÆ.

Lagena Walker and Boys [1784].

Lagena globosa Montagu sp., plate VIII. figs. 1 *a*, *b*.

Vermiculum globosum Montagu, 1803, Test. Brit., p. 523. *Entosolenia globosa* Reuss, 1862, Sitzungsber. d. k. Ak. Wiss. Wien, vol. xlvi. p. 318, pl. i. figs. 1–3. *Lagena globosa* Brady, 1884, Chal. Rep., vol. ix. p. 452, pl. lvi. figs. 1, 2, 3. *L. globosa* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 555, pl. IX. figs. 1, 2, 4.

This well-known species is represented in the Gault by two specimens only, of an elongate form; and one of them (the specimen

EXPLANATION OF PLATES.

Plate VIII.

Fig. 1 *a*, *b*.—*Lagena globosa* Montagu sp. (elongate var.). × 60.
„ 2 *a*, *b*. „ *apiculata* Reuss (typical elongate form). × 60.
„ 3 *a*, *b*. „ „ „ (globose form). × 60.
„ 4, 7. „ „ var. *emaciata* Reuss. × 60.
„ 5. „ *lævis* Montagu sp. × 60.
„ 6. „ *gracillima* Seguenza sp. × 70 and × 80.
„ 8. „ *aspera* Reuss. × 60.
„ 9 *a*, *b*. „ *hispida* Reuss (globose form). × 60.
„ 10 *a*, *b*. „ „ „ (elongate form). × 60.
„ 11. „ *sulcata* Walker and Jacob. × 60.
„ 12 *a*, *b*. „ *acuticosta* Reuss. (12 *b* represents view from the aboral end.) × 60.
„ 13. „ *gracilis* Williamson. × 60.
„ 14. „ *alifera* Reuss. × 60.
„ 15. „ *striatopunctata* Parker and Jones. × 70.
„ 16 *a*, *b*. „ *marginata* Walker and Boys. × 120.

figured) has an elliptical aperture. Besides occurring in many fossiliferous beds older* and newer than those of the Cretaceous group, it has been recorded from the Gault of France (Berthelin); the Red Chalk of Speeton (Burrows, Sherborn and Bailey); the Chalk of the North of Ireland (Wright); the Phosphatic Chalk of Taplow (Chapman); the *Belemnitella-mucronata* Chalk of Lemberg, in Galicia, and the Maestricht Chalk (Reuss). In the waters of the present day this species as regards depth appears to be unrestricted. Zone viii., very rare; zone xi., 55 ft. from the top, very rare.

Plate VIII.—*continued.*

Fig. 17 *a*, *b*. *Lagena quinquelatera* Brady, var. *inflata* var. nov. × 100.
„ 18.—*Nodosaria* (*Gl.*) *humilis* Roemer. × 50.
„ 19, 20. „ „ *mutabilis* Reuss. × 50.
„ 21. „ „ *cylindracea* Reuss. × 50.
„ 22. „ *radicula* Linné, var. *Jonesi* Reuss var. × 50.
„ 23. „ *oligostegia* Reuss. × 50.
„ 24. „ (*D.*) *expansa* Reuss. × 60.
„ 25. „ „ *farcimen* Soldani sp. × 60.
„ 26. „ „ *soluta* Reuss. × 50.
„ 27. „ „ „ var. *discrepans* Reuss var. × 50.
„ 28. „ „ „ var. *pulchella* var. nov. × 60.
„ 29. „ „ *gracilis* d'Orbigny. × 60.
„ 30. „ „ *Lorneiana* d Orb. (curved var.). × 60.
„ 31. „ „ „ „ (straight var.). × 50.
„ 32. „ „ *pauperata* d'Orb. × 60.
„ 33. „ „ *consobrina* d'Orb. × 60.
„ 34. „ „ *cylindroides* Reuss. × 60.
„ 35. „ „ *hamulifera* Reuss. × 60.
„ 36. „ „ *xiphioides* Reuss. × 60.
„ 37. „ „ *legumen* Reuss. × 50.
„ 38. „ „ *Roemeri* Neugeboren. × 60.

Plate IX.

Fig. 1.—*Nodosaria* (*D.*) *communis* d'Orbigny. × 60.
„ 2. „ „ *mucronata* Neugeboren. × 65.
„ 3. „ „ *costellata* Reuss. × 60.
„ 4. „ „ *raristriata* sp. n. × 60.
„ 5. „ *hispida* d'Orbigny. × 50.
„ 6. „ *perpusilla* sp. n. × 75.
„ 7. „ *bambusa* sp. n. × 50.
„ 8. „ (*D.*) *intercellularis* Brady. × 75.
„ 9. „ *sceptrum* Reuss. × 60.
„ 10. „ *internotata* sp. n. × 60.
„ 11. „ (*D.*) *tubifera* Reuss. × 60.
„ 12. „ „ *Zippei* Reuss. × 60.
„ 13, 14. „ „ *paupercula* Reuss. × 60.
„ 15. „ „ *Fontannesi* Berthelin. × 60.
„ 16. „ „ *obscura* Reuss. × 60.
„ 17, 18. „ *inflata* Reuss. × 60.
„ 19, 20. „ (*D.*) *tenuicosta* Reuss. × 60.
„ 21. „ *prismatica* Reuss. × 60.
„ 22, 23. „ *orthopleura* Reuss. × 60.
„ 24. „ *tetragona* Reuss. × 60.

* Common in thin slices of Wenlock limestone, Dudley (F. C.); and in the Woolhope Shales, Malvern (Brady).

Lagena apiculata Reuss, plate VIII. figs. 2 *a*, *b*, and 3 *a*, *b*.

Oolina apiculata Reuss, 1850, Haidinger's Naturw. Abhandl., vol. iv. p. 22, pl. i. fig. 1. *Lagena apiculata*, var. *elliptica* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 35, pl. ii. fig. 2. *L. apiculata* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 319, plate i. figs. 4–8, 10, 11. *L. apiculata* Brady, 1884, Chall. Rep., vol. ix. p. 453, figs. 4, 15–18. *L. apiculata* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 555, plate IX. figs. 6, 7, 9–11.

This somewhat variable form is widely distributed through the Gault, and is perhaps the commonest of all the *Lagenæ* from that formation. The two specimens figured give an idea of the variation in the shape of the test; the pyriform variety, with a circular aperture, is much more common than the globose form with bordered fissure. It has been found in beds as old as the Lias; and in recent deposits it affects shallow and deep water alike. In the Cretaceous rocks it has been found in the North-German Gault* and the *Belemnitella mucronata* bed of Galicia (Reuss); in the Red Chalk of Speeton, &c. (Burrows, Sherborn and Bailey); and in the Chalk of the North of Ireland (Wright). It is found in the Gault of Folkestone in zone i. specimen *b*, very rare; zone ii., specimen *a*, very rare; zone iv., very rare; zone v., very rare; zone vii., very rare; zone x., very rare; zone xi., 55 ft. from the top, rare; 50 ft., frequent; 45 ft., very common; 40 ft., very rare; 35 ft., rare; 30 ft., frequent; 25 ft., frequent; 12 ft., rare; 6 ft., very rare.

Lagena apiculata, var. *emaciata* Reuss, plate VIII. figs. 4, 7.

Lagena apiculata, var. *emaciata* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 319, pl. 1, fig. 9. *L. apiculata*, var. *emaciata* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 555, plate ix. figs. 8, 12, 13.

This variety has been found in the Septaria-clay of Pietzpuhl (Reuss.); and in the Red Chalk of Speeton (Burrows, Sherborn and Bailey). It occurs in the Gault at one horizon only; zone xi., 45 ft. from the top, rare.

Lagena lævis Montagu sp., plate VIII. fig. 5.

Vermiculum læve Montagu, 1803, Test. Brit., p. 524. *Lagena lævis* Brady, 1884, Chall. Rep., vol. ix. p. 455, pl. lvi. figs. 7–14, 30. *L. lævis* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 555, plate IX. fig. 3.

The specimens of this Foraminifer which occur in the Gault are somewhat variable in size, and are occasionally smaller than the one

* N.B. The Gault of Germany is equivalent to the Gault and Lower Greensand of England.

figured. Some of the specimens have the lip of the neck everted, similar to those found in the Red Chalk. This species is one of the oldest fossil forms of *Lagena*, occurring in strata from the Silurian* and upwards. It is found in zone iv., very rare; zone v., very rare; zone xi., 35 ft. from the top, very rare; 30 ft. rare.

Lagena gracillima Seguenza sp., plate VIII. fig. 6.

Amphorina gracillima Seguenza, 1862, Foram. Monotal. Mess., p. 51, plate i. fig. 37. *Lagena gracillima* Jones, Parker and Brady, 1866, Monogr. Foram. Crag, p. 45, plate i. figs. 36, 37. *L. gracillima* Brady, 1884, Chall. Rep., vol. ix. p. 456, plate lvi. figs. 19–28.

Hitherto this species has not been found in beds older than the Miocene. The specimens found in the Gault are very small and were obtained by very careful examination of the finest washings. It occurs in the Gault in zone xi., 50 ft. from the top, very rare.

Lagena aspera Reuss, plate VIII. fig. 8.

Lagena aspera Reuss, 1861, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xliv. p. 305, plate i. fig. 5. *L. aspera* Brady, 1884, Chall. Rep., vol. ix. p. 457, plate lvii. figs. 7–10.

This species is rather uncommon in the Gault. It does not vary greatly in contour from the specimen figured, but the apiculate portion is usually absent. *Lagena aspera*, though new to the Gault, is known as a fossil from Middle-Liassic beds, the Oolite, Upper Chalk, Tertiary beds, and also from recent deposits. In the Gault it occurs in zone iii., very rare; zone xi., 45 ft. from the top, frequent; 12 ft., rare.

Lagena hispida Reuss, plate VIII. figs. 9 *a*, *b*, 10 *a*, *b*.

Lagena hispida Reuss, 1858, Zeitschr. d. deutsch. geol. Gesellsch., vol. x. p. 434. *L. hispida* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 335, plate vi. figs. 77–79. *L. hispida* Brady, 1884, Chall. Rep., vol. ix. p. 459, pl. lvii. figs. 1–4 and plate lix. figs. 2, 5.

A well distributed and tolerably common form in the Gault, though here recorded for the first time. It has also been found in the Middle Lias of France and in most Tertiary deposits. In recent soundings it occurs in shallow water and at depths varying from 129–1900 fathoms. The Gault specimens vary somewhat in shape, and are represented on the accompanying plate by drawings from the two principal types, viz. the elongated or flask-shaped form, and the globose form. This species is found in the Gault in zone ii., specimen *a*, very rare; zone iii., common; zone iv., very common; zone v.,

* From the Woolhope Beds (Brady).

very common; zone vi., rare; zone vii., very common; zone xi., 50 ft. from the top, frequent; 45 ft., very rare; 40 ft., very rare; 35 ft., rare; 30 ft., very rare; 25 ft., rare; 12 ft., rare.

Lagena sulcata Walker and Jacob, plate VIII. fig. 11.

Serpula (*Lagena*) *sulcata* Walker and Jacob, 1798, Adams's Essays, Kanmacher's ed., p. 634, plate xiv. fig. 5. *Lagena sulcata* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 351, plate xiii. figs. 24, 28–32, and plate xvi. figs. 6, 7. *L. sulcata* Brady, 1884, Chall. Rep., vol. ix. p. 462, plate lvii. figs. 23, 26, 33, 34.

This well-marked species is here recorded for the first time from the Gault. It also occurs fossil in shales of Upper Silurian age; in the Lias of Yorkshire (Blake); in the Maestricht Chalk (Parker and Jones); and in various Tertiary beds ranging up to the present time. In recent deposits it is found in all latitudes, and in shallow-water to depths as great as 2750 fathoms. In the Gault it is found in zone ii., specimen *c*, very rare; zone iv., very rare.

Lagena acuticosta Reuss, plate VIII. fig. 12 *a*, *b*.

Lagena acuticosta Reuss, 1861, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xliv. p. 305, plate i. fig. 4. *L. acuticosta* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 331, pl. v. fig. 63.

The solitary specimen found in the Gault agrees with the form described by Reuss, with the exception that the Gault specimen has thinner costæ. It is very closely allied to *L. sulcata*. Previously recorded from the Maestricht Chalk (Reuss); and the Septaria-clay of Pietzpuhl (Schlicht). Found in the Gault in zone v., very rare.

Lagena gracilis Williamson, plate VIII. fig. 13.

Lagena gracilis Williamson, 1848, Ann. and Mag. Nat. Hist., ser. 2, vol. i. p. 13, pl. i. figs. 3, 4. *L. gracilis* Brady, 1884, Chall. Rep., vol. ix. p. 464, plate lviii. figs. 2, 3, 7–10, 19, 22–24.

This elegant and somewhat variable form is found in the Gault series for the first time. Its variation consists in the relative length of the neck, and in the degree of development and thinness of the costæ. In one example, at least, the test possesses the typical mucronate or apiculate aboral end; whilst the others have that end denticulate. This species has also been found in the Chalk of Rügen (Marsson); in the Septaria-clay of Pitzpuhl (Reuss and Schlicht); and in various Pliocene and Post-pliocene beds. As a recent form it is well distributed and is found to as great a depth as 2775 fathoms. In the Gault it occurs in zone ii., specimen *a*, very rare; zone iii., very rare; zone xi., 20 ft. from the top, very rare.

Lagena alifera Reuss, plate VIII. fig. 14.

Lagena alifera Reuss, 1870, Sitzungsb. d. k. Ak. Wiss. Wien, vol. lxii. p. 467, No. 11; Schlicht, 1870, Foram. Pietzpuhl, plate iii. figs. 15, 16, 21, 22.

One specimen was found which resembles Reuss's *L. alifera* in having wing-like costæ; the shape of the shell is however somewhat different, since, instead of being flask-shaped, as in Reuss's figure, it is elliptical, with pointed extremities. It does not appear necessary, however, to make any distinction on account of this variation in form from the type. The specimen was found in zone ix.

Lagena striatopunctata Parker and Jones, plate VIII. fig. 15.

Lagena sulcata, var. *striatopunctata* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 350, plate xiii. figs. 25–27. *L. seriato-granulosa* Reuss, 1870, Sitzungsb. d. k. Ak. Wiss. Wien, vol. lxii. p. 468, No. 16; Schlicht, 1870, Foram. Pietzpuhl, plate xxxviii. fig. 20. *L. striatopunctata* Brady, 1878, Ann. and Mag. Nat. Hist., ser. 5, vol. i. p. 434, plate xx. fig. 3. *L. striatopunctata* Brady, 1884, Chall. Rep., vol. ix. p. 468, plates lviii. figs. 37, 40.

The specimens from the Gault are very typical. The aperture is entosolenian and the perforate costæ vary in number from 11–15. This species has also been found in the Phosphatic Chalk of Taplow (Chapman); in the Septaria-clay of North Germany (Schlicht); in the Post-tertiary deposits of the West of Scotland (Robertson), and of the North-east of Ireland (Wright). As a recent form its bathymetrical range is not restricted, and it is also a widely distributed species. It is found in the Gault in zone iv., very rare; zone xi., 55 ft. from the top, very rare; 30 ft., very rare.

Lagena marginata Walker and Boys, plate VIII. fig. 16 *a, b*.

"*Serpula* (*Lagena*) *marginata*" Walker and Boys, 1784, Test. Min., p. 2, pl. i. fig. 7. *Lagena marginata* Brady, 1884, Chall. Rep., vol. ix. p. 476, pl. lix. figs. 21–23.

The specimen of *Lagena marginata* from the Gault is almost precisely similar to the first of the figures given by Dr. Brady in his Report on the 'Challenger' Foraminifera, save that its keel-like margin is denticulate at the aboral end. This species has been before recorded from the Phosphate beds of Cambridge, the Upper Chalk of Rügen, and from many other fossiliferous deposits of Eocene, Miocene, Pliocene, and Post-pliocene ages. It occurs in the Gault in zone xi., 12 ft. from the top, very rare.

Lagena quinquelatera Brady, var. *inflata*, plate VIII. fig. 17 *a, b*.

Test elongate, five-sided; the oval end broad, tapering somewhat gradually below the middle to the inferior end; the angles formed by

5 rounded costæ; aperture ectosolenian, and the aboral extremity minutely denticulate. Length 1/100 in.

This variety differs from the species described by Dr. Brady * in having rounded angles to the shell and slightly inflated sides. One specimen only, from zone ii., specimen *a*.

Sub-family NODOSARIINÆ.

Nodosaria Lamarck [1816].

Sub-genera {Glandulina / Dentalina} d'Orbigny [1826].

Nodosaria (*Gl.*) *humilis* Roemer, plate VIII. fig. 18.

Nodosaria humilis Roemer, 1841, Verst. norddeutsch. Kreide, p. 95, pl. xv. fig. 6. *Glandulina mutabilis*, pars, Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. pp. 58, 91, pl. v. figs. 9, 11.

This is a somewhat uncommon but very distinct form in the Gault series. Dr. Reuss has grouped the longer forms with Roemer's species under the name of *Gl. mutabilis;* but since *Gl. humilis* exhibits very slight variation from the typical peg-top-shaped form, it seems justifiable to retain the earlier name for the species possessing an ovoid outline. It has been recorded, with the species next to be described, from the Upper Hils-clay, the Speeton Clay, and Gault of North Germany (Roemer, Reuss); from the Gault of Folkestone (Reuss, Rupert Jones); from the Gault of France (Berthelin); and from the Chalk-detritus of Charing (Rupert Jones in Morris's Cat.). It is found in the Folkestone Gault in zone v., very rare; zone x., very rare; zone xi., 40 ft. from the top, very rare.

Nodosaria (*Gl.*) *mutabilis* Reuss, plate VIII. figs. 19, 20.

Glandulina mutabilis, pars, Reuss, 1862, vol. xlvi. pp. 58, 91, plate v. fig. 7, 8, 10.

The forms which are here placed under Reuss's name of *Gl. mutabilis* are the very variable, lengthened, and irregular ones of which the two specimens figured are examples. The references to previous occurrences given for *Gl. humilis* apply also to this form. It is found in the Gault of Folkestone in zone iii., very rare; zone vi., very rare; zone xi., 35 feet from the top, very rare; 20 ft., rare; 6 ft., very rare.

Nodosaria (*Gl.*) *cylindracea* Reuss, plate VIII. fig. 21.

Nodosaria (*Gl.*) *cylindracea* Reuss, 1845, Verstein. d. böhm. Kreideform., pt. i. p. 25, plate xiii. figs. 1, 2. *Glandulina cylin-*

* *Lagena quinquelatera* Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. N. S. p. 60. Id., 1884, Chall. Rep., vol. ix. p. 454, pl. lxi. figs. 15, 16.

dracea Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 190, plate iv. fig. 1. *Nodosaria* (*Gl.*) *cylindracea* Burrows, Sherborn and Bailey, 1890, Journ. R. Micr. Soc., p. 556, plate ix. fig. 17.

N. cylindracea is peculiarly a shorter form in the Gault than from the other localities. It usually has from 2–3 chambers, whilst Reuss's specimens had from 3–6. This species has also been found in the Red Chalk of Speeton (Burrows, Sherborn and Bailey); and in various strata of Cretaceous age in Bohemia, and North Germany (Reuss). It is found in the Folkestone Gault in zone xi., 50 ft. from the top, rare; 45 ft., rare; 30 ft., very rare; 12 ft., frequent.

Nodosaria radicula Linné sp., var. *Jonesi* Reuss, plate VIII. fig. 22.

Nodosaria Jonesi Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 89, plate xii. fig. 6.

This variety is distinguished by the regular increase in the size of the chambers, and by the first one commencing with a sharp point. The surface of the shell is always extremely polished. It was first described by Reuss from the Folkestone Gault, and this is apparently the only locality where it occurs. It is found in zone ix., very rare; zone xi., 55 ft. from the top, very rare; 50 ft., very rare; 45 ft., common; 30 ft., very rare; 12 ft., very rare.

Nodosaria oligostegia Reuss, plate VIII. fig. 23.

Nodosaria oligostegia Reuss, 1845, Verstein. d. böhm. Kreideform., pt. i. p. 27, plate xiii. figs. 19, 20. *N. simplex* Silvestri, 1872, Nodos. Foss. e Viv. d'Ital., p. 95, plate xi. figs. 268–272. *N. oligostegia* Burrows, Sherborn and Bailey, 1888, Journ. R. Micr. Soc., p. 384. *N. simplex* Burrows, Sherborn and Bailey, 1890, Journ. R. Micr. Soc., p. 556, plate ix. fig. 19.

This species has been recorded from the Speeton Chalk (Burrows, Sherborn and Bailey); the Plänermergel of Bohemia (Reuss); the Chalk-detritus, Charing (Rupert Jones); the Pliocene of Italy (Silvestri); and as a recent form from 129 and 275 fathoms (Brady). It occurs in the Gault in zone vii., very rare; zone xi., 55 ft. from the top, very rare; 45 ft., very rare.

Nodosaria (*D.*) *expansa* Reuss, plate VIII. fig. 24.

Dentalina expansa Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 188, plate iii. fig. 4.

This form is represented by fragments only; and it was in this condition that Reuss found it, in the Senonian of Westphalia. It occurs in the Gault in zone ii., specimen *b*, very rare; zone iii., very rare; zone xi., 45 ft. from the top, very rare; 35 ft., very rare.

Nodosaria (D.) farcimen Soldani sp., plate VIII. fig. 25.

"*Orthoceras Farcimen*" Soldani, 1791, Testaceographia, vol. i. pt. 2, p. 98, plate cv. fig. O. *Nodosaria (D.) laxa* Reuss, 1865, Denkschr. d. k. Ak. Wiss. Wien, vol. xxv. p. 132, plate ii. fig. 2, 3. *N. (D.) farcimen* Brady, 1884, Chall. Rep., vol. ix. p. 499, fig. 13 (woodcut *c*).

This form, the Gault variety of which is perhaps more nearly represented by Reuss's figure of *D. laxa*, is met with in rocks as old as the Permian. Reuss's specimen was found in the Septaria-clay of Pietzpuhl. It is found in the Gault in fragments only in zone viii., rare; zone x., frequent; zone xi., 45 ft. from the top, very rare; 6 ft., very rare.

Nodosaria (D.) soluta Reuss, plate VIII. fig. 26.

Dentalina soluta Reuss, 1851, Zeitschr. d. deutsch. geol. Gesellsch., vol. iii. p. 60, plate iii. fig. 4 *a*, *b*. *D. catenula* Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 185, plate iii. fig. 6. *D. soluta* Hantken, 1875, Mitth. Jahrb. d. k. ung. geol. Anstalt, vol. iv. p. 29, plate ii. figs. 2, 14. *N. (D.) soluta* Brady, 1884, Chall. Rep., vol. ix. p. 503, plate lxii. figs. 13–16.

This very distinct form is met with in the Gault in zone i., specimen *b*, frequent; zone ii., specimen *b*, very rare; zone x., very rare; zone xi., 50 ft. from the top, common; 30 ft., very rare; 25 ft. frequent; 12 ft., very rare.

Nodosaria (D.) soluta Reuss, var. *discrepans* Reuss var., plate VIII. fig. 27.

Dentalina discrepans Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 184, plate iii. fig. 7.

This variety is distinguished from the type form (*N. soluta*) by having less constricted sutures and elliptical-shaped chambers. It was described by Reuss from specimens found in the Senonian of Westphalia. One example only from the Folkestone Gault was found in zone viii.

Nodosaria (D.) soluta Reuss, var. *pulchella*, plate VIII. fig. 28.

This variety differs from the typical *D. soluta* in having a more slender and tapering shell; the commencing segments are spherical and closely conjoined, and in subsequent growth approach the type form in being separated by the sutural constrictions. Length 1/34 in. It is found in the Gault in zone ix., rare; zone xi., 40 ft. from the top, very rare.

Nodosaria (D.) gracilis d'Orbigny, plate VIII. fig. 29.

Dentalina gracilis d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 14, plate i. fig. 5.

The Gault specimens generally possess fewer chambers; otherwise they correspond with the figure given by d'Orbigny, of the specimens from the White Chalk of France. This form has been previously recorded from the Gault of Folkestone and the Chalk-detritus of Charing, &c. (Rupert Jones); and also from the Bohemian Chalk (Reuss). In the Gault it is found in zone ii., specimen *a*, very rare; zone iii., very rare; zone iv., rare; zone vi., rare; zone ix., very rare; zone x., very rare; zone xi., 50 ft. from the top, very rare; 45 ft. rare; 6 ft., very rare.

Nodosaria (D.) Lorneiana d'Orbigny, plate VIII. figs. 30, 31.

Dentalina Lorneiana d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 14, plate i. figs. 8, 9. *Nodosaria Lorneiana* Reuss, 1845, Verstein. böhm. Kreideform., vol. i. p. 27, plate viii. fig. 5.

This variety has long and somewhat elliptical chambers, with the sutural lines strongly marked. Two specimens from the Gault are figured, one of which (imperfect) is quite straight, and the other curved; the two specimens may serve to illustrate the fact that both the *Nodosarine* and the *Dentaline* modes of growth may be seen in what are evidently the same species. It has also been recorded from the Chalk of Kent, and the Lower Chalk of Dover (Rupert Jones); and from the Bohemian Chalk (Reuss). Found in zone iii., very rare; zone xi., 50 ft. from the top, very rare; 45 ft., very rare; 25 ft., very rare.

Nodosaria (D.) pauperata d'Orbigny, plate VIII. fig. 32.

Dentalina pauperata d'Orbigny, 1846, For. Foss. Vien., p. 46, plate i. figs. 57, 58. *D. pauperata* Bornemann, 1855, Zeitschr. d. deutsch. geol. Gesellsch., vol. vii. p. 324, plate xiii. fig. 7. *D. pauperata* Brady, 1884, Chall. Rep., vol. ix. p. 500, woodcuts fig. 14 *a*, *b*, *c*. *D. pauperata* Sherborn and Chapman, 1886, Journ. R. Micr. Soc., p. 750, pl. xv. fig. 9.

This species is present in most microzoic strata from the Lias to Recent. In the Folkestone Gault it is found in zone iii., rare; zone iv., very rare; zone vii., rare; zone xi., 55 ft. from the top, very rare; 45 ft., frequent; 25 ft., rare; 12 ft., very rare.

Nodosaria (D.) consobrina d'Orbigny, plate VIII. fig. 33.

Dentalina consobrina d'Orbigny, 1846, For. Foss. Vien., p. 46, pl. ii. fig. 1–3. *N. (D.) consobrina* Brady, 1884, Chall. Rep., vol. ix. p. 501, pl. lxii. figs. 23, 24.

This cosmopolitan species is well distributed in the Gault. It is found in zone iii., very rare; zone v., very rare; zone viii., rare; zone xi., 50 ft. from the top, frequent; 40 ft., very rare; 35 ft., rare; 30 ft., very rare; 25 ft., frequent; 12 ft., very rare.

Nodosaria (D.) cylindroides Reuss, plate VIII. fig. 34.

Dentalina cylindroides Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 185, pl. i. fig. 8. *D. cylindroides* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 41, pl. ii. fig. 16.

This form has been recorded from the Gault and Chalk of North Germany (Reuss); and from the French Gault (Berthelin). In the Gault of Folkstone it is found in zone v., very rare; zone x., very rare; zone xi., 45 ft. from the top, rare; 20 ft., very rare.

Nodosaria (D.) hamulifera Reuss, plate VIII. fig. 35.

N. (D.) hamulifera Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 42, pl. ii. fig. 17.

The figure given by Reuss under the above name agrees exactly with the specimen found in the Gault, except that the latter has three chambers instead of four. Its distinguishing character, however, of a commencing hooked process is of value most probably only in separating local varieties of the *N. communis* type. Previously recorded from the Upper Hils-clay of Germany (Reuss). In the Gault it is found in zone xi., 25 ft. from the top, one specimen.

N. (D.) xiphioides Reuss, plate VIII. fig. 36.

N. (D.) xiphioides Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 43, pl. iii. fig. 1.

The specimen originally figured by Reuss possessed seven to eight chambers, whilst the Gault specimen has only four. There is no doubt, however, that this is the same species, as it possesses the distinct characters of a spike at the commencement placed eccentrically, and has the chambers separated by deeply marked sutural lines. Previously found in the *Mimimus*-clay of North Germany (Reuss); and in the French Gault (Berthelin). In the Folkestone Gault it is found in zone v., very rare.

Nodosaria (D.) legumen Reuss, plate VIII. fig. 37.

Nodosaria (D.) legumen Reuss, 1845, Verstein. böhm. Kreideform., pt. i. p. 28, plate xiii. figs. 23, 24. *N. legumen* Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, p. 187, plate iii. fig 5.

This is a well-defined and widely distributed form in the Gault. It has been found in various strata of the Chalk series in Bohemia, Galicia, and Hanover; in the Gault of the Rhine (Reuss); in the Gault of Folkestone (Rupert Jones); and in the Gault of Montcley (Berthelin). In the Folkestone Gault it is found in zone vii., very rare; zone xi., 50 ft. from the top, frequent; 40 ft., rare; 35 ft., rare.

Nodosaria (D.) Roemeri Neugeboren, plate VIII. fig. 38.

Dentalina Roemeri Neugeboren, 1856, Denkschr. d. k. Ak. Wiss. Wien, vol. xii. p. 82, plate ii. figs. 13–17. *D. nana* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 39, plate ii. figs. 10, 18. *D. nana* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. mém. 5, p. 43.

This species has been found in the North-German Gault (Reuss); the Gault of Montcley, France (Berthelin); the Septaria-clay of Germany (Reuss, Schlicht); and the Miocene of Transylvania (Neugeboren). As a recent form it affects depths down to 400 fathoms (Brady). It is found in the Gault of Folkestone in zone i., specimen *b*, very rare; zone iv., very rare; zone vii., very rare; zone x., frequent; zone xi., 55 ft. from the top, frequent; 45 ft., very rare; 35 ft., frequent; 30 ft., frequent; 25 ft., frequent; 20 ft., very rare; 12 ft., frequent; 6 ft., very rare.

Nodosaria (*D.*) *communis* d'Orbigny, plate IX. fig. 1.

Nodosaria (*D.*) *communis* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 254, No. 35. *D. communis* d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 13, plate i. fig. 4. *N.* (*D.*) *communis* Reuss, 1845, Verstein. böhm. Kreideform., pt. 1, p. 28, plate xii. fig. 21.

The typical *D. communis* is found in various Cretaceous deposits newer than the Gault, such as the Plänermergel of Bohemia (Reuss); besides all important deposits above and below the Cretaceous series. In the Folkestone Gault it occurs in zone iii., very rare; zone v., rare; zone vii. frequent; zone ix., frequent; zone xi., 55 feet from the top, common; 50 ft. common; 45 ft., rare; 40 ft., frequent; 35 ft., common; 30 ft., frequent; 25 ft., very common; 12 ft., frequent.

Nodosaria (*D.*) *mucronata* Neugeboren, plate IX. fig. 2.

Dentalina mucronata Neugeboren, 1856, Denkschr. d. k. Ak. Wiss. Wien, vol. xii. p. 83, plate iii. figs. 8–11. *N.* (*D.*) *mucronata* Brady, 1884, Chall. Rep., vol. ix. p. 506, plate lxii. figs. 27–29. *N.* (*D.*) *mucronata* Burrows, Sherborn and Bailey, 1890, Journ. R. Micr. Soc., p. 557, plate ix. fig. 31.

This species has been found in the Speeton Chalk (Burrows, Sherborn and Bailey); and in various beds of Tertiary age. As a recent form it is unrestricted as to depth. In the Gault it is found in zone v., very rare; zone x., very rare; zone xi., 30 ft. from the top, very rare; 25 ft., very rare; 12 ft., very rare.

Nodosaria (*D.*) *costellata* Reuss, plate IX. fig. 3.

Nodosaria costellata Reuss, 1845, Verstein. böhm. Kreideform., pt. 1, p. 27, plate xiii. fig. 18.

This form was found by Reuss in the Plänermergel of Bohemia. The lower part of Reuss' shell was ornamented with striæ extending half-way across the chambers, whilst the upper part was wholly striate. A fragment only was found in zone xi., 45 ft. from the top.

Nodosaria (D.) raristriata, plate IX. fig. 4.

Shell filiform, consisting of ten or more segments, tapering to the commencement with a sharp point. The surface of the test decorated on each aspect with three or four somewhat interrupted and fine costæ. Length 1/26 in. This elegant but rare form is found (usually fragmentary) in zone xi., 55 ft. from the top, rare; 45 ft., rare; 40 ft. very rare; 30 ft., very rare; 6 ft., very rare.

Nodosaria hispida d'Orbigny, plate IX. fig. 5.

Nodosaria hispida d'Orbigny, 1846, For. Fos. Vien., p. 35, plate i. figs. 24, 25. *N. hispida* Brady, 1884, Chall. Rep., vol. ix. p. 507, plate lxiii. figs. 12–16.

The specimens found in the Gault are in a fragmentary condition, and with the superficial processes evidently worn down close to the surface of the shell. This species has been recorded from the Lias of England (Brady, Walford); the Chalk of Ireland (Wright); the Phosphatic Chalk of Taplow (Chapman); and from numerous beds in the Tertiary and Post-tertiary formations. It occurs in zone i., specimen *b*, frequent; zone iv., common; zone v., frequent; zone vii., frequent; zone xi., 45 ft. from the top, frequent.

Nodosaria perpusilla, plate IX. fig. 6.

Shell slightly tapering to the commencement, cylindrical, and consisting of a straight series of about seven chambers, the breadth of each chamber nearly equal to the length; the sutures distinctly marked; the aboral end mucronate. Surface of the shell ornamented with from six to seven delicate longitudinal costæ. Length 1/70 in. This form is the smallest of the Gault Nodosariæ. It is found in zone iii., rare; zone v., very rare; zone xi., 50 ft. from the top, very rare.

Nodosaria bambusa, plate IX. fig. 7.

Shell consisting of subcylindrical, or slightly inflated, segments, four times longer than their breadth; the divisions between the chambers seen only as translucent sub-surface markings. The surface of the test decorated with fine and numerous longitudinal costæ, which are slightly diverted or twisted towards one side. Found in fragments only. Average length of chambers 1/33 in. This elegant species occurs in the Gault in zone v., rare; zone xi., 55 ft. from the top, very rare.

Nodosaria (D.) intercellularis Brady, plate IX. fig. 8.

Nodosaria intercellularis Brady, 1881, Quart. Journ. Micr. Sci., vol. xxi. N.S., p. 63. *N. (D.) intercellularis* Brady, 1884, Chall. Rep., vol. ix. p. 515, plate lxv. figs. 1–4.

The Gault specimens agree very closely with the figures given by Dr. Brady. Regarding the peculiar shell-structure shown in Dr. Brady's Report, p. 516, fig. 15 *a*, *b*, it has been impossible to give sufficient material for a drawing, from the Gault specimens, owing to their rarity; from a shell mounted in Canada balsam, however, some evidence has been obtained, which supports the idea of the existence of the same structure as is seen in the recent specimens. Dr. Brady's specimens were obtained from one locality only, off Bermuda, at a depth of 435 fathoms. It is found in the Gault in zone iii., very rare; zone xi., 25 ft. from the top, rare.

Nodosaria sceptrum Reuss, plate IX. fig. 9.

Nodosaria sceptrum Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 37, plate ii. fig. 3.

This species was figured by Reuss from specimens obtained from the Upper Hils formation of North Germany. This form has appeared in one instance only in the Folkestone Gault, near the base of the beds; and it is interesting to note that, while Reuss's specimens are large and fully developed, and have come from beds older than the Gault, the specimen from the latter formation is small and ill-developed. It occurs in the Gault in zone i., specimen *b*, one specimen.*

Nodosaria internotata, plate IX. fig. 10.

Shell consisting of five more or less inflated chambers, the last much larger than the others. The surface ornamented with delicate costæ, between which are secondary costulæ consisting of much interrupted lines and dots. Length 1/48 to 1/30 in. Found in zone i., specimen *b*, very rare; zone iii., very rare; zone v., very rare; zone xi., 50 ft. from the top, very rare; 45 ft., rare; 35 ft., very rare; 30 ft., very rare.

Nodosaria (D.) tubifera Reuss, plate IX. fig. 11.

Nodosaria tubifera Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 37, plate ii. fig. 4.

This form was figured by Reuss from specimens obtained from the Hils formation of North Germany. The Folkestone specimens are sometimes slightly curved in the line of growth; and the specimen figured shows a larger number of costæ than is usually seen, though the form of the shell is very typical. It is found in zone i., specimen *b*, frequent; zone iii., frequent; zone iv., very rare; zone v., very rare; zone vi., rare; zone viii., very rare; zone xi., 55 ft. from the top, rare; 50 ft., very rare; 45 ft., frequent; 40 ft., frequent; 35 ft., frequent; 20 ft., very rare.

* This specimen was unfortunately destroyed after the drawing was made.

Nodosaria (D.) Zippei Reuss, plate IX. fig. 12.

Nodosaria Zippei Reuss, 1845, Verstein. böhm. Kreideform., pt. i. p. 25, plate viii. figs. 1–3. *N. Zippei* Rupert Jones, 1854, Lecture on the Geological History of Newbury, pl. ii. fig. 1.

This characteristic Cretaceous form has been recorded from various horizons in the Chalk of Bohemia (Reuss); and from the Chalk of England (Rupert Jones), and of the North of Ireland (Wright). Many of the Gault specimens are distinctly curved in the line of growth. It is found in zone v., very rare; zone vii., very rare; zone ix., very rare; zone x., very rare; zone xi., 55 ft. from the top, common; 50 ft., rare; 45 ft., rare; 35 ft., frequent; 30 ft. very rare; 25 ft., very rare; 20 ft., very rare; 12 ft., very rare; 6 ft., very rare.

Nodosaria (D.) paupercula Reuss, plate IX. figs. 13, 14.

Nodosaria paupercula Reuss, 1845, Verstein. böhm. Kreideform., pt. i. p. 26, pl. xii. fig. 12. *Dentalina paupercula* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i., No. 5, p. 43, pl. ii. fig. 17 *a, b*.

This somewhat variable species is well distributed in the Gault. It is also found in the Chalk of Bohemia (Reuss); and the Gault of France (Berthelin). At Folkestone it is found in zone i., specimen *b*, very rare; zone ii., specimen *b*, very rare; zone iii., rare; zone iv., common; zone v., common; zone vii., frequent; zone ix., frequent; zone xi., 12 ft., from the top, frequent; 6 ft., very rare.

Nodosaria (D.) Fontannesi Berthelin, plate IX. fig. 15.

Dentalina Fontannesi Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 42, plate ii. fig. 14.

This form, which has been described from the French Gault, is found at Folkestone in zone ii., specimen *a*, rare; zone iii., frequent; zone iv., rare; zone v., very rare; zone vi., rare; zone ix., very common; zone x., very common; zone xi., 55 ft. from the top, very rare; 50 ft., frequent; 35 ft., frequent; 12 ft., frequent.

Nodosaria (D.) obscura Reuss, plate IX. fig. 16.

Nodosaria obscura Reuss, 1845, Verstein. böhm. Kreideform., pt. i. p. 26, plate xiii., figs. 7, 8, 9. *N. obscura* Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 557, plate ix. fig. 24.

The above name can be conveniently applied to those strongly costate forms of *Nodosaria*, in which the septation is imperfectly defined on the surface of the shell. This species has been previously recorded from the Gault of Folkestone and the Upper Greensand of Warminster (Rupert Jones); the French Gault (Berthelin); the Red Chalk of Speeton (Burrows, Sherborn and Bailey); from the Greensand of the Gault of the Rhine, and in various Cretaceous strata from the Lower to the Upper Chalk in England and Bohemia (Reuss). It is found in the Folkestone Gault in zone i., specimen *b*, frequent; zone ii., specimen *b*, very rare; zone iii., rare; zone vi., very rare; zone vii., very rare; zone viii., frequent; zone ix., very rare; zone x., very common; zone xi., 55 ft. from the top, common; 50 ft., rare; 45 ft., rare; 40 ft., rare; 35 ft., very rare; 30 ft., frequent; 25 ft., frequent; 20 ft., rare.

Nodosaria inflata Reuss, plate IX. figs. 17, 18.

Nodosaria inflata Reuss, 1845, Verstein. böhm. Kreideform., pt. i. p. 25, plate xiii. figs. 3, 4.

The name of *N. inflata* may be applied to those somewhat aberrant forms which have the commencement of the test with or without constrictions, but with the later growth more or less inflated. Reuss described this species from the Plänermergel of Luschitz, Bohemia. It is found in the Gault in zone v., very rare; zone ix., rare; zone xi., 55 ft. from the top, very rare; 25 ft., rare; 12 ft., very rare.

Nodosaria tenuicosta Reuss, plate IX. figs. 19, 20.

Nodosaria tenuicosta Reuss, 1845, Verstein. böhm. Kreideform., pt. i. p. 25, plate xiii. figs. 5, 6. *N. lamellosocostata* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi., p. 38, plate ii. fig. 16. *N. tenuicosta* Berthelin, 1880, Mém. Soc. géol. France, sér. 3, vol. i. No. 5, p. 32, plate i. fig. 18 *a*, *b*.

This form was originally described from specimens out of the Plänermergel of Bohemia (Reuss; also found in the Gault of Montcley (Berthelin). The smaller specimen here figured closely approaches the form described by Reuss under the name of *N. lamellosocostata*, but which I have included with *N. tenuicosta*, as there is enough evidence in a large series of specimens to show that it is quite unnecessary to separate them. *N. lamellosocostata* has been found in the Upper Hils formation, the Speeton Clay, and the *Minimus*-thon of North Germany (Reuss); and the Gault of Folkestone (Reuss, Rupert Jones). In the Gault of Folkestone it is found in zone i., specimen *b*, frequent; zone iii., rare; zone vi., frequent; zone vii., rare; zone viii., frequent; zone ix., frequent; zone x., common; zone xi., 50 ft. from the top, frequent; 45 ft., frequent; 40 ft., very rare; 35 ft., rare; 30 ft., rare; 25 ft., very rare; 20 ft., very rare; 12 ft., common.

Nodosaria prismatica Reuss, plate IX. fig. 21.

Nodosaria prismatica Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl., p. 180, plate ii. fig. 2. *N. prismatica* Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 36, plate ii. fig. 7.

N. prismatica Burrows, Sherborn and Bailey, 1890, Journ. Roy. Micr. Soc., p. 557, plate ix. fig. 25 *a*, *b*.

This fossil has been recorded from various beds in the Gault and the Speeton Clay of North Germany (Reuss); from the French Gault (Berthelin); and from the Red Chalk of Speeton (Burrows, Sherborn and Bailey). In the Folkestone Gault it is found in zone i., specimen *b*, rare; zone ii., specimen *b*, rare; zone ii., specimen *c*, very rare; zone iii., common; zone iv., rare; zone v., common; zone vi., very rare; zone vii., very rare; zone x., frequent; zone xi., 55 ft. from the top, frequent; 45 ft., rare; 35 ft., very rare; 20 ft., very rare; 12 ft., frequent; 6 ft., very rare.

Nodosaria orthopleura Reuss, plate IX. figs. 22, 23.

Nodosaria orthopleura Reuss, 1862, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi. p. 89, plate xii. fig. 5.

This is a very typical species from the Gault. It was originally described by Reuss from Folkestone, and appears to be restricted to that locality. It can be easily distinguished from *N. prismatica* by its thinner costæ, and perfectly straight edges. The number of the costæ is generally five, but sometimes six. It occurs in zone ii., specimen *b*, very rare; zone iii., very rare; zone iv., very rare; zone v., common; zone vi., very rare; zone vii., frequent; zone viii., common; zone ix., frequent; zone x., very common; zone xi., 55 ft. from the top, frequent; 50 ft., common; 45 ft., frequent; 40 ft., frequent; 35 ft., common; 30 ft., common; 25 ft., common; 20 ft., frequent; 12 ft., rare; 6 ft., common.

Nodosaria tetragona Reuss, plate IX. fig. 24.

Nodosaria tetragona Reuss, 1860, Sitzungsb. d. k. Ak. Wiss. Wien, vol. xl. p. 181, plate ii. fig. 1.

The specimen originally described was obtained by Reuss from the greensand in the Gault of the Rhine. It is perhaps only a four-ribbed variety of the more constant form *N. orthopleura*, as examples are sometimes seen having a tendency to become five-ribbed like the latter species. It occurs in zone iv., very rare; zone vii., very rare; zone x., rare; zone xi., 35 feet from the top, very rare; 12 ft., very rare; 6 ft., rare.

Erratum.—In Part III. of this paper, 1892, p. 750, line 12 from the bottom, for *annectens* read *complanata*.

XII.

On the Development of the Continental Form of Microscope Stand.

By J. B. Nias, M.D.

(*Read* 21*st June*, 1893.)

In spite of unfavourable criticism from many quarters, the Continental pattern of stand is coming into general use in this country, as the proportion of professional workers with the Microscope increases; and it is worth while to inquire into the grounds of such a preference, because there must exist a good reason for it; and moreover, in proportion as we recede from the date of an invention, details about its origin come to possess a historic interest, and are worth putting on record.

I find that this particular chapter in the history of the Microscope has been very briefly treated by every writer, and yet there should be many better able than myself to add to our knowledge on the subject, and only in their absence do I venture on the task. Even if I should not entirely succeed in it, I may render the service of directing attention to sources of information out of the ordinary path.

The first point of interest to note about the Continental stand is that it has maintained its form without substantial alteration for nearly fifty years—a proof, in general, that a design has been at the outset the creation of a practical man; and yet this stand presents several features which are open to criticism, and are in fact unfavourably criticized if taken as representing an optician's idea of what is suitable for a Microscope; so that it became necessary to investigate the reasons for the steady preference shown for this stand on the Continent, in spite of such defects; and it soon appeared to me that they could only be explained as limitations introduced into the design at the bidding of some particular worker, such restrictions being submitted to by the optician, so that the stand may be regarded as one in which certain features desirable from the purely optical point of view have been deliberately suppressed in order that other advantages may be gained. And as the partisans of this stand are chiefly found among the ranks of anatomists, it seemed reasonable to look for the original designer among them also, the result being that I have arrived at conclusions that appear novel and interesting, and worth communicating to others.

The Parisian optician Oberhaeuser is generally named as the inventor of this stand, but, as I have said, it is not easy to understand how an optician by himself could have arrived at a model so defective from the optician's point of view, and differing so widely from the other types of Microscope in use at the time. Let us, however, suppose him to have worked under directions, and the matter becomes easy of explanation. Accordingly, upon investigation I meet with repeated assertions, never effectively denied, on the part of a certain anatomist, that it was he who designed the original model of the Continental stand for his own particular use, and that it was made for him by the firm to which Oberhaeuser belonged, and finally, that with his sanction it was patented by them, so as to give them for a certain period a monopoly of the manufacture—a fact which well explains its association with their names. I also find that this firm were permitted by the anatomist Dujardin to do the same thing with an achromatic condenser which he had invented, and, indeed, that they were actually the first opticians in France who conceived the idea of patenting inventions in connection with the Microscope; but to substantiate this position requires the enumeration of a considerable number of details.

The anatomist to whom I have referred, Strauss-Durckheim by name, pupil of Cuvier, first addressed the scientific public with a work on the anatomy of the Coleoptera, in which the common cockchafer served as a type, which work being beautifully illustrated from his own dissections, aroused some curiosity, as he tells us subsequently, on the part of naturalists as to the methods of investigation employed. To gratify this he undertook a second treatise on the methods of comparative anatomy, in which, among other instruments, are figured two Microscopes which appear to me to present the earliest type, regard being had to dates, of the Continental stand.

The work of dissecting small animals requiring the alternate use of the simple and the compound Microscope with as little disturbance as possible of the preparation, together with its arrangement in a convenient form for manipulation, we find this point particularly studied in the design of these two stands: firstly, by the introduction of a rotating stage; secondly, by a limited height and a vertical position of the model. A precise account of his claims to this invention is to be found in a letter written by Strauss-Durckheim in 1850 to the optician Chevalier, which is printed in the life of the latter by his son; from it I quote the following paragraphs:—

"Having formerly had to occupy myself a good deal with anatomical researches on very small animals with a Microscope, which by a kind of chance, was of small dimensions, I did as other microscopists do, I tried to make the best of it by perfecting the mechanical part by several means which necessity suggested to me, and reflecting on all the inconveniences which I had encountered in my microscopical researches during my long experience, I finished by designing one of these instruments in which all difficulties were removed, and this was the Microscope of which I published the description in my work on the art of dissecting which I mentioned above" (the Treatise on Comparative Anatomy published in 1842, this being written in 1850).

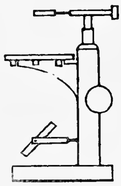
He continues, "The first requisite of the Microscope is to have in all about 3 dm. (= 12 inches) in height, so that the observer, comfortably seated at the table at which he is working, and on which the Microscope is placed, may have his hands on the stage of the latter where the object is which he is examining, whilst he looks into the eye-piece to see what he is doing while dissecting this object; which amounts to saying that the proportions which have appeared to me most suitable are those where the stage is raised about a decimetre (4 in.) above the table, and the entire tube of the Microscope is only about 2 dm. (8 in.) long or a little more. The difficulty of arranging and suitably fixing the object which one examines being equally one of the greatest inconveniences in this kind of research, especially in the case of very small objects which a displacement of 1/10 mm. will cause to travel out of the field of the Microscope, and which one ordinarily thus loses without being able to find them again, this inconvenience requires that such objects should be capable of being turned on themselves in every direction without displacing them from their situation in order to attack them from all sides. This advantage I have obtained by simply making the stage of the Microscope movable on its centre. By this means, without touching the object itself, whether it be fixed or not, one can place it in all desired positions, and that without its receiving the slightest shock which might displace it. The observer requiring to have his hands firmly resting on this same stage while dissecting the object which he is studying, I have also found that the most suitable width for such a stage is that where it has about 1 dm. (4 in.) in breadth."

He goes on to state the requirements of such a Microscope in a similar way at some length, but enough has been quoted to suggest that we meet here for the first time with a precise definition of what have become the standard dimensions of the Continental Microscope stand.

Up to 1835, which appears to have been about the date of the introduction of this model, there was no uniformity in the design of Microscope stands, and it appears to me that this pattern succeeded in ousting all others by conforming in some degree, as described above, to the proportions of the human body, much as a spectacle frame is adapted to the face. One may be sure that for continuous and laborious use, such as falls to the lot of a professional worker, such an instrument as is least productive of muscular fatigue will be most fruitful in results. For it is evident that a man sitting at a table in the attitude of work will have his eyes naturally situated about 14 in. above the table, and about 6 in. from its edge, so that his arms, as they rest on the table before him, will bring his hands close together in front, the direction of his eyes falling upon them without constraint, at an angle of about 15° from the vertical. A stand which falls into place within these dimensions will save fatigue—an advantage for which much may be sacrificed in many kinds of work. With a weighted foot, if produced slightly backwards, sufficient stability may be gained for such a small degree of inclination, or the vertical position will not be found extremely irksome, at least to the professional worker. The breadth of the hand regulates the height of the stage and its breadth; and the remainder of the space between the eyes and the table is all that is available for the length of the tube. Whatever opticians may say, those who have to economize labour will be found generally to prefer such a type of instrument; and the question arises whether it is more probable that such a design should have originated in the mind of an optician, or in that of a user of the Microscope. I incline to the latter opinion, and may interpose the query whether any other reason can be given for fixing the tube-length for which Continental objectives are corrected at 150 mm. or thereabouts.*

In fig. 89 the first of the two instruments described by Strauss-Durckheim is represented in outline. It is merely a dissecting Microscope of common type with the important addition that the stage, which is carried by a movable bracket, is made to rotate, and is provided at its edge with several sockets, of which three are shown, for what we now term stage forceps, by which the various parts of the object under dissection are drawn asunder and fixed, while by rotation of the stage the preparation is turned into convenient positions for dissection. I do not find the right of Strauss-Durckheim to be regarded as the inventor of this rotating type of stage anywhere disputed, and in the letter to Chevalier quoted the writer makes the explicit statement that the first Microscope of the kind was constructed for him by the optician Cauchoix before 1824, four years before the publication of his work on the Coleoptera.†

Fig. 89.



In fig. 90, the compound Microscope is represented, and as being much more novel in form, it deserves a detailed examination. The foot is round and weighted with lead, and carries a cylinder or drum of brass with an aperture at one side for the admission of light to the mirror, which, swung between pivots of which the ends project through the sides of the drum, is focused vertically by a rack and pinion of which the milled head is seen behind. At the top of the drum is a slit which gives passage to the edge of a circular diaphragm, and the stage, like that of the simple Microscope, is round and fitted in the

* The following are the authorities for the foregoing statements:—(*a*) H. Strauss-Durckheim, 'Traité d'anatomie comparative,' Paris, 1842, pp. iii. and 74–90. (*b*) A. Chevalier, 'Vie de Charles Chevalier,' Paris, 1862, pp. 120 *et seq.* (*c*) 'Comptes rendus de l'Académie des Sciences,' xx. pp. 574, 892. (*d*) Dujardin, art. Microscope in 'Dictionnaire de l'industrie manufacturière par A. Baudrimont,' Paris, 1838. (*e*) Charles Chevalier, 'Notes rectificatives pour servir à l'histoire des Microscopes,' Paris, 1835, pp. 10, 19, for a sight of which rare pamphlet I am indebted to the courtesy of Mr. Frank Crisp, F.R.M.S. (*f*) Patents to be seen in our Patent Office Library, Trécourt and Oberhaeuser, French Patents, series i. vol. xlviii., No. 5469, Aug. 17, 1837; G. Oberhaeuser, series ii. vol. xvii. p. 81, July 16, 1849.

† See a statement to this effect in Ch. Robin's 'Traité du Microscope,' where the rotating stage is expressly attributed to Strauss-Durckheim. 2nd ed., Paris, 1877, p. 54.

same way for numerous stage forceps; but, inasmuch as its rotation with these in place would bring their projecting ends against the pillar of the Microscope, the direct connection of the latter with the foot is severed, and it is inserted instead on a projecting lip of the stage upon which it is centered by being fitted loosely in a hole, where it is clamped in concentricity with the diaphragm by the clamping screw seen underneath. It is expressly admitted by Strauss-Durckheim that the working out of this feature was effected by M. Trécourt, Oberhaeuser's senior partner; and here we may ask for the original source of such a model. The inventor having stated that he originally worked "with a Microscope which, by a kind of chance, was of small dimensions," there was only one pattern extant at the time, which corresponds to this description and could have served as a basis for the design. This is the so-called drum Microscope, shown in fig. 91, which is now only used for toys, but was adopted by the optician Fraunhofer, of Munich, as a regular pattern about 1815, and was certainly manufactured in Paris by Chevalier, Lerebours, Trécourt, and perhaps others from 1830 onwards; and it is not difficult to see how the combination of this stand with a rotating stage would result in the design of fig. 90.* Returning to this instrument it will be noticed that the pillar which carries the body is enveloped in two outer tubes or sleeves, the inner of which, by means of a micrometer screw and spring, slides up and down to afford the now familiar form of fine-adjustment, whose milled head is seen below the clamping screw which its stem perforates; while the outer is intended to allow the body to be swung to one side through an angle of 90°, when a simple lens mounted on another stand is to be brought over the dissection—a necessity only likely to be foreseen by an anatomist. The tube of the Microscope itself is so evidently adapted from fig. 91 as to need no observation, and the only novelty is that it is double within, so as to permit of the use of a second objective above the first, as an erector, an original feature for which Strauss-Durckheim can also claim priority.†

Fig. 90.

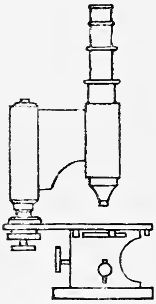
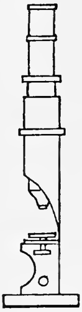


Fig. 91.

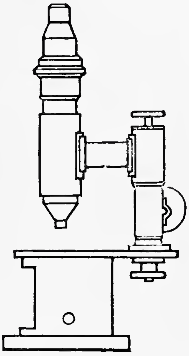


* An exact apportionment of the credit between the joint inventors is difficult to make after this lapse of time, and beyond the main purpose of this paper. Chevalier in the pamphlet quoted ('Notes Rectificatives, &c.'), tells us that Trécourt and Oberhaeuser on beginning the manufacture of Microscopes about 1830, employed this stand of Fraunhofer's exclusively, which had the advantage over all others in cheapness. The remainder of this pamphlet is occupied with a controversy about priority in the matter of achromatizing objectives, with which we have nothing to do, on the present occasion.

† On this point, and Trécourt and Oberhaeuser's subsequent introduction of such a feature in a Microscope of their own, see Strauss-Durckheim's 'Traité,' [pagg. cit.; also Comptes Rendus, ix. p. 322, sitting of the Académie des Sciences, Sept. 2, 1839.

In fig. 92 is represented the stand as patented by Trécourt and Oberhaeuser, after a cut in Dujardin's article (loc. cit.) and the drawings of the patent; specimens of the manufacture, however, which I have seen correspond more closely to the design of fig. 90. Certain features which suggest themselves more particularly to the anatomist as indispensable, have been suppressed, such as the outer tube for swinging the body to one side, and the numerous sockets for stage forceps; and the rotating diaphragm has been replaced by a tube moving vertically through the opening in the stage, by the aid of a lever at the side, so as to take from above the achromatic condenser of Dujardin patented at the same time, or a set of cylindrical diaphragms, a feature to which Strauss-Durckheim expressly objected as necessitating the disturbance of the preparation on the stage. A rack-and-pinion coarse-adjustment has been added, and the milled head of the fine-adjustment removed to the top of the pillar.

Fig. 92.



This instrument came into great favour, much aided by its cheapness, and the goodness of the objectives; and was exhibited at the sitting of the Académie des Sciences on February 13, 1837.*

On the occasion of Nachet exhibiting to the Académie des Sciences an apparatus for oblique illumination by means of a prism on June 14, 1847, ten years later, Oberhaeuser, now in business by himself, announces to that body that he has modified his stand so as to admit of the use of the mirror for that purpose, the idea having been suggested to him from England by a Mr. Abraham, of Liverpool, and a patent was taken out for this improvement also, though not till two years later.† Fig. 93 represents this second stand, which has now arrived at its modern form. The sides of the drum have been cut away so as to leave a flat pillar, and the round foot has been modified, to correspond, into a horseshoe form. The mirror, borne by a swinging arm, is adjustable vertically by means of a clamping screw. The stage rotates, as before, with the body, but is now made square, and the diaphragms and condenser are carried by a sliding substage. A hinge for inclining is the only subsequent addition to this model; and the smaller stands with which we are more familiar in this country in the hands of students, are derived from, and posterior to the invention of this larger one, which continues to be made by every Continental optician at a price of 10*l.* or 15*l.*

In fig. 94 I have added, for contrast, the type of Microscope current

* Comptus Rendus, iv. p. 250.

† French Patents (in our Patent Office Library), series ii., vol. xvii. p. 81, dated July 16, 1849, for a term of 15 years. See Comptes Rendus, xxiv. p. 1052.

at the time of the introduction of the Oberhaeuser stand; it is that made by Chevalier for Dujardin, and with which he worked, the drawing being taken from the article already cited. Like others of the period, it is fixed for use by screwing into the lid of its cabinet, and the focusing is effected by movement of the stage. In the present specimen the compound body can be lifted off the pillar, to be replaced by the arm carrying a simple lens shown in the margin, and by means of a hinge and the interposition of a right-angled prism above the objective, it can be used in the horizontal position. It is, in fact, a simplified form of the "Microscope Universel" of Chevalier. Stands of similar form were made by Plössl and others at the time, and were equally superseded by the new pattern.

Fig. 93.

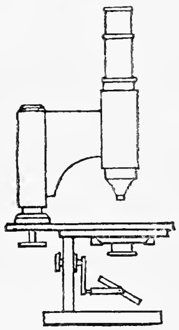
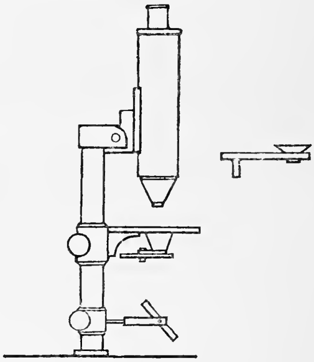


Fig. 94.



[In the original paper, as read, some comparisons followed between the Continental and English forms of stand, which unfortunately were taken as representing me as the advocate of the former exclusively. This was not my intention, and with the approval of Professor Bell, I omit these remarks. With the various observations of the speakers in the discussion I entirely agreed.

This matter suggested itself to me originally in the form of two questions to which I found no answer ready: First, why is the tube-length of the Continental stand 150–160 mm.; why should objectives be corrected for this length and no other; and who first decided upon it? Secondly, why is the Continental Microscope-stand in its complete form provided with a rotating stage of peculiar pattern, the significance of which is not at once apparent? I investigated the matter historically, with the result presented in the text.]

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Vitelline Body of Balbiani in Egg of Vertebrates.‡—M. L. F. Henneguy finds that the vitelline nucleus or so-called vitelline body of Balbiani is a constituent of the egg which may be observed in animals belonging to every class; its existence in a given species is nearly constant. Although presenting numerous variations, it may be said to consist of a central body surrounded by a more or less modified zone of protoplasm, which gives it the appearance of a cellular element. It does not appear till the primordial ovum has ceased to multiply and begun to grow. It arises from the germinal vesicle, and appears to be formed by the nucleolar substance, which it resembles in its relations to staining fluids. It generally disappears very early in Vertebrates, while the egg is still but little developed, but in certain Invertebrates it may persist in the ripe egg, and be found even in the embryo.

The author regards it as an ancestral organ which, with the nucleolar elements of the germinal vesicle, corresponds to the macronucleus of Infusoria; the micronucleus is represented by the chromatic network, which alone takes part in the phenomena of fecundation.

Centrosome and Yolk-nucleus.§—Though M. E. G. Balbiani has investigated these bodies in Spiders, where he finds the yolk-nucleus

* 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, &c., 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, and Reproduction, and allied subjects.

‡ Journ. de l'Anat. et de la Physiol., xxix. (1893) pp. 1–39 (1 pl.).

§ Tom cit., pp. 145–79 (2 pls.).

to be the homologue of the centrosome (or Nebenkern) of seminal cells and of the centrosome of somatic cells, his remarks are of general interest. It arises from the nucleus of the young egg, from which it becomes separated as a small bud, at the moment when the egg leaves the epithelial or germinal layer of the ovary to continue its development in the ovarian follicle. The vitelline nucleus exercises on the protoplasm of the egg an influence analogous to that which the centrosome exercises on the protoplasm of ordinary cells; it condenses on its surface the surrounding vitellus, in the form of a more or less thick layer, the appearance and arrangement of which vary with the age of the egg and the species of the animal. This peripheral layer of the vitelline nucleus is comparable to the plasmic mass which is called attractive sphere in other cells.

Another analogy which the vitelline nucleus presents to the centrosome is its occasional existence in a double form. The size of this nucleus generally increases with that of the egg, so that it equals or may be larger than the germinal vesicle. This growth is a true hypertrophic degeneration due to the superabundant nutrition of an element which has passed into a state of physiological inactivity.

The vitelline nucleus does not appear to be formed in certain Araneids, or, if it is, it disappears early, or is so fine that it cannot be perceived with the means as our disposal. In other Araneids it can be easily observed at all periods of development of the egg and embryo.

The theory of Boveri regarding the physiological decadence of the female centrosome is confirmed by the author's observations on Spiders; their vitelline nucleus may, in fact, be considered as the female centrosome which has become degenerate, and lost its physiological significance in the life of the cell. The formation of a vitelline nucleus deprived of its normal properties is a phenomenon which has something more than a mere atavistic signification; it is a "phylogenetic reminiscence."

As there is a homology between the vitelline nucleus and the centrosome it is probable that these two elements have an identical origin. The nuclear origin of the centrosome explains the important part which this element plays in the reproduction of the cell.

Development of Liver and Pancreas.*—Herr W. Félix has studied the development of the liver and pancreas in the Chick and in Man. In the former the first sign of the liver is to be found in the depressions of the pharynx; the walls of the intestine form two grooves which extend from the head towards the tail of the embryo, and become gradually constricted to form two distinct canals. The more anterior (cephalic) canal is situated on the dorsal side of the large veins which go to the heart, while the posterior (caudal) canal lies on the ventral side of the same veins. The caudal canal (which corresponds to the right hepatic duct of the adult) gives off two wing-like prolongations which bud into the mesenchymatous tissue. The median parts of these prolongations are hollow, while the peripheral or terminal buds are solid; as they meet the buds anastomose, and form the hepatic plexus.

* Arch. f. Anat. u. Physiol., 1892. See Journ. de l'Anat. et de la Physiol., xxix. (1893) pp. 143 and 4.

The cephalic duct forms but a small part of the hepatic tissue. The buds of the two ducts unite in such a way that the liver gradually takes on the form of a single organ which surrounds the venous sinus.

The gall-bladder is developed from a diverticulum of the caudal canal. Once formed the liver loses most of its connections with the caudal canal, and there is then formed the plexus of excretory ducts which brings the hepatic mass into relation with the cephalic canal, which contributes so little to the development of the organ. The caudal canal persists as the cystic-enteric duct.

The author has been able to study three human embryos; he finds that the mode of development of the liver is analogous to that which he has observed in the Chick; but the constriction which separates the canals from the duodenum begins early, and so causes the length of the ducts.

Like Goette, Félix finds that the pancreas of the Chick arises from three foundations, one dorsal and two ventral; all three are diverticula of the anterior part of the intestine. The same seems to be true of Man, save that the ventral diverticula fuse.

Development of Mustela ferox.*—Dr. A. Robinson has some notes on the early stages of development in the Ferret. He was able to see two primitive germinal layers, and he points out that if it is right to call the inner one hypoblast the remainder of the cellular wall with which it is continuous is also hypoblast; in this case the blastocyst is essentially a large yolk-sac which bears upon one pole a small area of epiblast. If this be so, the ovum of the Ferret, as well as those of the Rat and Mouse, bear testimony to the descent of the Mammalia from a large-yolked protamniote ancestor, for it shows during its early stages the typical features of all comparatively large-yolked vertebrate ova. No trace could be seen of any difference in thickness of the margin of the germinal area such as would indicate the existence of a widely open true blastopore, nor was there any trace of such an aperture within the area itself.

Development of Mammalian Dentition.†—Dr. W. Leche begins an important essay with some criticisms and cautions in reference to some of the numerous recent publications on the dentition of Mammals. Some of these seem to him to be unduly rash. He indicates what is the safe method of investigation.

By means of continuous serial sections the author has for many years been accumulating facts in regard to the development of the teeth and the relations of the two dentitions. He begins with the hedgehog. The formula of its normally persistent dentition is—

$$\frac{i.\,1,\ i.\,2,\ d\,i.\,3;\ \ C;\ d.\,p.\,m.\,2,\ \ p.\,m.\,3,\ p.\,m.\,4,\ \ m.\,1\text{–}3}{i.\,2,\ d.\,i.\,3;\ d.\,C;\qquad d.\,p.\,m.\,3,\ p.\,m.\,4,\ m.\,1\text{–}3}.$$

The functional replacing teeth are—

$$\frac{i.\,1,\ i.\,2,\ C,\ p.\,m.\,3,\ p.\,m.\,4}{i.\,2,\qquad\qquad p.\,m.\,4};$$

* Anat. Anzeig., viii. (1893) pp. 116–20 (2 figs.).
† Morphol. Jahrb., xix. (1892) pp. 502–47 (21 figs.).

the corresponding teeth which these have replaced would in ordinary terminology be called milk-teeth. But what is to be said of those teeth which persist without replacement, viz.—

$$\frac{d.\ i.\ 3,\quad d.\ p.\ m.\ 2,\quad m.\ 1\text{–}3}{d.\ i.\ 3,\quad d.\ C.,\quad d.\ p.\ m.\ 3,\quad m.\ 1\text{–}3}\ ?$$

Morphologically these belong to the same series as the so-called milk-teeth. On at least some of them replacing teeth are represented by distinct bud-like enamel-germs with corresponding mesodermic thickenings. The so-called molars develope from the enamel ridge in precisely the same manner as the preceding milk-teeth. The hedgehog has a complete milk-dentition, but the replacement is less perfect than in most Placentalia, thus what persists is partly due to the first set, partly to the second. But in connection with the third upper incisor (*d.i.3*) and some others, there are hints or residues of a still earlier generation of teeth, so that what we call the first and second set should be called second and third. Nor is the possibility of development exhausted in forming what is called the second set, for there are hints of yet another. The dentition of certain fossil Erinaceidæ agrees with the first set rather than with the second.

Omitting what the author says in regard to shrew and cat, we shall notice his interpretation of the marsupial dentition. He confirms some of Kükenthal's work. The second set of teeth is represented by bud-like enamel-germs, partially surrounded by thickened connective-tissue, which at a certain stage are associated with all the teeth in front of the third molar. But of these germs only one, the third premolar, developes into a functional tooth. All the persistent teeth of marsupials, except the third premolar, correspond to those of the first set in Placentals. Reasons are given for believing that a complete second set never existed in Marsupials.

In connection with Edentata, it is noted that in embryos of *Tatusia peba* there are rudiments of more teeth than do subsequently become calcified. The dentition of Dasypodidæ is not strictly homodont; only the first and eighth tooth are simple cones, those intervening (in the first set) have a median tubercle and a lower lateral one. In regard to Cetacea, the author states that the persistent dentition of toothed whales (all ?) corresponds to the first set in other Placentals.

The teeth of the second set (replacing teeth) are not descendants of those of the first set (milk teeth), but develope lingual-wards to these direct from the enamel ridge. Reasons are given showing that the first set may be regarded as ontogenetically and phylogenetically the older. Four stages of dentition may be established:—

(1) The persisting dentition consists wholly of the first set (Odontoceti).

(2) The persisting dentition consists of the first set excepting the third premolar (Marsupials).

(3) The persisting dentition consists of molars of the first set, while incisors, canines, and premolars are partly of the first and partly of the second set (Hedgehog).

(4) The persisting dentition consists, excepting the molars, only of the elements of the second set (higher Mammals).

There are two kinds of "monophyodontism" in Mammals. In the lower forms it is due to a non-appearance of the second set; in the higher forms it is due to a suppression of the first set. In higher Mammals the monophyodont state is always the result of regression, but this is not the case in Marsupials at least. It seems likely that the second set has been gradually acquired by the Mammals. Prof. Leche closes with a discussion of the differentiation of the various types of dentition. His detailed memoir will be looked for with expectation.

Development of Urino-genital System in Birds.*—Prof. C. K. Hoffmann has investigated this in various Grallatores and Natatores (*Totanus*, *Vanellus*, *Larus*, *Sterna*, *Tringa*, *Fulica*, &c.), whose embryos are preferable to those of the fowl. All the embryos were taken from the nest, the abnormalities of artificial incubation being thereby avoided. In the present memoir the author deals with the development of the gonads, the supra-renal capsules, and the oviducts. As to the kidneys, he has not yet obtained satisfactory results.

As is well known, the gonads, at first in a sexually indifferent state, develope from a patch of germinal epithelium on the wall of the abdominal cavity. At the expense of the lateral germinal epithelium, the Müllerian duct developes; the median part forms the gonads with its large "primitive ovules." These are present in very early stages, e. g. in embryos with thirty-two somites, among the peritoneal cells. In fact, it seems impossible to state when they originate. They are not "privileged" peritoneal cells at all events. The origin of the "cordons génitaux" *from the Malpighian corpuscles*, and their subsequent relation to the genital epithelium are described.

In Grallatores and Natatores the right gonad developes for a considerable time as strongly as does the left. The Müllerian duct is at first equally developed in both sexes. Thus it is very difficult to distinguish at an early state embryo males from embryo females; subsequently it becomes easier by the reduction of the genital "cordons" in the female. The history of these "cordons" in both sexes is described in detail. That each individual is originally hermaphrodite is more clear than ever.

The author then describes the origin of the supra-renal capsules from nerve-strands of the sympathetic and renal strands from the Malpighian corpuscles of the Wolffian body. The Müllerian duct is formed quite independently of the Wolffian duct; it begins as an invagination of peritoneal cells, but grows on its own account.

Gastrulation in Chelonia.†—Prof. K. Mitsukuri has studied the process of gastrulation in *Chelone caouana*, and publishes a preliminary notice of his results. Over the great part of the blastoderm there is a separation into a superficial epiblast of columnar cells, and a lower composed of irregular stellate cells, and probably not forming a complete membrane. At the posterior end there is a small area in which this separation does not take place, and there is then a thick knob consisting of a reticulated mass of cells in the formation of which the subjacent yolk takes part; this is the primitive plate or primitive knob. In the middle of this knob an invagination appears, which is the archenteron,

* Verh. K. Akad. Wet. Amstel., 1892, 54 pp. (7 pls.).
† Anat. Anzeig., viii. (1893) pp. 427–31 (8 figs.).

and its dorsal opening is the blastopore. This cavity extends gradually forwards as the primitive knob enlarges anteriorly. The roof of the archenteron, which becomes continuous with the epiblast at the dorsal lip of the blastopore, becomes columnar; and from the median part of the roof the notochord and gastric mesoblast are formed. On the floor of the archenteron becoming divided into two parts the larger and posterior portion gives rise to the peristomial mesoblast, while the rest is finally absorbed, together with that part of the primitive knob which lies beneath it; the archenteron is thus put into communication with the large subgerminal cavity in the yolk. The primitive knob continues to spread till the whole of the ventral surface of the embryonic shield has been covered. At some distance back from the anterior end of the embryonic shield the head-fold is developed. As the primitive knob marks the posterior end of the embryo, and the lateral folds arise within the embryonic shield, it would appear that the future embryo-body is developed entirely within the area covered ventrally by the part derived from the primitive knob.

In other words, the epiblast of the embryonic shield gives rise to the epiblast and its derivates; in the region of the primitive plate and its anterior enlargement there are produced the archenteron, the yolk-plug, the notochord, the mesoblast, the definite hypoblast and its derivates. The only contribution to the body of the embryo made by the primitive lower layer is to be found in some of its cells which are mixed up with the cells of the primitive knob.

Looking at the matter generally, the author is led to the view that the enclosure of the yolk of the Chelonian egg is a simple growth of the edge of the blastoderm, and is cenogenetic in nature, while in Elasmobranchs it is a part of the process of invagination, and is palingenetic. He rejects, therefore, Balfour's theory of a yolk-blastopore in Sauropsida.

Life-history of Rhodeus amarus.* — Dr. Ad. Olt describes the peculiar metamorphosis of the embryos of this Cyprinoid Fish during their stay in the gills of mussels, the remarkable structure of the sexually mature female, and the system of currents within the bivalve.

The Bitterling is widely distributed in Central Europe. It spawns from the middle of May to the middle of July, laying its eggs within species of *Unio* and *Anodonta*. An ovipositor is inserted at the exhalant aperture, and the ova pass into the interlamellar spaces of the gills. The nature of the ova and the mode of their transmission are described in detail. Milt is shed by the males near the respiratory siphon. While the ova enter against the stream, as above noted, the spermatozoa follow the currents.

After a few notes on the segmentation of the ovum, Dr. Olt describes the embryos. Very remarkable is the manner in which the yolk serves as an attaching and protective organ. The precise relations of the embryos to the gills are noted.

The females are remarkable in having an ovipositor and an accessory gland. The ovary is single, but was originally paired. In the posterior part of the body-cavity, covered by peritoneum, lies the paired accessory gland with a common duct, which may be regarded as the beginning of

* Zeitschr. f. wiss. Zool., lv. (1893) pp. 543–75 (1 pl.).

the ovipositor tube. The latter is really a modification of the skin, which is retracted by a muscle and stretched by the entrance of an ovum and associated mucus. On the mature male there are well-known warts, which the author regards as integumentary modifications of the nature of tubular glands. The bitterness of the fish is due to the bile which is always abundant in the very large gall-bladder.

Elimination of Nuclear Elements in Ovarian Ova of Scorpæna scrofa.*—Prof. Ch. Van Beneden has observed this in ovarian ova of the second phase—the phase of growth. The elimination affects the chromosomes only, the nucleoli take no part. After giving an account of analogous eliminations observed by other investigators, the author discusses possible interpretations. He does not think that there is any essential difference between the eliminating process and nuclear gemmation; he is sure that the process is not artificial nor pathological; it is a reduction of chromosomes. The eliminated elements are usually disposed in the vitellus at an equal distance from the germinal vesicle and from the periphery, but their fate is unknown.

Experimental Embryology.—Prof. O. Hertwig † has made a number of experiments with the developing ova of the frog, modifying their segmentation by gentle compression between two slides or by confining them within glass tubes. The deviations corroborate a conclusion which Hertwig stated, in 1884, that the two poles of the nuclear spindle, by which the direction of the segmentation-plane is defined, come to lie in the direction of the largest protoplasmic masses. Thus, in ova forced to assume a barrel-like form within a glass tube, the poles of the first segmentation always lie in the longitudinal axis of the tube. According to Hertwig, the results of his experiments, of which we have given only a general indication, go to show that it is not the segmentation which separates the ovum into qualitatively diverse parts such that each part has but limited developmental possibilities; the predisposition is already in the unfertilized ovum.

Herr D. Barfurth ‡ criticizes recent work in regard to the teratological development of Ascidians. He opposes the conclusion of Chabry that the embryo obtained after the destruction of one of the two first blastomeres was a complete embryo of half size, and supports Roux in maintaining that a typical half-morula, half-gastrula, and a right or left half-larva is produced. He points out that Chabry describes the normal Ascidian larva as asymmetrical, the left eye and left otolith being undeveloped. In describing his teratological larvæ, however, he describes them as complete, except that organs of "slight importance," such as the otolith or a fixing papilla, are wanting. By a detailed consideration of the larvæ described by Chabry, Herr Barfurth endeavours to prove that these are in reality half-larvæ, the complete appearance being produced by the fundamental want of symmetry or by the post-generation of Roux. By this means the divergent results of the two investigators are harmonized.

Herr Barfurth also notes that in an investigation of his own as to

* Bull. Acad. Belg., xxv. (1893) pp. 323–64 (2 pls.)
† SB. K. Preuss. Akad. Berlin, 1893, pp. 385–92.
‡ Anat. Anzeig., viii. (1893) pp. 493–7.

the effect produced by the destruction of one of the first blastomeres in *Siredon pisciformis*, in the only case in which he obtained any result, a half-embryo of the right side was produced.

Herr H. Driesch* finds that it is easy to shake the fertilized ova of sea-urchins so as to liberate the membranes. Membraneless ova placed under the pressure of a cover-glass, as in a former experiment by the same investigator, divide into 8-celled stages, in which the blastula consists of an annular zone of "animal" cells and two separated zones of "vegetative" cells. It is as if the "animal" cells formed the tropical zone, and the separated "vegetative" cells the polar-temperate zones. Yet from these there develope normal Plutei. "It is therefore proved that from a blastomere something may result quite different from that which would have resulted in normal development." While the material of the normally "vegetative" half is separated into two distinct zones, the resultant gastrula has but one gut; therefore at least some of the cells which would normally have formed "endoderm" do in reality form "ectoderm."

Dr. F. Braem † points out a fallacy in one of Driesch's arguments. Driesch exposed developing ova of *Echinus microtuberculatus* to the pressure of a cover-glass with the result that a two-layered plate of eight cells on each layer represented the blastula-stage. "What should have formed one pole formed the two sides, and what should have formed the other pole formed both poles." Yet normal Plutei developed, whence Driesch concluded that the segmentation-spheres were uniform and might be arranged in any way without affecting the result. Therefore the doctrine of specific germinal areas must be corrected. But Braem notes the unproved assumption that the eight cells formed under the influence of pressure are the equivalents of the cells in the normal eight-cell stage. That this assumption is likely to be incorrect is shown in detail. Driesch's experiment showed only that the normal form of segmentation may be greatly altered without affecting the ultimate development. Nor is the doctrine of His affected by the fact that one of the first two segmentation cells may form a complete gastrula, for this is simply a striking instance of regeneration, and the power of regeneration is naturally energetic in the immediate cell-descendants of a fertilized ovum.

Heredity and the Theory of Descent.‡—Prof. C. Emery discusses the recent developments of Darwinism at some length. At the outset he explains his own position to be that of a Darwinist in the narrower sense; he considers natural selection to be a highly important, but not the only, perhaps not even the most important factor in evolution.

The first point taken up is that of secondary sexual characters. The possibility of sexual selection is granted in the case of certain birds; in polygamous birds it is however a fact of observation that the females belong to the conqueror, and some of these birds are brightly adorned. The suggestion that the bright colours, &c., of the male serve as an indication of his strength is noticed; it can, however, hardly account for the beautiful patterns and combinations of colour. With regard to many of these characters, as, for example, peacocks' feathers, the pregnant

* Anat. Anzeig., viii. (1893) pp. 348–57 (16 figs.).
† Biol. Centralbl., xiii. (1893) pp. 146–51.
‡ Tom. cit., pp. 397–420.

comment is made that while the morphological side of their phylogeny can be constructed with some success, their physiological origin is quite unknown. In endeavouring to throw light upon the origin of sexual dimorphism and on the wider problem of the origin of species, the author emphasizes the importance of the blood, as bringing into connection the organs of the body, and thus enabling one organ to influence another which is at a distance from it. Of the importance of the constituents of the blood many illustrations can be given; the evil effects often following transfusion of blood, many facts of bacteriological investigation, the influence of the extirpation of the thyroid or of the suprarenal bodies, and so on. The last of these examples especially shows what an important effect the products of the metabolism of one organ may have on the whole organism. The author therefore concludes that secondary sexual characters are directly due to the varying reactions of the organs of the body to the chemical stimuli which pass out from the sexual organs.

With regard to the theory of the germ-plasm, the importance of self-induced variations of its elements is especially dwelt on. If the germ-plasm, as the undying substratum in perishable organisms, begins to vary, it is conceivable that during successive generations it will continue to vary in the same direction unless new influences alter this direction. Free crossing would of course prevent this, but if the necessary conditions of isolation are preserved we might have a new form produced without either natural selection or the influence of environment having had any direct effect. These considerations lead the author to the conclusion that there are three types of variation: (1) The primary variations "which are the result of intimate changes in the germ-plasm, and which result in the formation of new kinds of ids, or in the alteration of the existing kinds. These variations are inherited, are apparently from their nature progressive, and may lead to the formation of new species." (2) Secondary variations; these arise from different combinations of ids which are already present in the germ-plasm, and are produced by the conjugation of cells. They are inherited and lead to individual variation; they may however be fixed by isolation and so lead to the formation of species. (3) Tertiary variations, the result of the action of environment on the organism, are not usually inherited.

With regard to the inheritance of acquired characters, variations of the third type, the author has a new hypothesis to put forward. He believes in the inheritance of certain acquired characters, such as the epilepsy of the Brown-Séquard experiments. He considers that in such cases the modified activity of certain of the organs results in the formation of certain products, probably ferments, which are taken up by the reproductive cells, and, without forming an integral part of the germ-plasm, are handed on to the developing organism, and during the development and future life exercise their proper influence upon function. This accessory part of the germ-cell he calls the *zymoplasm*.

The paper concludes with a careful consideration of the part played by Natural Selection, in which the author emphasizes the *definiteness* of variation, and the fact that natural selection tends to eliminate the bad rather than to preserve the good, so that its action must be negative rather than positive as is artificial selection. On this point

Mr. Lloyd Morgan's paper on "Natural Elimination" may be referred to.

Transmission of Acquired Characters.*—Herr K. Knauthe notes the following three cases which suggest to him that acquired characters may be transmitted: (1) A cow twisted one of its horns so that the point, formerly directed upwards, was turned downwards. One of its calves (a female) had the same peculiarity. (2) An ugly way of holding the tail was traced from a mare through two generations. (3) Two bull-dogs were taught to "carry." One of the offspring of this pair was sent away when quite young; without any training it exhibited the habit of carrying sticks and other objects from its youth up.

Inheritance of Acquired Characters.†—Prof. M. Wilckens opposes Weismann's view on this subject on account of his own observations on artificial selection in domestic animals. He points out the undeniable fact that the characters of an English racehorse, for example, tend to be transmitted to its offspring, and by applying the term "acquired" to these characters he arrives at the conclusion that Weismann's "theory is false and cannot be reconciled with the facts."

With regard to the inheritance of mutilations he points out that all the experience of the practical breeder is against the possibility.

With regard to the inheritance of characters acquired through climatic influences he asserts that measurements made in his own laboratory prove that, not only do cattle of the same breed vary with regard to the thickness of the hide and the length of the horns according to the climate, but that these variations are inherited. Dr. Wilckens also considers that the facts of physiology are opposed to the idea that the germ-plasma can remain uninfluenced by the nutrition and metabolism of the organism. In all this, however, there seems to be lacking a precise appreciation of Weismann's position as now stated.

Ontogeny and Regeneration.‡—Dr. F. von Wagner has investigated the processes of regeneration of organs, with a view to testing the validity of the common assumption that these processes run parallel to embryonic development; that tissues and organs are reformed by cells of the same embryonic layer as that from which they first took origin. With regeneration are also included ordinary processes of asexual budding. In the budding of *Hydra* and some polypes, Lang § has already shown that the ectoderm and endoderm of the bud alike arise from the ectoderm of the parent. Lang endeavours to harmonize this with embryonic conditions by asserting that the ectoderm of the parent, over the budding area, is homologous with the *blastoderm* of the embryo. This is, however, an untenable position, and cannot conceal the fact that budding is not a repetition of embryonic development in the case of these hydropolypes.

In his own experiments, especially on *Microstoma*, Dr. Wagner found that the pharynx was regenerated by the parenchyma of the body—that is by a mesoblastic tissue, while in ontogeny it arose from the ectoderm. The parenchyma also reformed the nerve-ring when this was destroyed.

* Zool. Anzeig., xvi. (1893) p. 174.
† Biol. Centralbl., xiii. (1893) pp. 420–7.
‡ Tom. cit., pp. 287–96.
§ Zeitschr. f. wiss. Zool., liv. pp. 366 *et seq.*

Although the necessary embryological data are here wanting, it is not likely that the nerve-ring was originally mesoblastic. Similar regenerative experiments on *Lumbriculus* led to similar results.

The author's conclusion is that the conception of the parallelism of ontogeny and regeneration must undergo fundamental modification, and points out the danger of filling up gaps in embryological observations with inferences drawn from processes of regeneration.

The Origin of Species.*—M. Lavocat in a lengthy paper opposes the current doctrine of evolution, which he terms "the theory of transformations." He asserts that no transition form between two species has been found, either fossil or living, and that variability is so limited as to be only able to produce varieties or races and not species. The author's own theory is that "every species has had a special and distinct origin; that in every case forms primitively imperfect have gradually developed; and that every species has proceeded not from a single centre, but from every region where circumstances were favourable for its formation and development."! The question of the first origin of these primitive species is said to be unanswerable.

β. Histology.

Recent Views on Protoplasm.†—Enquiries are often made for some useful critical summary of recent speculations on protoplasm. This appears to have been given by Prof. W. A. Haswell, who took "recent views on the structure of protoplasm and the significance of the various parts of the cell" as part of the subject of his presidential address to the Linnean Society of New South Wales. He thinks that some definite progress has undoubtedly been made of late in our knowledge of the relative importance of the different parts of the cell. A serious assault has been made on the predominance of the nucleus. The centrosomes or attraction spheres, first discovered by E. van Beneden, appear to be independent centres of activity, and they, with the spindle-fibres that proceed from them, appear to be of importance in cell-division; indeed, according to Rabl and others, they form the actual vital parts of the cell. We commend the address to the enquirers to whom we have referred.

The Cell.‡—Prof. O. Hertwig's admirable book should have found earlier notice in our pages. It contains in compact form an account of the more important facts in regard to the cell, stated with the author's wonted clearness and is well illustrated. A short historical chapter is followed by a discussion of the structure, functions, and chemistry of the cell. The animal and the vegetable cell receive parallel treatment, and throughout the book the relation of the established facts to general biological conclusions is kept in the foreground. As the author admits in the preface, his own views are emphasized. This emphasis is natural, for Prof. O. Hertwig's contributions to cellular biology have been numerous and of great importance, but we are inclined to think that a little more space might have been found for the conclusions of other workers. The second volume will treat of tissues.

* Mém. Acad. Sci. Nat. Toulouse, iv. (1892) pp. 44–65.
† Proc. Linn. Soc. N.S.W., vii. (1893) pp. 673–85.
‡ O. Hertwig, 'Die Zelle und die Gewebe. Grundzüge der allgemeinen Anatomie und Physiologie,' Theil i., 8vo, Jena, 1892, 296 pp., 168 figs.

Origin of the Centrosoma.*—Dr. A. Brauer records some observations made on the spermatocyte of *Ascaris megalocephala* var. *univalens*, which he regards as conclusive. In the nucleus of the spermatocyte at the stage when a four-partite chromosome was present, he saw, apart from the nucleolus, a relatively large rounded body. During the formation of the first spindle, threads radiate out from this body, in all directions, to the chromosome; it then lengthens and divides. The halves then separate, while the threads communicating with the chromosome remain unbroken; as they separate, the nucleus becomes lengthened in the same direction. At last, at two opposite points the two bodies pass through gaps in the nuclear membrane into the cell-protoplasm. Here a radiating arrangement of cell-protoplasm becomes obvious round each. The two structures thus formed from the original spherical body are undoubtedly the centrosomes. In some cases before its division the centrosome leaves the nucleus and appears on the outside of its membrane. In this observed case it is clear that the centrosome belongs to the nucleus and not to the cell-protoplasm. The strongly accentuated distinction between nucleus and centrosome thus breaks down, and increased probability is given to the view which regards the chromatin elements as the bearers of hereditary tendencies, the centrosome as simply an organ of division. The author's observations also lead him to conclude that the whole of the spindle is nuclear in origin.

Muscle-spindles.†—Dr. L. Kerschner gives a useful summary of investigations (since 1888) on muscle-spindles. He dismisses various interpretations, e. g. that they are pathological growths, or that they are merely transitional structures. Most striking is the well-developed terminal nerve-apparatus. This cannot be motor, for on each of Weismann's fibres there is at least one motor terminal plate, and there is no connection between the terminal apparatus and the motor tracts. Kerschner's own interpretation is that the apparatus is sensory. In support of this he marshals various arguments, and promises a fuller statement.

Intercellular Bridges between Smooth Muscle Cells and Epithelial Cells.‡—Dr. M. Heidenhain finds that in the poison-glands of *Triton* the ensheathing muscle-cells are connected by plasmic bridges with the ectodermic epithelial cells at the neck. He regards this connection as of primary significance, and as a proof that these muscle-cells of the skin-glands belong genetically to the ectoderm. In the case of the pelvic and cloacal glands he believes that the muscle-cells are in the same way demonstrably endodermic.

γ. General.

Nerve-cord and Notochord in Amphioxus.§—Herr B. Lwoff discusses the import of the supporting fibres associated with the nerve-cord of *Amphioxus*. Those which lie ventrally are the strongest. The ependyme cells, homologous with similar elements in other Vertebrates, form the original supporting tissue, and remain much more distinct and

* Biol. Centralbl., xiii. (1893) pp. 285–7.
† Anat. Anzeig., viii. (1893) pp. 449–58.
‡ Tom. cit., pp. 404–10 (1 fig.).
§ Zeitschr. f. wiss. Zool., lvi. (1893) pp. 298–309 (1 pl.).

primitive than in higher forms. The vesicular epithelial tissue of *Sigalion* and other Annelids—a tissue which serves for the fixing of the supporting elements of the nervous system, and also for the insertion of the musculature—corresponds to the notochord of *Amphioxus*. It may be remembered that according to Lwoff the notochord of *Amphioxus* arises from the ectoderm, differentiating from a rudiment from which nervous system and lateral musculature also develope. The above-mentioned supporting tissue of Annelids is also ectodermic. It has a developmental, histological, and functional correspondence with the notochord of *Amphioxus*.

B. INVERTEBRATA.

Mollusca.

Land and Fresh-water Mollusca of New Zealand.*—Messrs. C. Hedley and H. Suter have published a reference list of these Molluscs which should be useful to students and residents. They remark that as the New Zealand fauna becomes better known, its insularity stands out more prominently. One by one foreign genera that have been falsely imposed on the fauna by the negligence of collectors or the mistakes of authors, have been eliminated. All the species are now known to be strictly endemic, and the relation to North Australia has been shown to be based on fictitious evidence. One hundred and eighty-four species are catalogued.

α. Cephalopoda.

Coloration of Integument of Cephalopoda.†—Dr. L. Joubin finds that the development of the chromatophore commences with the invagination of an ectodermic cell into the mesodermic connective tissue; it gradually sinks in, and ends by forming the base of an ectodermic depression from which it, finally, becomes detached. It then becomes connected with some mesodermal connective cells which are applied to its surface; it grows, dilates, and disposes its contents in two zones, the inner of which is the denser. The nucleus, which is at first distinctly visible, becomes less and less well marked as the chromatophore becomes complete.

Meantime, the mesodermal cells increase rapidly in number, and form a corona of cells for the ectodermic cell, which is now lenticular in shape. The peripheral cells become contractile and soon fibrillated, when they serve to fix the principal cell to the surrounding tissues and maintain it perfectly distended, so as to allow of the play of the coloured protoplasmic contents. This double transformation of the peripheral cells into muscular, and thence into connective fibres, explains the two opposing views that have been held as to the constitution of the chromatophore. It is, at the same time, clear that the fibres, even during their muscular phase, have no action on the coloured protoplasm, which is animated only by amœboid movements of expansion.

In studying the coloration of living animals, the author applies a process of staining which has, as yet, been only used for Fishes and

* Proc. Linn. Soc. N.S.W., vii. (1893) pp. 613-65.
† Arch. Zool. Expér. et Gén., x. (1892) pp. 277-330 (3 pls.).

Batrachians. This consists either in injecting a highly concentrated solution of methylen-blue into the veins of an adult, or of making a very dilute solution in the sea-water in which the embryos of Cephalopods are living. The latter gradually accumulate the colouring matter in their integument without any apparent injury to the animal. The injection of a concentrated solution into an adult very rapidly shows up the cutaneous nervous network which is peculiar to the chromatophores. The terminal fibres of the nerves may be seen ending in a swelling in each of these organs. The immersion of embryos in coloured sea-water rapidly leads to the appearance of the sinuous lines of the special cells; the network of nerves soon becomes evident, and their terminations are seen even better than in the adult. If the staining be deeper the nerve-centres which preside over the movements of the chromatophore become very sharply coloured. These centres are the pallial ganglia, which are united by a transverse commissure which has never yet been described.

The author has investigated the cutaneous glands of *Eledone moschata*; he finds that the skin of this Cephalopod contains very large mucous epithelial cells in which there is a large droplet of fatty matter, which is the "musk." The contents of these cells are probably a mixture of fatty and volatile matters which are soluble in ether; the residue obtained dry in small quantities only is of a yellowish colour and strongly odorous.

Finally, the author discusses the cutaneous ink-secreting organs of *Nautilus*. As a *Nautilus* grows it comes in contact by its back with a part of the shell which has been for a more or less long time exposed to shocks from without, and has become rugous. It covers this part with a black varnish secreted by the edge of the mantle. This varnish is itself, some time later, covered by the nacre which is also secreted by the mantle. The part of the mantle which is charged with the deposit of varnish is the superficial cutaneous epithelium, modified in a special region for this secretion. The cells of this region are caliciform and curved; they secrete very fine black granulations which accumulate in the cuplike part, and are deposited in the successive zones of the shell with which they come into direct contact by their large orifice.

γ. Gastropoda.

New Classification of Helices.*—Mr. H. A. Pilsbry invites consideration of a classification of the Helicoid snails which is, he says, essentially modern and essentially original. In dissecting the male generative organs of snails, note should be made of (1) the shape of the penis, (2) the presence or absence of internal papilla and external appendix, (3) presence or absence of flagellum or epiphallus, and (4) the point of insertion of the retractor muscle and of the vas deferens. In the female system the presence or absence and the form of dart-sacs, darts, mucous glands, should be noticed, as well as the length of the spermathecal duct, the form and position of the cæca of the ovotestis, and, finally, whether the right eye-peduncle is retracted between the branches of the genitalia or to the left side.

With regard to the value of the jaw as a basis for classification there

* Proc. Acad. Philadelphia, 1892, pp. 387–404 (1 fig.).

are still a number of unsettled questions, but on some points there is more certainty. It may be confidently asserted that the strongly ribbed type of jaw (odontognath) intergrades by imperceptible stages with the entirely smooth, *Zonites*-like type (oxygnath). "Odontognathy" and "oxygnathy" are therefore "controvertible terms," as far as classification is concerned, and consequently cannot be used for the separation of genera or even sub-genera.

The primary groups recognized by the author are:—

I. Eggs or young very large at birth. (1) MACROON.

II. Eggs or young smaller or minute at birth.

a. Female system with dart-sac and mucous gland. (2) BELOGONA.

aa. Female system without accessories; male with flagellum and appendix on penis; no epiphallus. (3) TELEOPHALLA.

aaa. Female ditto, male with epiphallus, but no appendix. (4) EPIPHALLOPHORA.

aaaa. Genital system lacking all accessory organs.

b. Jaw soldered into one piece. (5) HAPLOGONA.

bb. Jaw composed of 16–24 separate plates. (6) POLYPLACOGNATHA.

Mr. Pilsbry defines his groups and gives short notices of the constituent genera of each.

Integument of Zonites cellarius.*—M. E. André notes certain peculiarities in the integument of this Mollusc, which have not yet been described. These peculiarities, which obtain in no other Pulmonate Gastropod, consist of crypt-like organs solely formed on the right side of the body, where they extend from the genital orifice to the mouth, and from the upper boundary of the foot to the middle of the dorsal surface of the body. These crypts are formed by invaginations of the external epithelium, and are 1/4 to 1/3 mm. deep. They vary in form, being sometimes simple, sometimes more or less branched, and are sometimes provided with swellings. The epithelium of these organs differs from that of the surface in that the cells and their nuclei are more elongated; they have no vibratile cilia. The dorsal surface of the body is peculiar in the presence of very large mucous cells, so closely packed as to form an almost uninterrupted layer. It is not at present possible to suggest what is the function of the crypts.

Development of Umbrella mediterranea.†—Dr. R. Heymons makes an important contribution to our scanty knowledge of the development of Opisthobranchs. The formation of three generations of micromeres, their further multiplication to the 24-cell stage, the subsequent division of a macromere, and the associated origin of the mesoderm are facts in the development of *Umbrella*, which are in essential harmony with what is known to occur in *Planorbis*, *Neritina*, and *Crepidula*, but they have not been previously observed for Opisthobranchs. After a careful comparative study, the author goes on to discuss the excretory organ. His most important result is a demonstration of the entirely ectodermic

* Zool. Anzeig., xvi. (1893) pp. 39 and 40 (1 fig.).

† Zeitschr. f. wiss. Zool., lvi. (1893) pp. 245–98 (3 pls.).

nature of this structure. The mesoderm takes no part in its formation. It may be compared with the so-called external primitive kidney cells of Prosobranch embryos, but the suggestion of a complete homology would be premature.

Homalogyra.*—M. A. Vayssière has a preliminary notice of his investigation of this genus, formed in 1867 by the late Dr. Gwyn Jeffreys. He finds that it has two dorsal tentacles of some length, and that the radula has not been correctly delineated either by Sars or Jeffreys. He gives amended diagnoses of the family and generic characters. The species studied appears to be *H. atomus*, which was found for him off Marseilles.

Structure and Habits of Jorunna Johnstoni.†—Mr. W. Garstang, in a short note on this Nudibranch, states that it lives on the same stones as the small *Halichondriæ* which it so closely resembles. The form and general colour of the Mollusc and the Sponge are very similar, and there are even the same slight variations in tint. The only external difference is presented by the two dorsal tentacles of the Nudibranch, but the presence of conspicuous spots on the back of the animal, coloured doubly like the tentacles, and arranged so that the tentacles are included in the same series, effectually deceives the eye and conceals almost entirely the projecting tentacles. It is to be remembered that the author has shown that sponges are shunned by predatory fishes under both natural and artificial conditions.

Branchial Sensory Organs of Patellidæ.‡—Dr. J. Thiele describes an organ in *Patina pellucida* which forms a knob-like projection of the epithelium, at the sides of the body between the foot and the mantle. It is supplied by a delicate nerve from Spengel's olfactory ganglion, which is somewhat difficult to detect between the fibres of the retractor muscle. The epithelial band presents the characters of sensory epithelium.

Neomeniidæ.§—Dr. H. Simroth begins his study of these interesting types with a compact summary of what is known in regard to their structure. Passing over this we find the following genera suggested for the twenty-six known species:—Genus I. *Neomenia* Tullberg; II. *Proneomenia* Hubrecht; III. *Solenopus* Sars; IV. *Rhopalomenia* g. n.; V. *Macellomenia* g. n.; VI. *Dondersia* Hubrecht; VII. *Nematomenia* g. n.; VIII. *Myzomenia* g. n.; IX. *Paramenia* Pruvot; X. *Ismenia* Pruvot; XI. *Lepidomenia* Kowalewsky et Marion; XII. *Echinomenia* g. n. Simroth attaches much importance to the fact that the Neomeniidæ are distributed between the littoral and the abyssal fauna. They avoid the surface region, keeping out of the reach of waves, whereas the Chitonidæ are surf-animals with dorsal armature and broad suctorial soles. Pruvot's discovery that *Myzomenia banyulensis* bears in its youth the dorsal plates of a *Chiton* shows that the *Chiton*-type is the more primitive. The passage of the Neomeniidæ from the zone of rapidly moving water to quieter regions is supposed by Simroth to have been associated with the loss of protective shells, the narrowing and

* Comptes Rendus, cxvii. (1893) pp. 59 and 60.
† Conchologist, ii. 3 (1892) 4 pp. (sep. copy).
‡ Zool. Anzeig., xvi. (1893) pp. 49 and 50.
§ Zeitschr. f. wiss. Zool., lvi. (1893) pp. 310-27.

degeneration of the sole, the approximation of the genital pores, a change to carnivorous diet, with the consequent shortening of the gut, and other characteristic features.

δ. Lamellibranchiata.

Gills of Lamellibranchs.*—Dr. F. Janssens appears to find himself in greater agreement as to the morphology of the gills of Lamellibranchs with the late Mr. Peck than with any other of the numerous observers of these organs.

The author commences his account of his own observations by describing the general anatomy of the gill in various forms. In considering the histological constitution of the gill he deals separately with the parts formed from the mesoblast and from the hypoblast, but his method of description, in which he constantly refers to figures, and the complete absence of any general deductions, make the paper one which can only be properly studied with the illustrations at hand.

Molluscoida.

α. Tunicata.

Perivisceral Cavity of Ciona.†—Mr. A. H. L. Newstead finds that the primary condition of the epicardium is undoubtedly that found in *Clavellina*, where it has the function of a budding organ. In *Ciona* there is considerable modification and loss of the original function. The view of Herdman that the stolons of *Ciona* are modified budding organs appears to be correct.

The view of Roule that the perivisceral cavity of *Ciona* is a primitive condition is not supported by Mr. Newstead's observations, which point rather to the cavity being a specially modified epicardium which has become greatly enlarged. The space in question is certainly not homologous with the general blastocœl space of *Appendicularia;* and there are no reasons for supposing that the other simple Ascidians pass through a stage in which the epicardium is enlarged as in *Ciona;* in fact, so far as the perivisceral cavity is concerned, *Ciona* is the most modified of the simple Ascidians.

Development of Tunicates.‡—Herr J. Hjort finds that the only kind of budding in Botryllidæ is that described by Metschnikoff and Della Valle as pallial, and that the stolons are purely ectodermic in origin. He describes the early stage of the bud in which there is a median vesicle, from the dorsal part of which the blind dorsal tube grows forwards, while the two peribranchial vesicles appear laterally. In the posterior third of the bud these structures are all connected, and from this region the coiled gut grows backwards. The dorsal tube differentiates into hypophysis and permanent ganglion. In regard to the heart, Hjort observes that it arises from an unpaired compact mass of cells on the right side. As to the gonads, the results of Della Valle are confirmed.

From a study of the larva of *Distaplia magnilarva*, the author comes

* La Cellule, ix. (1893) pp. 71–91 (4 pls.).
† Quart. Journ. Micr. Sci., xxxv. (1893) pp. 119–28 (1 pl.).
‡ MT. Z. Stat. Neapel, x. (1893) pp. 584–617 (3 pls.).

to the following conclusions:—(1) The larval and the persisting nervous system arise from the same rudiment as the hypophysis, viz. the original ectodermic invagination which forms the cerebral vesicle; (2) the larval cerebral vesicle is, during the later larval period, in communication with the gut through the future hypophysis; (3) the anterior part of the hypophysis arises directly from the anterior region of the elongated cerebral vesicle, the posterior part from the left epithelial wall of the same; (4) the lumen of the hypophysis is, in the adult, the only persisting residue of the larval cerebral cavity; (5) the persistent brain of the adult arises from the thickening of the left wall of the cerebral cavity from which the hypophysis grows out.

γ. Brachiopoda.

New Classifications of Brachiopoda.*—Miss Agnes Crane has a critical notice of some recent modifications in the taxonomy of Brachiopods. Mr. C. Schuckert has published in the 'American Geologist' (xi. 3) a classification "based on the history of the class (chronogenesis) and the ontogeny of the individual." Beecher's suborders of Atremata, Neotremata, Protremata, and Telotremata are adopted as orders; the Protremata are divided into the Trullacea and the Thecacea; in all nine new families are added. Mr. C. E. Beecher published, in March last, a "revision of the families of loop-bearing Brachiopods"; he divides the Terebratellidæ into the three well-defined families of Dallininæ, Magellaniinæ, and Megathyrinæ. Both branches of the Terebratellidæ appear to have originally sprung from some minute form allied to the existing *Gwynia*, which, doubtless, lived before the Jurassic period, and to which palæontologists should turn their attention. Miss Crane considers that the advances in our knowledge of the genealogy of the recent Brachiopods are such as to have brought us to a turning-point in the history of the race.

Arthropoda.

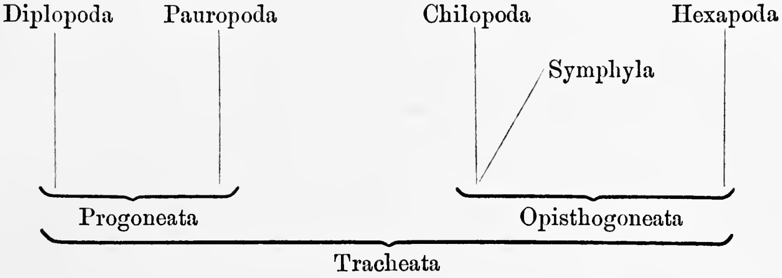
Classification of Tracheate Arthropoda.†—Mr. R. I. Pocock urges that the Tracheata may be considered to consist exclusively of the Myriopoda and Hexapoda, and inquires whether the group, as thus limited, is a natural one. After pointing out the well-known characters which the two classes have in common he remarks that the division into Myriopoda and Hexapoda is based principally upon the external form. On further examination, however, it is clear that the so-called group of Myriopoda is sharply divisible into two sections upon a character which admits of no exception. This character is the position of the generative organs. In the Pauropoda and Diplopoda the genital orifices are situated near the anterior end of the body, while in the Chilopoda and Symphyla (*Scolopendrella*) they are placed at the posterior end, quite close to the anus; this latter position is that which is seen also in the Hexapoda. Now various writers have pointed out that *Scolopendrella* is closely related to the Thysanura, and the author remarks, no one who compares a *Scolopendrella* with a Chilopod on the one hand and with a Thysanurous Hexapod on the other can avoid being struck by the fact that the differential characters between the Insects and the Centipedes

* Geol. Mag., x. (1893) pp. 318–23. † Zool. Anzeig., xvi. (1893) pp. 271-5.

are to a large extent bridged over, and that *Scolopendrella* must consequently be regarded as the living form that comes nearest to the hypothetical ancestor of the two great divisions of Tracheates.

Mr. Pocock proposes to divide the group into two sections, one to contain the Pauropoda and Diplopoda, the other the Chilopoda, Symphyla, and Hexapoda; the former may be called Progoneata, the latter Opisthogoneata. If the affinities between the Symphyla and Chilopoda are greater than those between the Symphyla and the Hexapoda, a group Homopoda may be formed to contain those two orders of Myriopoda.

Phylogenetically the classification is represented thus:—



α. **Insecta.**

Life-history of Cochliopodidæ.*—Prof. A. S. Packard gives accounts of the life-histories of some members of this family of Moths. He finds that the young, like the fully formed, larvæ have no traces of abdominal legs. The shape of some of the young is such as to suggest that either the Cochliopodidæ have originated from the Saturniidæ or forms allied to them, or that both these families have descended from a common stem-form, which was, perhaps, Notodontian. The tuberculated larvæ of *Euclea*, *Adoneta*, and *Empretia* are those that are most like the larvæ of other Bombyces.

Some of them, probably from adaptation to a series of causes unlike those which affect any other caterpillars, might easily be mistaken for a fold or bend in a leaf. Others, such as the larvæ of *Heterogenea*, are wonderfully similar to the red dipterous or aphidid galls on oak and other leaves.

It is now of importance to determine how late in embryonic life the abdominal legs disappear.

The forms of which the author gives more or less full life-histories are *Empretia stimulea*, *Euclea querceti*, *Parasa chloris*, *Adoneta spinuloides*, *Phobethron* sp., *Limacodes scapha*, *Packardia elegans*, *Lithacodia fasciola*, and *Heterogenea* spp.

Nutritive Relations of Lepidoptera.†—Dr. Ad. Seitz discusses thirty-three points of interest concerning the nutritive relations of Lepidoptera. The arc of possible oscillation is often very wide, much wider than in most other insects; abnormal diet, scarcity, periodic

* Proc. Amer. Phil. Soc., xxxi. (1893) pp. 83–108 (4 pls.).
† Zool. Jahrb. (Abth. Syst., &c.), vii. (1893) pp. 131–86.

absence of food, &c., can be survived. The various effects of diminished nutrition on the individual, on pupation, on the number of offspring, are spoken of. It is recognized that fasting may be associated with progress. The choice of food-plants and its motives, the causes of change of diet, cannibalism, the influence of nutrition on reproduction, the rate of growth and its limit, moulting, and water-drinking are among the subjects discussed in this essay, which is full of interest to the student of biology and bionomics.

Evolution of Papilionidæ.*—Prof. G. H. Th. Eimer answers a criticism brought against him by Herr A. Spuler.† By his study of Lepidoptera Eimer endeavoured to show how species arise "by definite modifications in a few directions," one species differing from its nearest neighbours in the relative predominance of certain characters—in short, that species form definite morphological series. The specific distinctions are not only not indefinite, they are not explicable on a utilitarian theory. Eimer supported this view in a large work and atlas; Spuler disputed the accuracy of certain facts and the legitimacy of the conclusions; Eimer answers that Spuler fails to make good his criticism, and that he has not read the book with sufficient care.

Respiratory Phenomena in Chrysalids of Silk Moth.‡—Prof. L. Luciani and Dr. D. Lo Monaco have made daily and nightly quantitative estimates of the amount of CO_2 given off during twenty-two days. The oscillations demonstrate that the life of the chrysalis may be divided into four periods:—(1) A long lethargy of four days, (2) a long activity of seven days, (3) a short lethargy of two days, and (4) a short activity before emergence. The authors, of course, regard the fluctuations in the amount of CO_2 liberated as indices and, to some extent, measures of the intensity of the vital processes occurring within the chrysalid.

Remarkable Behaviour of the Spermatozoa of Dytiscus marginalis.§—Prof. L. Auerbach has observed the spermatozoa in their passage through the convoluted seminal vesicles. All those arising from one testicular follicle are united in a bundle. Each has a very complex structure, bilateral but unsymmetrical. The right side of the head is concave, the left convex; the whole head is longitudinally curved to the right or left; and on the posterior half of the right side there is a projecting ridge bearing a hook-shaped "anchor." Of the entire structure a careful description is given. At the free end of the cyanophilous anchor an erythrophilous spherule appears. But the most remarkable fact is that the spermatozoa unite in pairs in a perfectly definite fashion, opposed and crossed in a manner somewhat suggestive of a pair of scissors, with the right sides of the heads in contact. During this conjugation, or "dejugation" as Auerbach calls it, the anchors change in form, and the little spherules are lost. Hundreds of these double spermatozoa are found together in little balls. The conjugation is a temporary one, but it may permit a molecular exchange of substance, perhaps with the result of mixing the hereditary qualities and limiting variability.

* Zool. Jahrb. (Abth. Syst., &c.), vii. (1893) pp. 186–205 (8 figs.).
† See this Journal, 1892, p. 469; 1893, p. 174.
‡ Bull. Soc. Entomol. Ital., xxv. (1893) pp. 12–24.
§ SB. K. Preuss. Akad., 1893, pp. 185–203 (2 figs.).

Chirping and Jumping Ants.*—Prof. C. Emery notes that two large American Poneridæ do really chirp. In species of *Paraponera* and *Pachycondyla* the surface of the second (or more strictly the third) abdominal segment is transversely striated and produces a chirping sound when rubbed against the margin of the segment in front. This sound Emery was able to produce artificially, and Herr A. Schulz has heard it from living specimens of *Pachycondyla flavicornis*. The same observer noted that the Brazilian *Gigantiops destructor* Fab. springs from twig to twig, as does also *Odontomachus hæmatodes* in similar localities.

Nests of Formica rufa.†—Sig. P. Bargagli describes the heaps of pine leaves and twigs which form the superficial parts of the nests of this ant as these occur on the Tyrol mountains. What seems to be new in his description is the fact that considerable quantities of resin are accumulated by the ants in little grains and larger balls. The author has also an interesting note to make on the favourable influence which the heaps made by the ants exert on the associated vegetation.

Hylotoma pagana.‡—Dr. G. Del Guercio gives an account of this Hymenopterous Insect, which is known to gardeners as the yellow rose-fly. He describes the ova, the larvæ, the nymph, and the perfect insect. The eggs are laid in the young branches, the larvæ browse on the leaves, the chrysalids are buried in the soil at the base of the stem, the adults flit rapidly from bush to bush. Copulation, oviposition, and other events of the insect's life are described. The eggs are readily destroyed by insecticide fluids or with a knife.

Autumnal Generation of Diaspis pentagona.§—Prof. F. Franceschini has discovered a third generation of this injurious insect, and points out the practical importance of his discovery.

Pogonius bifasciatus F.‖—Herr C. Verhoeff gives a short account of the development and life-history of this species. He found a cocoon containing a larva towards the end of August in a deserted nest of *Chalicodoma muraria*. As a general rule *Pogonius* passes its larval stages in rock crevices. The larva took about eight months to complete its development, the imago being produced at the end of the March of the year following its capture. The nymph possesses a stinging apparatus similar to that already described for *Agenia*, and corresponds with the latter in several other respects.

Biology of Chalcididæ.¶—Mr. L. O. Howard gives an account of the general economy of these parasitic Hymenoptera. Dealing first with the Insects and stages of Insects infested by them, he points out that representatives of all of the original Linnæan orders suffer from them in one or other of their stages: the orders which suffer most are the Lepidoptera, Hymenoptera, Hemiptera, and Homoptera. Information with regard to the mode of life of the Chalcidid larva is so slight and so contradictory

* Biol. Centralbl., xiii. (1893) pp. 189–90.
† Bull. Soc. Entomol. Ital., xxv. (1893) pp. 42–5.
‡ Op. cit., xxiv. (1893) pp. 331–45 (5 figs.).
§ Atti Soc. Nat. Sci., xxxiv. (1893) pp. 285–93.
‖ Zool. Anzeig., xvi. (1893) pp. 258–60.
¶ Proc. U.S. Nat. Mus., xiv. (1892) pp. 567–88.

that it is very difficult to make general statements, and their method of respiration is quite a puzzle. There is evidently considerable variation in the rapidity of development, and, consequently, of the number of annual generations; this variation is partly due to the particular parasite and partly to the habits of the particular host; in some cases growth appears to be very slow. As a rule, Chalcidid larvæ which are internal feeders transform internally into naked, more or less coarctate pupæ. Some cause a marked inflation in the host-larva by the formation of oval cells around the parasite. From one to three thousand parasites may develope in a single host. The study of agamic reproduction will probably prove of the highest interest and importance. According to the author's estimate, the number of species of Chalcididæ will prove to be immense.

British Phytophagous Hymenoptera.*—Mr. P. Cameron has published the fourth and concluding volume of his monograph. In all 382 species of Tenthredinidæ, 9 of Cephidæ, 5 of Siricidæ, 1 of Physcidæ, and 179 of Cynipidæ have been described. The present volume contains an appendix which brings up our information to date.

Copulatory Organs of Cockchafer.†—Dr. J. E. V. Boas gives a detailed and apparently complete account of the copulatory apparatus of the Cockchafer. After a general account of the parts and of their function he enters into greater detail as to special organs; there is in the cloaca a chitinous band fused to the cloacal stylet; the latter is of importance as a point of origin of muscles; of these there are a number which take part in the movements of the penis.

Eggs of Acridium peregrinum.‡—M. R. Dubois has a note on the oil found in the eggs of this grasshopper. In colour and consistency the oil is like that of the hen's egg; in a short time it becomes rancid, and has the smell of cod-liver oil. It contains as much as 1·92 per cent. of its weight of phosphorus, but no sulphur. The author hopes the oil may be proved to be of use in therapeutics or commerce, when a prize would be offered for "the destruction of the plague of our colonial agriculture."

β. Myriopoda.

Functions of Nervous System of Myriopoda.§—Mr. C. M. Child has made some observations on the central nervous system of *Lithobius*, from which he draws the following general conclusions. The nervous system consists of, firstly, a series of centres which are capable, unaided, of responding to sensory stimulation by appropriate co-ordinated motions; or, in other words, a series of complex reflex centres lie in the ventral cord. Secondly, there is situated in the head a single ganglion to which all the reflex centres are subordinated, and which contains also the centres for the eye and the antennæ, and is the seat of whatever intelligence may be possessed. Steiner defines a true brain as a centre possessing a general motor centre together with the centres of at least one of the higher senses. According to this definition the supra-œso-

* London, printed for the Ray Society, 1893, 248 pp., 19 pls.
† Overs. K. Danske Vid. Selsk., 1892, No. 3, pp. 239–61 (1 pl.).
‡ Comptes Rendus, cxvi. (1893) pp. 1393–4.
§ Amer. Natural., xxvi. (1892) pp. 1051–5.

phageal ganglion of *Lithobius* is a brain. The ventral cord is analogous in function to the spinal cord of some of the lower Vertebrates.

Production of Light in Orya barbarica.*—M. R. Dubois has studied the mechanism of the production of light in this Myriopod. He finds that it is secreted by special organs, and can be collected in a pure state. It is found in unicellular hypodermic glands, which are pyriform in shape, 8–10 mm. long and 5–6 mm. wide. Sections one-hundredth of a millimètre in thickness, stained with methylen-blue or hæmatoxylin, reveal the presence of numerous rounded or ovoid drops in the granular glandular protoplasm. These drops blacken with osmic acid, and exhibit the histo-chemical characters of protoplasm or of condensed albuminoid bodies. Soon after contact with free air a highly refractive point appears at their centre, and this point becomes the centre of a crystal or rather of a group of crystals. The encrusted protoplasmic matter passes, under the eyes of the observer, from the colloid to the crystalloid state, while light is produced. While contact with air is necessary and excites the luminosity, contact with water is no less so. The author considers that we have here to do with two successive stages of the photogenous material, and for them the name luciferin may be retained until the atomic structure has been determined.

δ. Arachnida.

Habits of Living Scorpions.†—Mr. R. I. Pocock has some interesting notes on the habits of living Scorpions, two species of which—*Parabuthus capensis* and *Euscorpius carpathicus*—he has kept in captivity for some months. With regard to the latter he is able to confirm many of the observations of Prof. Ray Lankester. Though sluggish during the day they could always be roused by the application of a little artificial warmth, but more than very little heat was sufficient to throw them into a state of the greatest consternation. *Parabuthus*, like *Prionurus*, digs shallow pits or holes in the sand, but *Euscorpius* was never observed to do so. All scorpions appear to be carnivorous; they are very adroit in seizing anything that comes within reach; they never seem to need anything to drink, unlike Spiders, which are very thirsty. The only one of the higher senses that appears to be well developed is that of touch; and Mr. Pocock cannot substantiate the statement of M. Becker that sight and hearing are excessively developed. At a distance of more than three or four inches they cannot see a moving body. The accusation of infanticide appears to be groundless, and as to the charge of being suicidal, the author is as sceptical as Prof. Morgan, who some years ago made some observations on South African Scorpions, and various other authors.

Parasitism of Pseudoscorpions.‡—Prof. F. Leydig expresses his opinion that the presence of Pseudoscorpions on the bodies of other Arthropods is a case of real though temporary parasitism. In the case of a Brazilian beetle with a dense chitinous carapace the Pseudoscorpion was found below the membranous wings and the abdomen; that is to say, at a point where the beetle was vulnerable.

* Comptes Rendus, cxvii. (1893) pp. 184–6. † Nature, xlviii. (1893) pp. 105–7.
‡ Zool. Anzeig., xvi. (1893) pp. 36 and 7.

Parthenogenesis in Spiders.*—Herr N. Damin records what he believes to be the first known case of parthenogenesis in Spiders. In the spring of 1891 he placed two living specimens of *Filistata testacea* in two separate tubes; of these, one moulted twice in 1891 and once in 1892; on the 8th July, 1892, it spun a cocoon and laid eggs, as unfertilized Spiders often do; on the 27th July the author opened the cocoon, and, contrary to all his expectation, found sixty-seven young. The young were alive on the 1st March of this year, and had already moulted once. Few, if any, observers have found the male of *F. testacea* on the continent of Europe, but it still remains to be decided whether the parthenogenesis of the females is an occasional, or a regularly recurrent, phenomenon. And, of course, the observations open up the other question, Is parthenogenetic development found in any other Spider?

New British Acarus.†—Mr. A. D. Michael gives an account of a new genus of Tyroglyphidæ from Cornwall; it was first observed in the water-weed *Cladophora fracta*, and it is proposed to call it *Lentungula algivorans*. The great peculiarity and interest of the form are to be found in the tarsi and claws; the tarsi of the two front pairs of legs are very powerful, and form efficient climbing organs; the claws of the same pairs of legs are mounted on long flexible peduncles which spring from the sides of the tarsi and are capable of being flexed at the will of their possessor. Most nearly allied to *Hericia*, the new genus is distinguished not only by the characters already mentioned, but by the terminal position of the anus, and the absence of sexual dimorphism.

Brain and Sense-Organs of Limulus.‡—Dr. W. Patten deals at considerable length with the morphology and physiology of these parts of the nervous system of *Limulus*. Dealing first with the sense-organs, he urges that we can reduce the whole system of them either to isolated sense-cells or sense-buds, or aggregations of the same. In the young, sense-buds are found in all parts of the body and are everywhere alike; afterwards they degenerate, or they become olfactory, gustatory, or temperature organs; the resemblance of these buds to ommatidia is so striking that both must be included in the same category.

The author next deals with the morphology of the Arthropod brain, and asserts "that after we have torn off the deceptive Arthropod mask that disguises *Limulus* we discover that the nervous system, with all its complex and intricate modifications, shows, as a whole, a profound structural similarity to that of Vertebrates." Compared with the light thrown by the King-Crab on the phylogeny of Vertebrates, Ascidians, *Balanoglossus*, Nemerteans, Annelids explain nothing. Dr. Patten truly says that, if the Arachnid theory of the origin of Vertebrates be true, many current views on phylogeny, ontogeny, and important problems in Comparative Anatomy are based on false conceptions and must be revised.

* Abh. Zool.-Bot. Ges. Wien, xliii. (1893) pp. 204–6.
† Proc. Zool. Soc. Lond., 1893, pp. 262–7 (1 pl.).
‡ Quart. Journ. Micr. Sci., xxxv. (1893) pp. 1–96 (5 pls.).

ε. Crustacea.

Indian Carcinology.*—Prof. J. R. Henderson's memoir, which deals only with Decapod and Stomatopod Crustacea, contains identifications of 289 species, thirty-three of which are new; two are regarded as the types of new genera. Several species are shown to be synonymous with others. The author gives an interesting account of the nature of the ground from which he himself has collected specimens. Large numbers were obtained by divers, who brought to the surface blocks of coral, in the crevices of which, or on the branches of which, many Crustacea are to be found. The Indian Crustacean fauna is that of the Indo-Pacific area generally, and it is doubtful whether there is a single genus confined to or characteristic of India.

Nearly two-thirds of the total number of species described in the present memoir are known from the seas of the Malay Archipelago; about one-third occur near Mauritius, and about the same proportion is known from North Australia.

Physiology of the Crayfish.†—M. L. Cuénot has fed Crayfishes with food stained with different anilin colours; these show that the "liver" has the function of absorbing soluble bodies such as peptone and sugar, while the short mid-gut is charged with the duty of absorbing fats. The dorsal pyloric valve is found not to be a means, as Huxley and others have supposed, for preventing flow from the intestine back to the stomach; an injection *per anum* is sufficient to show that the passage is free. Its function is to convey non-digested solid matters directly to the terminal intestine, which is lined by chitin, and to save from their rude contact the delicate wall of the mid-gut. So far it is comparable to the funnel found by Schneider in the intestine of many Insects. In *Astacus* and *Maia* the author has found a circular mass of spherical glands at the point where the mid- and hind-gut join; and from these glands fine ducts open at this point.

The "liver" of Decapod Crustacea, in addition to secreting digestive ferments and accumulating reserve-products such as glycogen and fat, plays an important part not only as a place for the absorption of the soluble products of digestion, but as a regulator of the amount of water which is contained in the blood.

Embryology and Morphology of Oxyrhynchi.‡—Dr. G. Cano contributes a welcome study of these forms, describing the segmentation, the origin of the organs, and the larval stages. We cannot do more than state a few of his general results. The Inachidæ and Maiadæ are hatched in a stage between zoëa and metazoëa—the deutozoëa stage—in which the internal branch of the second antenna is well developed, and there are eight pairs of thoracic appendages.

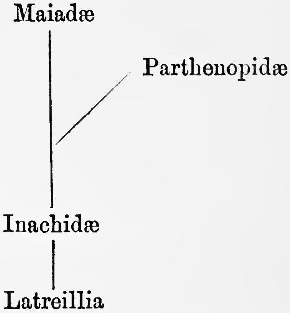
The zoëa is a polymorphic cœnogenetic form from which few phylogenetic conclusions can be deduced. Purely larval modifications are such as the following:—The diverse forms of zoëa in Macrura and Brachyura, the variable reduction of the thorax associated with the loss of one or more appendages, the conformation of the second pair of

* Trans. Linn. Soc. Lond., v. (1893) pp. 325-458 (5 pls.).
† Comptes Rendus, cxvi. (1893) pp. 1257-60.
‡ MT. Zool. Stat. Neapel, x. (1893) pp. 527-83 (3 pls.).

antennæ in *Pinnotheres* and Leucosiidæ, the variable development of the lateral laminæ of the telson, the disappearance and subsequent reappearance of some appendages (first maxillipede in *Scyllarus*).

As phylogenetic characters of the zoëa may be noted the presence of the unpaired nauplius eye, the persistence of the exopodite in two or more thoracic appendages, the presence of the ganglionic chain in the abdomen of Brachyura, the distinctly bilobed mandibles in Brachyura, the presence of the mobile spine on the second antennæ, and the characteristic form of the anal segment.

The systematic relations of the Oxyrhynchi may be thus expressed:—



Development of Maia Squinado.*—Herr F. Urbanowitz gives a preliminary account of the development of this Crab. From the ventral blastoderm small cells migrate into the vitellus, forming a transitory endoderm; a few which remain near the blastoderm form the first rudiment of midgut. Almost all the mesoderm of the nauplius is likewise transitory, and its degeneration is briefly described. In connection with the origin of the nervous system the author notes the appearance of a pair of ganglia, to which no appendages correspond, and which may be regarded as homologous with the "primary brain" of Copepods.

Embryology and Histogeny of the Isopoda.†—Herr Józef Nusbaum has investigated this subject chiefly on *Ligia oceanica* and *Oniscus murarius*.

With regard to the origin of the germ-layers in *Ligia*, the endoderm arises from an unpaired posterior median solid rudiment, the mesoderm chiefly from two paired lateral regions of the primitive three-cornered embryonic disc. The mesoderm then forms rows of cells arranged very regularly. The posterior and most important of the cell-rows are formed from the paired lateral regions, but the central rows seem to be largely formed from the endoderm. The ectoderm shows a somewhat similar arrangement in rows. The liver outgrowths and the rudimentary mesenteron are formed in a very complicated manner by the endoderm rudiment, which flattens out, becomes paired, and surrounds the yolk. The body-cavity is formed by the fusion of spaces arising between the mesoderm cells.

* Biol. Centralbl., xiii. (1893) pp. 348–54.
† Abh. Krakauer Akad., xxv. (1893) (6 pls.) (Polish); Biol. Centralbl., xiii. (1893) pp. 429–35.

In the nervous system the ganglia become differentiated from before backwards. A notable point of difference between the thoracic and the abdominal ganglia is that, while the former arise from an originally paired rudiment, the latter are primarily unpaired. The brain is formed by the fusion of three pairs of ganglia, the subœsophageal ganglion by that of four pairs. In the abdomen there is a trace of a seventh pair of ganglia, which is of great interest in the light of the fact that a reduced seventh pair of appendages exists.

From his observations on the development of the brain, the author is of opinion that the segment bearing the antennules is pre-oral; the antennæ of the insect, which are post-oral, cannot therefore be homologized with the antennules of the Crustaceans, but only with the first post-oral appendages, the antennæ.

The eyes develope towards the sides of the optic ganglia, which spread out and grow below their peripheral part. The eye-lobes at first consist of a single layer of cells which subsequently becomes several-layered. Behind this solid thickened region a deep inpitting is formed which is open above. There is, however, no optic invagination. The elements of the eye are differentiated from the layers of the thickened region.

The heart arises from two sets of cardioblasts which at first lie in the yolk. The two sets are at first widely separated, but later take up a position on either side of the proctodæum at its hinder end. They become hollowed out towards the proctodæum, and, moving towards each other above it, they fuse to form a hollow tube. The wall then becomes divided into muscular and endothelial layers.

The result of his investigations leads the author to the conclusion that the affinities of the Schizopoda to the Isopoda, and so to the Arthrostraca, are much greater than their affinities to the rest of the Thoracostraca. In both the Isopoda and the Schizopoda there is no invagination of the gastrula, and the endoderm grows round the food-yolk from without; there is no wandering of endoderm cells as in *Palæmon*. The embryos of the Isopoda are provided with two-forked thoracic feet, consisting of a two-jointed protopodite, a five-jointed endopodite, and an unjointed rudimentary exopodite, as well as an additional division perhaps homologous with the epipodite in *Nebalia*. The embryo also exhibits a rudiment of a seventh abdominal foot and ganglion, as is the case in Schizopoda.

Formation of Gonads of Amphipoda.*—Miss M. Rossykaia-Kojevnikova, finding that numerous embryologists have thrown doubt on her account of the development of the gonads of certain Amphipoda,† has examined the development of *Gammarus pulex*. She finds that she has been in error, and that the elements of the gonads are not detached from the hepatic sacs.

Amphipoda of Saint Vaast-la-Hougue.‡—MM. E. Chevreux and E. L. Bouvier give a list of sixty species from this locality; two are new to the French fauna, six to the Channel, and four to the French side of the Channel. The new genus *Perrierella* is established for the

* Zool. Anzeig., xvi. (1893) pp. 33–5. † See this Journal, 1889, p. 510.
‡ Ann. Sci. Nat., xv. (1893) pp. 109–44 (1 pl.).

species which has been called erroneously *Aristias tumidus* and *Lysianax andouinianus* by different authors.

Antennæ of Cyclopidæ.*—Prof. C. Claus shows how the prehensile 17-jointed antennæ of male Cyclopidæ are derived from the 10-jointed appendages of the young, and that they are referable to the type seen in the females and in Calanidæ. The distal portion of the prehensile antennæ of Cyclopidæ has the same number of joints as the corresponding part in Calanidæ, the geniculation occurs at a similar place, there are freshwater Calanidæ approximating to the Cyclopidæ, the youngest Cyclopid stage of *Cyclops* has rudiments of the antennary exopodite and 2-jointed mandibular palps; these and other facts corroborate a conclusion based on a wider series of observations, that the Cyclopidæ are simplified and retrogressive Copepods of the Calanid type, and that the Calanidæ and Pontellidæ are nearest the Protocopepoda.

Herr Al. Mrázek † has, independently, reached conclusions which are in the main similar to those of Prof. Claus, e.g. regarding the relations between Cyclopidæ and Calanidæ.

Freshwater Harpacticidæ.‡—Herr Al. Mrázek gives an account of the forms which he has found in Bohemia. His investigations reveal an unsuspected abundance of species. Indeed, the family appears to have been somewhat neglected by systematists. In his general notes the author speaks of the resemblance to Harpacticidæ exhibited by some species of *Cyclops*, e.g. *C. fimbriatus*, *C. affinis*, and *C. phaleratus*. This resemblance is the result of "convergence," i.e. of adaptation to similar conditions of life.

Herr Mrázek's systematic list is as follows:—

Subfam. Longipediinæ Boeck.
Phyllognathopus paludosus g. et sp. n.
„ Canthocamptinæ Brady.
Marænobiotus vejdovskyi g. et sp. n.
Epactophanes richardi g. et sp. n.
Ophiocamptus g. n., two new species and *O. brevipes*.
Canthocamptus autt., four new species.

Vermes.

α. Annelida.

Post-Larval Stage of Arenicola marina.§—Dr. W. B. Benham understands by "post-larval stage" that stage in the developmental history of *Arenicola* in which the full adult number of somites has appeared, and the body is divisible into an anterior chætigerous region and a posterior achætous region or tail, but in which the gills are not completely formed or have not made their appearance. The larvæ, as obtained by Mr. Garstang, were found to be each inhabiting a perfectly colourless and transparent gelatinous tube, obviously secreted by itself. This tube seemed to invest the body closely, and was certainly no impediment to the animal. Each segment of the tail was found to be surrounded by a band of gland-cells, and these cells were in a

* Zool. Anzeig., xvi. (1893) pp. 277–85. † Tom. cit., pp. 285–9.
‡ Zool. Jahrb. (Abth. Syst., &c.), vii. (1893) pp. 89–130 (4 pls.).
§ Journ. Mar. Biol. Ass., iii. (1893) pp. 48–53 (1 pl.).

double row in the anterior somites. The presence of a closely investing gelatinous tube, taken in connection with certain internal characters, seems to point to an affinity between *Arenicola* and the Chlorhæmidæ.

Wirèn has described in adult specimens a continuous perienteric sinus; this is not to be found at the larval stage. In this fact the author finds a support for the view he has already propounded that it is improbable that the perienteric sinus of certain earthworms is, as some have held, a primitive feature. In *Arenicola*, at any rate, the sinus of the adult is preceded by a network. In the body-wall the subepidermic tissue described by Wirèn has not yet made its appearance. In place of the great wide nephridial sac of the adult there is, in the post-larval stage, quite a simple narrow tube; this runs nearly in a straight line from the nephridiopore to the nephrostome; this last seems to be perfectly simple, and as it has no lips we cannot speak of a funnel in the usual sense of the word. The alimentary tract has the same regions as in the adult.

Polychæta of North Carolina.*—Dr. E. A. Andrews gives a list of 57 Polychætes from Beaufort, N.C., but he is convinced that this gives no real idea of the richness of the fauna. *Harmothoe aculeata* is a new species, but is a common form. *Acœtes lupina* Stimpson forms peculiar tubes which call to mind those of *Cerianthus*. *Proceræa tardigrada* Webster seems to be a Syllid in which there is a strong tendency to the acquirement of a regular metameric marking; this does not, however, coincide with the metamerism of the somites, but tends to follow a special law. *Eunice ornata* sp. n. is found not uncommonly in Sponges. *Diopatra cuprea* A. & E. is obviously in the habit of reproducing its anterior or posterior end, and this appears to be almost a necessity from the worm's custom of protruding itself from its tube. *D. magna* sp. n., is one of the largest Annelids on the East American coast. *Ophelina agilis* sp. n. is common; *Polydora commensalis* sp. n. was found in 50 per cent. of all the *Ilyanassa*-shells inhabited by the small Hermit Crab, *Eupagurus longicarpus*, and overgrown by colonies of *Hydractinia*. *Axiothea mucosa* sp. n. is one of the most abundant Annelids found at Beaufort; it forms a Y-shaped tube, one arm of which is closed at its end by the egg-mass, while the other gives the Annelid access to the water. Though placed in Quatrefages' genus *Petaloproctus*, *P. socialis* sp. n. would probably better find a place in a new genus; it is a common form which constructs thick coarse tubes of sand, often cemented together in groups and convoluted a few inches below the surface of the sand. *Ammochares ædificator* sp. n. is not uncommon in areas where they are scarcely uncovered by the tide; the excrement is discharged in the form of cylindrical masses, half the length of the body, and composed of excessively fine sand held together by mucus. *Loimia turgida* sp. n. is found under stones along the shore. Four of the other species enumerated are new to America. Various larval forms were also observed.

Polychæta from Deep Water off Ireland.†—Miss F. Buchanan has a note on the deep-water Polychætes collected during the Royal Dublin

* Proc. U.S. Nat. Mus., xiv. (1892) pp. 277–302 (7 pls.).
† Sci. Proc. Roy. Dublin Soc., viii. (1893) pp. 167–79 (1 pl.).

Society's survey off the west coast of Ireland. Only seven species were obtained, one of which, *Eunice philocorallia*, is new, and one, *Lætmonice producta* Grube, has only hitherto been recorded from Kerguelen. This last, however, is represented in the collection of the British Museum by a specimen from Japan. The Irish specimens are from the greatest depth, and, perhaps therefore, are distinguished by the absence of eyes. Notes are given to clear up the confusion which exists between *Lætmonice filicomis* Kbg. and *L. Kinbergi* Baird. *Eunice philocorallia* presents a good many individual variations; it occurred abundantly in parchment-like tubes in colonies of *Lophohelia proligera;* it appears to be most nearly allied to *E. floridana* of Ehlers.

Micronereis variegata.*—M. E. G. Racovitza has discovered the male of this Annelid, which has not been detected by previous observers; it is much smaller than the female, and has a smaller number of feet; on the third pair of feet it has also special hooks which are not found in the female, and there are differences in the form of the jaws which are fully explained. The hooks have a copulatory function, and by them the male attaches himself to the female, and may remain in position for three days. The female becomes quite altered in appearance after oviposition, and the modifications which occur are explained by the continual movement of the animal through the very thick glairy mass which surrounds the eggs.

Variations in Genitalia of British Earthworms.†—Mr. M. F. Woodward, continuing his researches on this subject, finds that the presence of additional pairs of gonads is by no means of rare occurrence; fifty worms belonging to five species, and taken at hazard, were found, in fourteen cases, to have additional gonads. In one case, a true hermaphrodite gland was, for the first time, observed in Chætopods. The author is of opinion that some of the facts he has noted "accentuate the belief in the inherent power of the entire cœlomic epithelium and their derivatives to produce sex-cells." It seems probable that the varying distribution of the gonads in the Oligochæta is the outcome of irregular abbreviation of some diffuse and possibly hermaphroditic condition under perfected segmentation, rather than of a condition in which the gonads were already restricted to definitely metamerically arranged centres as in the Planarians.

Anatomy of Ocnerodrilus.‡—Mr. G. Eisen gives an anatomical account of new species of this genus, eight being here diagnosed. He gives reasons for disagreeing with Mr. Beddard in regarding *Gordiodrilus* as one of the Ocnerodrilidæ, and proposes to form for it a new family Gordiodrilidæ; concise definitions are given of both families, and it is urged that they connect the limicolid Oligochæta with the higher terrestrial forms.

Anatomy of Kerria.§—Mr. G. Eisen describes two new species of this genus, somewhat lately established by Mr. Beddard; the author cannot accept the view of its affinity to *Acanthodrilus*, owing to the

* Comptes Rendus, cxvi. (1893) pp. 1390-2.
† Proc. Zool. Soc. Lond., 1893, pp. 319-24 (1 pl.).
‡ Proc. Calif. Acad. Sci., iii. (1893) pp. 228-99 (6 pls.).
§ Tom. cit., pp. 291-318 (1 pl.).

presence in the latter of blood-vessels on the nephridia. He thinks *Kerria*, *Ocnerodrilus*, *Gordiodrilus*, and *Pygmæodrilus* form one large group, though they should not all be placed in one family.

Earthworms of the Neighbourhood of Berlin.*—Herr A. Collin reports that, of the eighteen species of Lumbricids known from North Germany, thirteen have been found in Berlin; one, *Criodrilus*, has no other known German locality than Breslau.

Anatomy of Sipunculus.†—Mr. A. E. Shipley, in some notes on the anatomy of this Gephyrean, describes, *inter alia*, the projections in the brain. They are solid, and consist of a number of connective-tissue cells. They are rather richly supplied with nerve-fibres. Beyond this last fact there is nothing in their structure to suggest that they are sensory organs, and the author is quite unable to surmise what their function may be. Mr. Shipley had been wont to consider that the rectal diverticula of *Sipunculus* were homologous with the anal cæca of *Bonellia*. Close study, however, reveals a number of differences; they do not open into the cœlom; they have no ciliated funnels at their free ends; nor do they open into the lumen of the intestine, but into a well-developed system of lacunar spaces in the wall of the rectum. It is possible that these glands have somewhat the same functions as the lymphatics and the numerous glands which in all classes of animals exercise some influence on the constituents of the circulating medium.

β. Nemathelminthes.

Bradynema rigidum.‡—Dr. O. zur Strassen has made a detailed study of this Nematode, which is parasitic in the body-cavity of *Aphodius fimetarius*, one of the Scarabæidæ. Von Siebold, who discovered it, called it *Filaria rigida*, and Moniez erroneously referred it to the nearly related genus *Allantonema*. It requires, however, a new genus *Bradynema*. The parasite lives freely within its host; from two or three to twenty may occur together; they apparently do little injury. The adult female is at once recognizable as a Nematode; the body measures 3–5½ mm. in length by ·15–·27 mm. in breadth; there is no mouth nor anus nor excretory pore, but a conical elevation bearing the vulva marks the posterior end. In its movements *Bradynema* is exceedingly sluggish, and the musculature is extremely reduced. Most of the interior is occupied by the broad tubular uterus, parallel to which lie the ovary and the oviduct. There is a clear receptaculum seminis where the oviduct enters the uterus. The body-wall has a meshed structure which encroaches at both ends on the body-cavity.

In the development, which is described at great length, the following points may be noted. The prostoma persists and is always recognizable at least internally. In the same region a porus excretorius is formed. The ectoderm is a simple, never thickened sheath. A mouth-cavity is represented by a shallow depression at the anterior end. The mesoderm forms two lateral and one ventral longitudinal band, which unite anteriorly and posteriorly. Stomodæum and proctodæum are formed from mesodermic tissue. The rudiment of the gonad consists of

* SB. Ges. Naturf. Freunde Berlin, 1892, pp. 115 and 6.
† Proc. Zool. Soc. Lond., 1893, pp. 326–33 (3 pls).
‡ Zeitschr. f. wiss. Zool., liv. (1892) pp. 655–747 (5 pls.).

one germ-cell and two terminal cells. Some of the author's results distinctly corroborate the theory of Hallez that the Nematode larva is referable to the Trochophore type, but he is inclined to suspect that the late mesodermic formation of the Nematode anus points to derivation from Hatschek's Protrochula.

As to the sexual relations of *Bradynema*, the author comes to the interesting conclusion that the male larvæ are protandric hermaphrodites, which subsequently become the adult female parasites, and that the female larvæ have really not to do with the continuance of the species.

Development of Pseudalius inflexus.*—Herr Th. List finds that, in this form, the first segmentation-plane of the ovum is not in the middle line, so that the blastomeres are of unequal size. The smaller forms the ectoderm, the larger the endoderm. In the twelve-cell stage the cell-plate is distinctly two-layered, consisting of an eight-celled dorsal ectoderm and a four-celled ventral endoderm. As cell-division goes on, an amphiblastula is formed with a distinct blastula cavity. The ectoderm cells continue to increase very rapidly, so that the amphiblastula becomes a flat two-layered plate which forms a gastrula by epibole. The prostoma, which is at first a longitudinal slit, closes from behind forwards, leaving for some time a rounded opening at the anterior end. Two primitive mesoblasts appear at the sixteen-cell stage, having originated from the ectoderm. They give rise to long rows of mesoblastic cells which, in cross section, form a ring round the intestine, the ventral rows being the latest formed. Later, by the close connection of mesoderm and ectoderm cells, a homocœle is formed, which secondarily becomes schizocœlic. The nervous system arises, towards the end of gastrulation, from the upper thickened region of the ectoderm. The mouth and anus are formed as secondary invaginations after the closure of the prostoma.

Trichinosis.†—The occurrence of what appears to be the first case of an epidemic of trichinosis in Belgium led Dr. P. Cerfontaine to a research on this subject. He finds that, during the first two periods the cysts are destroyed in the stomach, in which the larval *Trichinæ* either live for some time, or they pass at once into the small intestine. In the intestine they grow, and fecundation is effected on and after the second day of infection; the males, after a stay of varying length in the intestine, are expelled with the fæces. In the female the development of the larvæ commences immediately after fertilization. The embryos begin to be set free about the sixth day of infection. A certain number of the females penetrate into the wall of the intestine, and even into the mesentery; these have more chance of infesting the organism than those which remain in the intestinal canal, since their embryos cannot be expelled with the fæces. It is probably by means of the lymphatic systems that the parasites first make their way into the tissues of their host. The fact that adult *Trichinæ* penetrate the tissues gives an explanation of the violence of the gastro-intestinal troubles which often characterize the beginning of the malady.

* Biol. Centralbl., xiii. (1893) pp. 312–3 (1 fig.).
† Bull. Acad. Roy. Belg., lxiii. (1893) pp. 461–88 (1 pl.).

New Heterakis.*—Dr. Magalhães describes a new species of *Heterakis* from the domestic fowl, which he calls *H. brasiliensis*, and he points out the differences between it and the four species of the same genus which are already known to live in *Gallus gallinaceus*.

γ. Platyhelminthes.

Nemertines of Plymouth Sound.†—Mr. T. H. Riches enumerates thirty-three species of these worms from Pymouth Sound. Of these, four are new, viz. *Tetrastemma nigrum*, *T. immutabile*, *T. ambiguum*, and *Amphiporus dissimulans; Nemertes candida* is new to Great Britain; *Carinella polymorpha* and *Micrura aurantiaca* have not been previously recorded north of the island of Herm, and *Drepanophorus rubrostriatus* has not till now been recorded north of Guernsey.

Although the Nemertines exhibit brilliant colours, and although many are conspicuously marked, the author has not been able to find any very definite relation to the surroundings. Varieties have been obtained which in many respects connect such well-marked species as *Tetrastemma candidum*, *T. vermiculatum*, and *T. melanocephalum.* The author adopts Bürger's classification into the orders Protonemertini, Mesonemertini, Metanemertini, and Heteronemertini.

With regard to the spawning periods it may be stated generally that, during the whole year some one or more species are breeding, and a large number of species were found with ripe generative products from late summer to the middle of December, when the author left Plymouth.

Cephalothrix bioculata has been successfully bred in captivity, and it is hoped that an account of its development will shortly be published. A very interesting description is given of the variations of *Tetrastemma candidum*, of which we may particularly note one that only differed from the reddish variety of the species with regard to the anterior pair of eyes; these, instead of being compact and round, were broken up into two little masses of minute specks, invisible except under the Microscope. A case in which a relation could be detected between the colour of the animal and that of its surroundings was afforded by *T. melanocephalum*, a specimen of which, found among red weeds, was coloured by minute red-brown pigment-granules.

Turbellaria of Plymouth Sound.‡—Mr. F. W. Gamble, who has lately published a memoir on British Marine Turbellaria,§ now gives a list of the species found in the neighbourhood of Plymouth. He had here to do with a practically unworked field. About 18 per cent. of the species found are known to occur in the Mediterranean. Of the fifty-six species but few are new, and several are known to occur in Scandinavian waters. Specimens were obtained by collecting sea-weeds and placing them in vessels of sea-water; thence the Rhabdocœles emerged in great numbers, especially towards night, and could be picked out with a pipette; another way is to use a hand-net, in the mouth of which a sieve is placed to prevent the entrance of bulky weeds; the dredge also brought up a large number of interesting forms, and examination of the dredge-

* Bull. Soc. Zool. France, xvii. (1892) pp. 219–21 (1 fig.).
† Journ. Mar. Biol. Ass., iii. (1893) pp. 1–29. ‡ Tom. cit., pp. 30–47.
§ See this Journal, *ante*, p. 479.

material at night gives a vivid idea of the activity and voracity of this group of worms. The classification of zones adopted by the author is regarded as purely tentative, and we still require much information as to the vertical distribution of Turbellaria.

Mechanism of Stinging Cells in Turbellaria.*—M. E. Penard has studied this subject in the Turbellarian *Stenostomum*. After pointing out the insufficiency of current explanations of the mechanism by which the thread is discharged, he gives an account of his own observations and inferences. The stinging cells are ovoid, surrounded by a firm membrane, which at the anterior pole thins suddenly, so as to form a delicate pellicle closing the cell. The cell contains a nucleus imbedded in protoplasm, and also an inner capsule attached to the anterior end of the cell, and containing the spirally coiled thread. Also within the capsule are three processes radiating from the closing membrane, and surrounding the coil thread. When discharge is about to take place, the plasma of the cell becomes turgescent, and so exerts pressure on the internal capsule. The three rigid processes form a pyramidal cage around the thread, and so keep it in position until the pressure becomes too great for the closing membrane. This yields, the apposed points of the processes divaricate suddenly and widely, while their other ends remain attached to the evaginated capsule. By this means the thread is launched forth explosively, and is at the same time uncoiled through all its length.

New European Land Planarian.†—Under the name of *Rhynchodemus pyrenaicus* Prof. L. Graff gives an account of a new species of Land Planarian taken near St. Jean de Luz. The single specimen measured 53 mm., so that it was of considerable size. The integument is of a honey-yellow colour, except on the ventral side; this last has a reddish-violet median part with the sides yellowish-grey. The species is declared by Dr. Simroth, who has described two Land Planarians from Portugal, to be unknown to him.

Swedish Tricladidæ.‡—Herr D. Bergendal describes *Gunda Ulvæ*, *Uteriporus vulgaris*, *Dendrocœlum lacteum*, *D. punctatum*, *Planaria torva*, *Pl. lugubris*, *Pl. polychroa*, and the genus *Polycelis*. He has some notes on classification, and recognizes two families—Uteriporidæ and Planariidæ, the latter with Planariæ, Polycelidæ, and Gundidæ as subfamilies.

Structure of Trematodes.§—Herr E. Walter has studied *Monostomum trigonocephalum* Rud., *M. reticulare* van Ben., *M. proteus* Brandes, parasites of *Chelone viridis*. After describing these species separately, he discusses some moot points in regard to the minute structure of Trematodes. To three of these we shall briefly refer. First, in regard to the parenchyma, Herr Walter distinguishes four types:—

(1) In the most primitive state the parenchyma consists of a homogeneous or finely granular substance in which nuclei are imbedded without distinct cell-boundaries, e. g. *Distomum reticulatum*.

* Arch. Sci. Phys. et Nat., xxix. (1893) pp. 487–94 (5 figs.).
† Bull. Soc. Zool. France, xviii. (1893) pp. 122 and 3.
‡ Ofversigt K. Vetensk.-Akad. Förhandl., xlix. (1892) pp. 539–57.
§ Zeitschr. f. wiss. Zool., lvi. (1893) pp. 189–235 (3 pls., 1 fig.).

(2) Within the cell-plasma, between the nuclei, intracellular vacuoles of different sizes appear, and cell-boundaries are indistinct, e. g. *Monostomum trigonocephalum.*

(3) The vacuoles are so large that the protoplasm forms only a sheath of the cell, and the elements form a connected meshwork in which each mesh represents a cell, e. g. *Mon. reticulare.*

(4) The vacuoles may fuse, and the cortical sheath is burst and torn at intervals, e. g. *Mon. proteus.*

The most important modifying factor is the formation of vacuoles, and it must be noticed that different types may occur in the same species at different ages and times, or at different parts of the body. The accumulation of water in the vacuoles probably brings about turgescence of cells and tension of the skin, and thus facilitates locomotion.

Secondly, as to the cuticle, which serves for the insertion of the parenchyma muscles, Herr Walter regards it as a product of the subjacent subcuticula, and that again as a product of the chromatophilous subcuticula cells. Thirdly, as to the so-called "large cells" of Trematodes, often regarded as ganglionic, they are also derived from the chromatophilous cells, and are merely stages in transition towards parenchyma.

Body-parenchyma of Trematodes.*—Herr A. Looss finds that this tissue, apart from what may be deposited within it, is originally formed of entirely homogeneous cells. In the adult state the firm and thick membranes of these cells persist, closely appressed, cemented by intercellular substance, forming a meshwork with colourless plasmic fluid in the meshes. The subcutaneous stratum of indifferent cells corresponds anatomically and physiologically to the cambium in plants. As to the skin, the author regards it as a secreted product, and is inclined to derive it for the most part from the body-parenchyma.

Trematodes of Reptiles and Amphibians.†—Dr. P. Sonsino gives a list, with some descriptions, of these parasites. Thus, in *Emys lutraria* there is *Polystomum ocellatum*, in *Chelone caretta* four species of *Distomum*, e. g. *D. cymbiforme*, in the chamæleon three doubtful species of *Distomum*, in the edible frog *Amphistomum subclavatum*, *Distomum vitellilobum*, *D. ovocaudatum*, *D. clavigerum*, *D. cygnoides*, *D. endolobum*, *D. variegatum*, *Codonocephalus mutabilis*, and so forth.

The predominant Tænia of Rome.‡—Dr. G. Alessandrini asks what species of *Tænia* predominates in Rome and the surrounding province, and answers that it is *T. mediocanellata* or *saginata*. But none seems very abundant.

Brazilian Helminthology.§—Dr. P. S. de Magalhães, in his first note, gives a description of Linstow's species *Tænia cuneata*, from the duodenum of the Fowl. There are certain differences, however, in the two descriptions, but these the author ascribes to variations in the length

* Ber. K. Sächs. Ges. Leipzig, 1893, pp. 10–34.
† Atti Soc. Tosc. Sci. Nat., viii. (1893) pp. 183–90.
‡ Boll. Soc. Rom. Stud. Zool., ii. (1893) pp. 83–6.
§ Bull. Soc. Zool. France, xvii. (1892) pp. 145 and 6.

of the hooks and the form of the suckers, which are frequent in the Tæniidæ. The intermediate host is also different, for Grassi and Rovelli have shown that, in Sicily, *Tænia cuneata* has as such *Allolobophora fœtida*, which is not found in Brazil.

Notes on Cestodes.*—Dr. C. W. Stiles has a short note on *Tænia giardi*, a species which has been the subject of some discussion as to its genital pores. The author states that they are generally alternate, as Rivolta and Neumann assert; at the same time, it is not rare to find segments with double genital pores, as described by Blanchard and Moniez. It often happens that quite a series of female organs are found developed on one side of a segment, while on the opposite side there are rudimentary female organs.

As *Tænia* (*Moniezia*) *expansa* is at present so diagnosed as to include two, if not three, distinct species found in Sheep and Oxen, Dr. Stiles has made an examination of some of the segments of the original example of Rudolphi. In them there are to be found near the posterior edge rounded organs, much larger than testes (with which, perhaps, they had been confounded); these are small cæca which arise from the boundary between two successive rings, and project into the parenchyma of the anterior ring. The sac is bounded by an invagination of the cuticle of the worm, which is surrounded by a, possibly, glandular tissue, which stains very deeply. The author gives a short notice of an allied species, which he proposes to call *Moniezia* (*Tænia*) *planissima*.

δ. Incertæ Sedis.

Philodinidæ.†—Dr. O. Janson gives a very useful and valuable summary of our present knowledge of this difficult family, including the result of his own researches. The essay consists of three parts:—Part i. deals with the anatomy, part ii. with the biology or habits, and part iii. with the classification of the Philodinidæ, giving at the same time a complete diagnosis of every recognized species, fifty-two in all. Some previously described species are excluded as not sufficiently known, and the following six species are described as new:—*Callidina longirostris*, *C. vorax*, *C. Ehrenbergii*, *Adineta tuberculosa*, *A. barbata*, and *A. gracilis*.

In the anatomical part Dr. Janson maintains Dr. Plate's view that the Philodinidæ have no separate contractile vesicle, but that the two lateral canals coalesce and form a short single tube which then enters the posterior part of the intestine or cloaca, which itself is contractile and contracts regularly. With regard to the function of the contractile vesicle in Rotifers the author agrees with Cosmovici,‡ who has stated his belief that the character of the contractile vesicle has hitherto been misunderstood, and that anatomically it is nothing but a cloaca having the function of driving out the water which has passed through the digestive tube, and not of expelling excretions from the perivisceral fluid. It must be stated, however, that while plausible enough in the case of the Philodinidæ, this view utterly breaks down when other

* Bull. Soc. Zool. France, xvii. (1892) pp. 157–9.

† "Versuch einer Uebersicht über die Rotatorien-Familie der Philodinaeen," von Dr. Otto Janson, Abhandl. des Naturw. Ver. Bremen, xii. (1893). Also printed separately, Marburg, 1893, 85 pp., 5 pls.

‡ This Journal, 1888, p. 955.

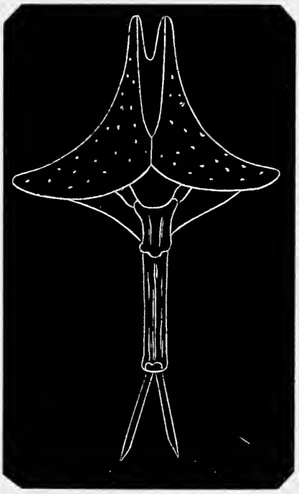
Rotifers are taken into consideration, such as the Asplanchnidæ, where the large contractile vesicle has obviously no connection whatever with the blind digestive tract.

Dr. Janson has been so fortunate as to discover for the first time some winter eggs in several species of *Callidina*, and as these so-called winter eggs in other rotifers have been proved to be the result of fecundation, it becomes probable that a male exists, although no male *Philodina* has yet been found.

The question of how the mature young and eggs leave the parent in the apparent absence of a uterus and oviduct is left much as it stood before. The young of viviparous Philodinidæ lie freely in the body-cavity of the parent, and break forcibly either through the wall of the cloaca or through the body-wall, generally at a point near the cloaca—an operation which generally causes the death of the mother. Three such acts have been seen by the author. The extrusion of an egg has not yet been witnessed by any observer, and it is still a mystery how it leaves the body-cavity of the parent, in which it appears to lie freely. Here is an interesting point left for future observers.

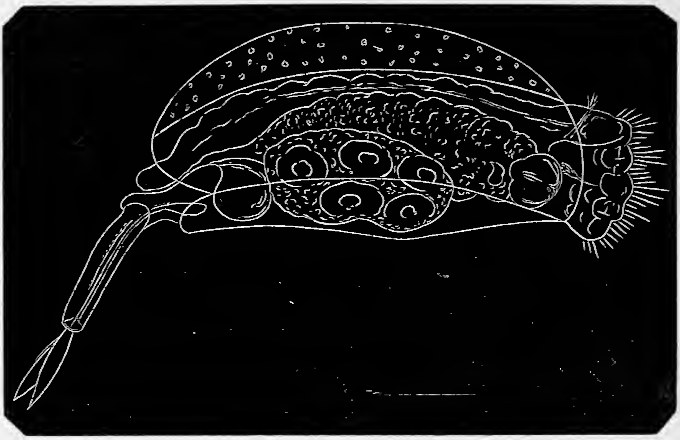
Euchlanis bicarinata Perty.—Mr. F. R. Dixon-Nuttall contributes the following note:—" I found this rotifer on 7th April, 1893, in some water sent to me by Mr. J. Hood, of Dundee. This rotifer is described as a *Euchlanis*, in Hudson and Gosse's 'Supplement to the Rotifera,' p. 40, pl. xxxiii. fig. 31, but it is undoubtedly a *Salpina*, as the lorica is a true form of that species; that is, all of one piece, and split on the dorsal surface. The lorica viewed from the posterior, fig. 89,[A] may be called four-cornered; there is a keel-like ridge on the ventral surface. It has the power, like most Salpinæ, to cause the dorsal split to gape or almost close up, though the normal size of the cavity is as shown in fig. 89.[A] One of the most striking points of this animal is the length of the lower joint of the foot, which is of itself about one-third the length of the lorica. The description given, as above mentioned, speaks of a short joint at the base of the two toes. There is no such joint, the toes come direct from the base of the "long joint." There is what might be called a "cup-and-ball" joint, where this long portion of the foot joins that part nearest the body. The toes are blade-shaped, and a little longer than half the length of the long joint of foot. The eye is elongated, and rests on the under part of the brain close to the mastax. There is a dorsal antenna, as seen in fig. 90.[A] Though this little animal is exceedingly restless, gliding quickly over anything it comes to, bounding first to one side and then to another, it is a very slow free swimmer. The length of the lorica is 1/100 to 1/95 in.

FIG. 89.[A]



Whenever this rotifer is placed in its genus it will have to be renamed, as there already is *Salpina bicarinata*—see Sup. Hudson and Gosse, p. 38, pl. xxxiii. fig. 30."

Fig. 90.A



Rotifer without "Rotating Organ." *—Prof. A. Wierzejski has discovered near Krakau a remarkable rotifer, which he names *Atrochus tentaculatus* g. et sp. n. The body is soft-skinned, without true segments; its anterior end is a broad funnel, with a wide central mouth, which is surrounded by a five-lobed wreath of hollow, conical tentacles. A ciliated apparatus is entirely absent, as is the foot, the latter being represented by a cupola-like, retractile, terminal joint, on which the cloaca opens. The body is covered by a layer of mud. On the gut there is a crop, and behind this a gizzard, with strong masticating organs. The gonads consist of ovary and uterus; the young are born viviparously; the male is unknown. The maximum length of the animal is 1·415 mm. The food consists of unicellular algæ. This new type seems to come nearest to *Acyclus inquietus* Leidy and *Apsilus lentiformis* Metschnikoff, aberrant Flosculariidæ.

New Floscularia.†—Prof. A. Wierzejski has a preliminary notice of *Floscularia atrochoïdes*, a Rotifer which unites the essential characters of a true *Floscularia* with those of the author's lately described *Atrochus tentaculatus*. In habits it calls to mind *F. uniloba*, but it has no gelatinous investment; in the contracted stage it is so like *Atrochus* that it might easily be mistaken for it. From all the known species of its genus it is distinguished by its free mode of life.

The structure of the internal organs agrees almost exactly with that of *Atrochus*, but the masticatory organs have the unci broad and bidentate. A diverticulum corresponding to the contractile vesicle of other Rotifers

* Zeitschr. f. wiss. Zool., lv. (1893) pp. 696–712 (1 pl.).
† Zool. Anzeig., xvi. (1893) pp. 312–4 (1 fig.).

was, in all specimens examined, found to be full of Bacteria. The young are fully formed before they leave the mother. The chief food of this new species appears to be Algæ. When fully extended it measures 1·4 mm. in length, the corona is 0·2 broad, and the body about 0·18 mm. The species, which appears to be rare, was found near Cracow.

Construction of Lorica of Brachionus.*—Mr. V. Gunson Thorpe concludes that the so-called dorsal surface of the lorica really consists of two plates—a "dorsal" and "basal"—and not of one antero-posteriorly curved plate, as is generally said. He directs attention to various cases, of which we may cite that of *Brachionus* from Colombo, in which the dorsal plate was distinctly prolonged, though to the very slightest extent, while the basal plate was well defined. The author thinks that the dorsal plate could not be so prolonged unless it and the basal were separately developed.

Echinoderma.

Excretory Organ of Sea-Urchins.†—Herr F. Leipoldt describes the much-discussed "dorsal organ," which extends between the lantern and the madreporic plate of sea-urchins, and which many credit with an excretory function. The author's researches refer to *Sphærechinus granularis* and *Dorocidaris papillata*, especially to the former. "One thing may be stated with certainty, that the organ is no 'gland,' above all, no 'kidney,' as P. and F. Sarasin maintain." For there is no glandular epithelium, and no connection between the cavity of the organ and the body-cavity. Moreover, the author agrees with Leydig, that in stone-canal and madreporite the current is wholly inwards. The pigment masses, regarded by Hamann as evidences of an excretory function, seem to result from unusable or injurious substances which the wandering cells carry, and they occur in many other parts of the body. Nor are Kowalevsky's experimental results accepted in proof of an excretory function. With Prouho, the author regards the dorsal organ as an area for the production of the amœboid cells of the perivisceral fluid.

Echinoderm Spermatogenesis.‡—Dr. G. W. Field gives a preliminary account of his comparative study of spermatogenesis in this group. He finds throughout a very general similarity, but considerable variation in minor details. The spermatogonia divide by mitosis to produce two spermatocytes, each of these again divides by mitosis to form two spermatids which, without further division, are directly changed into spermatozoa. In the nucleus alike of spermatogonium and spermatocyte, besides chromatin and karyoplasma, minute granules are found which seem to form the mitotic spindle. In the spermatid, on the other hand, similar granules are found not in the nucleus but in the cytoplasm. During the conversion of the spermatid into the spermatozoon the cell-membrane of the former becomes tightly drawn over the head of the spermatozoon, and as a mechanical consequence, according to the author, the granules fuse together to form a single large body, the *Nebenkern*.

* Journ. Quek. Micr. Club, v. (1893) pp. 229–31 (6 figs.).
† Zeitschr. f. wiss. Zool., lv. (1893) pp. 585-623 (2 pls.).
‡ Anat. Anzeig., viii. (1893) pp. 487–93.

In the spermatozoon a centrosome is present which can be traced from the mitosis of the spermatocyte, and ultimately becomes the sperm-centrosome of the fertilized egg. It is directly derived from the original centrosome of the spermatogonium, and as it takes part in the mitotic processes is probably one-fourth of this centrosome.

In the mature spermatozoon the nucleus, centrosome, and *Nebenkern* are enclosed in a delicate cell-membrane, which is apparently the persistent cell-membrane of the spermatid.

Synonymy of Starfishes.*—Sig. P. Marchisio maintains that Ludwig is in error in placing *Echinaster Doriæ* and *Ech. tribulus* as synonymous with *Asterias tenuispina*. Of the two first forms he gives a careful description; neither has anything to do with *A. tenuispina;* but whether they are distinct enough from one another to be regarded as separate species is left an open question. De-Filippi has distinguished *Astropecten aster* as a new species separable from *Ast. squamatus* Müller and Troschel; Ludwig has declared the two to be identical, and Marchisio, after a careful study of De-Filippi's type specimens, comes to the same conclusion.

Odontaster and Allied Genera.†—Prof. F. Jeffrey Bell gives reasons for uniting with Verrill's genus *Odontaster*, the *Gnathaster* of Mr. Sladen and the *Asterodon* of Prof. Perrier. The last-named authority places the genus with the Archasteridæ, Mr. Sladen with the Pentagonasteridæ; Prof. Bell agrees with Prof. Perrier. A list of the species of *Odontaster* with synonymy and a few critical notes are added.

Cidaris? curvatispinis.‡—Under this name Prof. F. Jeffrey Bell gives a description of a remarkable new species of *Cidaris* from Mauritius. As the name implies, many of the spines are curved, instead of being straight, and a number are of great length. So far as can be judged from a single specimen, the new species belongs to the *Dorocidaris*-division of the genus.

Cœlentera.

Catalogue of Madreporarian Corals.§—The part before us is entitled volume i., but it has the melancholy interest of being the only part which will be issued by the same author. Three preliminary papers by its author, Mr. George Brook, will have prepared the student for the publication of this handsome quarto volume, the photographs in which were, at considerable pains, taken by the author himself. An introductory essay deals with the history of the genus *Madrepora*, its morphology, and the principles of classification. Up to the time of its publication about 170 species had been more or less completely described; of these a complete revision has been made, the chief museums of Europe having been visited for the purpose of consulting original specimens. These species have been reduced to 130, but to these there have been added 91, of two-thirds of which preliminary diagnoses have already appeared.

* Boll. Mus. Zool. Univ. Torino, viii. (1893) No. 149, pp. 1–6 (1 fig.).
† Proc. Zool. Soc. Lond., xiii. (1893) pp. 303 and 4 (1 pl.).
‡ Trans. Zool. Soc. Lond., xiii. (1893) pp. 303 and 4 (1 pl.).
§ 'Catalogue of the Madreporarian Corals in the British Museum. I. The Genus Madrepora.' 4to, London, 1893, xi. and 212 pp., 35 photo. plates.

Septal Musculature and the Œsophageal Grooves in Anthozoa.*—Herr O. Carlgren finds that *Cerianthus Lloydii*, *C. membranaceus*, and *C. solitarius* bear longitudinal muscles on the side of the septa turned away from the directive pair, and transverse muscles on the side turned towards the directive pair. It seems that the Ceriantheæ possess an anterior or dorsal (not ventral) œsophageal groove, while that of the Alcyonaria and Zoantheæ is posterior or ventral. Of the two grooves in Edwardsiæ and in most Hexactinia, the dorsal corresponds to an anterior and the ventral to a posterior.

Brood-chambers in Actiniæ.†—Herr O. Carlgren finds two types of brood-chamber. In one type the brood-chamber is formed from the gastrovascular chambers, or from the gastrovascular space itself (in an unnamed Paractid and Bunodid). In the other type there are in the lower part of the body-wall special cavities—invaginations of the ectoderm—in which the embryos complete their post-embryonic development.

Comparative Embryology of Scyphomedusæ.‡—Dr. A. Goette finds that *Aurelia*, *Cotylorhiza*, and *Pelagia* differ in their development only in degree. All three exhibit in their youngest larvæ the essential structure of Scyphomedusæ, differing only in the degree of completeness with which the typical features are retained.

The author begins with a description of the larvæ of *Cotylorhiza tuberculata*. These exhibit an ectodermic œsophagus, four gastric pouches, and, indeed, all the essential characters of *Aurelia*-larvæ. The œsophageal ectoderm extends to a portion of the gastric pouches, and over the four gastric folds. In *Cotylorhiza* there are four true septal funnels before the proboscis is developed.

In *Pelagia* the mouth of the larva is to be found at the invagination-opening of the ectodermic gullet, and the prostoma at the base of the closed gullet, where the communication with the central stomach is formed. The ectodermic gullet forms the principal median portion of the gut; the central stomach and the gastric pouches are alone endodermic. The tetrad segmentation defined by the first four gastric pouches is in entire agreement with the symmetry of *Cotylorhiza*. We cannot follow Goette through his account of the development, but his conclusion is that the larvæ of *Pelagia* possess before the beginning of Ephyra-formation the most essential features of a scyphostoma.

Early Stage of Distichopora violacea.§—Dr. S. J. Hickson gives an account of the early stages in the development of *Distichopora violacea*. The result is the generalization that in the Stylasteridæ there is no segmentation, no process of invagination to form the endoderm, and no process that can be compared with ordinary primary delamination. The author next discusses the formation of the germinal layers in the Cœlentera generally, and gives the following plan:—

* Öfversigt K. Vet. Akad. Förhandl. Stockholm, 1893, pp. 239–47 (2 figs.).
† Tom. cit., pp. 231–8 (5 figs.).
‡ Zeitschr. f. wiss. Zool., lv. (1893) pp. 645–95 (4 pls.).
§ Quart. Journ. Micr. Sci., xxxv. (1893) pp. 129–58 (1 pl.).

A. Gastrula formed by invagination of large segmentation cavity: e. g. *Cotylorhiza*, *Pelagia noctiluca*, and *Nausithoë*.

a. Intermediate form between types A and B are found in *Aurelia flavidula*, in which the clump of cells that are invaginated is at first solid, and in *Cyanæa capillata*, in which this clump remains solid longer than in *A. flavidula*.

B. A solid planula (sterrula) formed by hypotropous immigration of cells into a large segmentation cavity: e. g. *Clytia*, *Tiara*, *Obelia*, *Cyanæa arctica*, &c.

b. Intermediate forms in which the migration takes place mainly at the hind end occur in *Mitrocoma*.

C. Sterrula formed by polypolar immigration of cells into a large segmentation cavity: *Æginopsis*.

D. Planula formed by primary delamination; a large segmentation cavity: e. g. *Geryonia*.

d. There are numerous intermediate forms in which the segmentation cavity is small.

E. Sterrula formed by precocious delamination; no segmentation-cavity: e. g. *Aglaura*, *Eudendrium*, &c.

e. Intermediate forms have the segmentation at first incomplete: e. g. *Renilla* and *Gorgonia*.

F. A multinucleated plasmodium; no segmentation, and no segmentation cavity: *Millepora*, Stylasteridæ.

Dr. Hickson suggests that there is now much evidence to support the view that considerable phylogenetic significance is to be ascribed to the plasmodium stage; he urges that too much weight has been given to the presence or absence of yolk, and that we should not expect that, when an ovum segments, it is simply repeating an ancestral phase, and that when it does not segment it is prevented from doing so by the physical obstruction of yolk.

In conclusion the author discusses the fragmentation of the oosperm nucleus; the general results at which he arrives are:—(1) Fragmentation of the nucleus is a normal method of nuclear division, and is not always a sign of pathological change. (2) In many cases in which the nucleus is supposed to disappear there is, as a matter of fact, minute fragmentation. (3) Fragmentation only occurs where there is no cell division. (4) Karyokinetic division of the nuclei is caused by the forces in the cell protoplasm, which bring about the division of the cytoplasm. There is a series of phenomena in the division of the nuclei, with typical karyokinesis at one end, and direct fragmentation at the other. In Dr. Hickson's opinion, the occurrence of any one kind or the other is determined by the forces which act simultaneously upon nucleus and cell-plasm; and this view seems to be supported by the observations of Flemming and of Bürger.

Protozoa.

Intranuclear Bodies.*—Dr. L. Rhumbler discusses the little bodies which occur in very variable number, size, and form within the nuclei of many Protozoa, and also within the germinal vesicles of Metazoa.

* Zeitschr. f. wiss. Zool., lvi. (1893) pp. 328-64 (1 pl.). See this Journal, *ante*, p. 494.

An observation made by Aimé Schneider on the condensation of a cloud of fine granulations within the nucleus of Gregarines (*Actinocephalus*, &c.) suggested to the author that the intranuclear bodies of Foraminifera and other Protozoa arise from the coalescence of substances at first fluid, then viscid, and finally firm. He works out this idea in detail, considering the various physical conditions in the process of coalescence. The bodies in question are not organized structures, certainly not cell-organs, but most likely aggregations of reserve material.

Destruction of Bacteria by Infusoria.*—Mr. D. Harvey Attfield brings forward some evidence that the so-called self-purification of impure water may be due to Infusoria. Into two sterilized flasks there were introduced 500 ccm. of well-water which was estimated to contain 10,000 bacteria per ccm. To one flask there was added 10 ccm. of river Isar water, which swarmed with Infusoria (chiefly *Paramæcium aurelia* and *P. caudatum*). It was found, by plate cultivations, that in water swarming with Infusoria the bacteria had decreased to less than one-fifth their original number in six days, while in water containing few or no Infusoria the decrease of bacteria in six days was only one-half of the original number. Other experiments led to similar results.

Coccidia of Birds.†—M. A. Labbé finds that the Coccidia found in the intestine and cæca of Birds belong to two groups. Some belong to the genus *Coccidium* and are very near the *C. perforans* of the Rabbit. In Passerines one frequently finds a spherical Coccidium with two equal sporoblasts, each enclosing four sporozoites; for this form the author has made the genus *Diplospora*, which is intermediate between *Cyclospora* and *Isospora*. In addition to a chronic infection of Coccidia, Birds may suffer from an acute attack which may be fatal. The author's observations suggest to him the question whether there may not be a dimorphism in development and an endogenous proliferation of sporozoites.

Organization of Choanoflagellata.‡—Herr R. H. Franzé calls attention to some points in the organization of the Choanoflagellata. He finds that Bütschli's account of the ingestion of food in *Codosiga botrytis* is hardly correct. The collar is connected with one of the contractile vacuoles by a fine curved line. This line corresponds to the boundary of a delicate plasmatic membrane, which, at times, leads to the vacuole, and it is by this membrane that the food-bodies pass to the digestive vacuole. It was the middle part of this membrane that Bütschli took for the mouth vacuole. The collar is not a circular appendage closed on all sides, but a cornet-shaped membrane which takes part in the ingestion of food. The contractions of the vacuole are not pulsations but swallowing movements.

The other, true, contractile vacuole pulsates at pretty regular intervals of about thirty seconds. It is remade by the appearance of one, then two, then three, very small vacuoles which suddenly unite; at the same time there become apparent two fine longitudinal canals which

* Brit. Med. Journal, 1893, i. pp. 1262 and 3.
† Comptes Rendus, cxvi. (1893) pp. 1300-3.
‡ Zool. Anzeig., xvi. (1893) pp. 44-6 (2 figs.).

convey fluid to it. The vacuole enlarges and then becomes emptied through a small efferent canal.

The body of *Codosiga* passes gradually backwards into the stalk, which must not be regarded as a secretion, but as a chemically altered, hardened part of the protoplasm. Fuller details are promised.

Ætiology of Texas Fever.*—Texas fever is an infectious disorder of cattle, and according to Dr. Th. Smith, is endemic between the Gulf of Mexico, and 37°–8° N.; it is marked by high temperature, profound and rapidly occurring anæmia and very frequently hæmoglobinuria. The chief pathological appearances found post mortem are seen in the spleen, which is much enlarged and soft almost to diffluence; in the liver, which not only is in a condition of parenchymatous degeneration but often of a necrosis starting from the central veins of the lobules; and in the kidneys, where a hæmorrhagic œdema is conspicuous.

On examining the fresh blood during the febrile stage many of the red corpuscles will be found to contain a pale mass of mobile protoplasm. Various forms of the parasite *Pyrosoma bigeminum* sp. n. are depicted by the author. Most of them are in pairs, and in the youngest stage are oval, more or less, while later they are distinctly pyriform. The pyriform bodies may lie side by side or be attached by a narrow bridge of protoplasm connecting their thin ends. Some of the bodies show corpuscles in their interior.

The parasite was stained by heating blood-films on cover-glasses for 1–1½ hours at 110°–20° and staining for some minutes in alkaline methylen-blue. The preparations may be contrast-stained with eosin or decolorized with 1/3 per cent. acetic acid, but neither procedure is found to possess any particular advantage.

In the circulation the number of corpuscles affected is rarely higher than 1 to 2 per cent., but in certain parts, as ascertained post mortem, much greater. Thus in the kidney 80 per cent. of the corpuscles are found to be infected; in the liver, 30 per cent.; in the spleen, 10 per cent.; and in the heart muscle, 50 per cent. After death the intraglobular parasite is almost invariably round and rarely pyriform, and in its earliest stage, as well as in the mild or chronic form of the disease, the parasite is coccoid in shape. That it is intimately connected with the disease is obvious from the fact that healthy cattle are easily infected by subcutaneous or intravenous injection of blood from a diseased animal, and it is interesting to note that blood of healthy cattle from districts where the disease is endemic is capable of imparting the disorder. The transference of the disease has been traced to ticks, *Ixodes bovis* vel *Boophilus bovis* by Kilborne who found that if the ticks were carefully removed from cattle so that the ground was not contaminated the disease did not break out, and further that meadows could be infected by scattering ripe ticks over them, even when diseased cattle were not present.

The author concludes with some remarks on natural and acquired immunity and on cattle-diseases resembling Texas fever.

Ætiology of Malaria.†—In describing the ætiology of malaria Prof. Laveran first alluded to the fact that he began to study the

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 511–27 (10 figs.).
† Trans. Seventh Internat. Congress Hygiene, ii. (1892) pp. 10–8.

question in 1878, while in Algeria, and then proceeded to describe the various forms of the parasite of malaria he had met with in human blood. (1) Spherical bodies with a diameter of 1–10 μ. These are endowed with amœboid movements and in their later stages enclose pigment-granules. These are usually free in the plasma but may adhere to the red corpuscles. (2) Flagella: these are mobile filaments found adhering at first to the spherical bodies but afterwards becoming free. (3) Crescentiform bodies 8–9 μ long. These usually contain pigment-granules massed towards the centre and the horns of the crescent are frequently united by a fine filament. (4) Segmented bodies: these are represented as rings or circles of spherical bodies having in their centre a small collection of pigment-granules. (5) Leucocytes containing pigment-granules. These leucocytes are supposed to have seized on and devoured pigment-bearing parasites. The author considers that the malaria parasite is a polymorphic organism belonging to the class Sporozoa, and then goes on to point out that intravenous injection of malaria blood almost invariably succeeds in reproducing the disease and this parasite as well. The first symptoms are developed in 5–10 days after injection and this time suggests the incubation period.

The author then passes on to review the relation between the blood-parasites found in animals and the hæmatozoa of malaria. In the red corpuscles of certain Vertebrates, especially of birds, are found forms strictly analogous to, and, indeed, resembling in almost every respect the parasites found in human malaria. But attempts to transfer this disease from one of these animals to another failed, although the parasite could be easily transferred from one individual to another of the same species. Thus Celli and Sanfelice have infected one lark from another, but failed in attempting to inoculate a pigeon with lark's blood.

Parasites of Red Blood-corpuscles.*—Prof. A. Celli thus compares the Italian doctrine of malaria with the views of Prof. Laveran. Both theories agree as to most of the facts, that is, there are forms free in the blood; spherical bodies with or without flagella; free flagella; semilunar bodies; forms adhering to or included in red corpuscles; sporulating bodies. The Italian observers, however, have described several other forms indicative of segmentation and dissemination:—(1) According to Laveran the free flagellum is the perfect parasite, the spherical bodies being merely cysts or sacs enclosing the parasite. According to the Italians the flagellated bodies are sterile, degenerative forms, and their movements, so to speak, expressive of their death struggle. (2) According to Laveran the parasite is always free except, perhaps, in its early stage where it is found adhering to the surface of the red corpuscle, while the Italian writers consider it to be essentially endoglobular; it is born and developed within the corpuscle, and if it leave before spore-formation it is sterile. (3) Both French and Italian schools accept the view that the crescentiform or semilunar bodies are degenerative conditions of the red corpuscles, directly due to the action of the parasites, though the latter observers maintain that this is only one of the degeneration forms of the parasite. (4) The segmentation bodies are the keystone or pivot of the Italian theory; this stage represents, according to them, the sporu-

* Trans. Seventh Internat. Congress Hygiene, ii. (1892) pp. 20–28.

lation of the parasite within the red corpuscle, while, according to Laveran, these forms are almost accidental. (5) Reproduction is entirely endoglobular, according to the Italian theory, while Laveran describes a sort of budding as well as segmentation. (6) The author points out that the Italian theory has the following consistent cycle:— (1) Amœboid endoglobular corpuscles at first non-pigmented. (2) These afterwards become pigmented and increase in bulk. (3) There are now two different paths open to them, they may either sporulate, the spores becoming free in the plasma, or they may remain sterile. Under these circumstances they may get larger and larger, sometimes becoming free in the plasma (spherical flagellated form), sometimes remaining within the red corpuscles (crescent-shaped bodies).

Parasitic Protozoa in Cancerous Tumours.*—Messrs. M. Armand Ruffer and H. G. Plimmer find that in carcinomatous tumours of the female mamma some of the Protozoa found therein inhabit the nucleus as well as the protoplasm of the cancer-cell. The Protozoon often appears as a small body in the nucleus, and then developes gradually until it exhibits the characteristics of the full-grown Protozoon. It then consists essentially of (1) a central round, oval or slightly irregular nucleus, sometimes connected by fine delicate rays with the periphery; (2) a variable amount of surrounding protoplasm almost filling up the capsule; and (3) a double contoured capsule which surrounds the whole. If the nucleus of a cancer-cell ever gets rid of the parasites, it appears to heal up in a wonderful manner, the details of which have yet to be studied.

Intracellular Parasitism of Cancerous Neoplasms.†—According to Dr. J. Soudakewitsch, the cell-inclusions described by him are for the most part surrounded by a double contour. Within is found the parasite under the most diverse appearances, usually, however, enclosed by a homogeneous viscid material. The cell-inclusions appear at times in the form of granules irregularly disseminated, having a filamentous arrangement. Their staining reactions show the greatest differences, for sometimes they are deeply stained with logwood, at other times not at all. Very good pictures are produced by safranin staining after fixation with Flemming's fluid. The cell-inclusions are single or in accumulations, and scattered throughout the cancerous tissue, but especially on the superficial layers. The author thinks that these forms cannot be mistaken for cell-nuclei, as they differ therefrom not only in their staining relations, but also in their morphological attributes.

Most of the cell-inclusions were found in cells, only a few were free, and usually these cells exhibited karyokinetic nuclei, or were hypertrophic, though occasionally their appearance was observed in necrotic cells. When the cancer cell is destroyed the enclosed parasite is set free, and then evacuates its contents, spores; these find their way into neighbouring cells, or, if into the blood or lymphatic vessels, are carried away to colonize new territory, to which process the term metastasis should be applied.

* Journ. of Pathol. and Bacteriol., i. (1893) pp. 395–403 (1 pl.).
† Ann. Inst. Pasteur, vi. (1892) No. 8. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 399–400.

New Cancer Parasite.*—Under the name *Rhopalocephalus carcinomatosus* g. et sp. n. Kor., Prof. A. Korotneff describes a new parasite which he has found chiefly in Carcinoma labii, but also in cases of Carcinoma mammæ, maxillæ, &c.

The adult form which receives its name from its somewhat club-shaped appearance, is an elongated ribbon-like body, with thickened head in which is a nucleus of variable contour. The outline of the animal's body is well defined; there are no pseudopodal extensions of the plasma, which is finely granular. In its more youthful state the parasite is found to inhabit the central portions of epithelial nests, and is less elongated and more rounded, and, according to the illustrations, exhibits from one to four nuclei.

The developmental cycle is fully described. Starting with a coccidioid form, larvæ or "zooids" are found within the interior. The zooids are elongated ovals in shape. Besides the zooids other offspring, sporozooids, are developed; these are crescentiform bodies, consisting of a hyaline investing membrane and protoplasmic contents.

The subsequent career of the zooids is either to penetrate a cancer cell and there assume the Gregarine adult form, or become an encapsuled coccidium. The sporozooid phase, however, seems to remain free at first, and is observable between cells as a granular nucleated body chiefly distinguished by its pseudopodial extensions. After a time, not only may zooids but sporozooids be observed in its interior. The zooid always is metamorphosed into a coccidium, the sporozooid into an amœba.

The organism described forms a bond of connection between the Coccidia and Gregarinida, the free amœboid and encapsuled forms pointing to the Coccidia, the adult condition possessing characters more akin to the Gregarinida.

According to the author the true reason why the amœboid form has not hitherto been easily discovered is the method of preparation. If the specimens be treated with sublimate and cut by hand, the appearances described by him are easily observed.

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 373–80 (15 figs.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

Oligodynamic Phenomena of Living Cells.*—Under this name the late Prof. C. v. Nägeli describes some very remarkable properties of living cells in their behaviour towards excessively small quantities of metallic substances in solution. The observations were made chiefly on *Spirogyra nitida* and *dubia*. If in water which is previously "neutral" i. e. not pathogenic to *Spirogyra*—a gold coin containing 10 per cent. of copper is placed, the water acquires the oligodynamic property of killing the *Spirogyra* in a very few minutes. The poison acts very much more energetically in the presence of only one or two filaments than if a larger quantity of the alga is present in the water. In this way 1 part of copper in 1000 million parts of water may be pathogenic. Glass vessels in which a piece of the poisonous metal had previously been placed acted in the same manner. In this way distilled water is often poisonous to *Spirogyra*. On the other hand, the presence in the water of certain insoluble solid substances, such as sulphur, carbon, wood, linen, cotton, gum, &c., and a large quantity of the alga itself, diminish its poisonous properties.

Oligodynamic poisoning manifests itself in the living cell in a different way from chemical poisoning. In the former case the protoplasm remains adherent to the wall of the cell, while the spiral band of chlorophyll detaches itself, and becomes looped into a solid mass surrounding the cell-nucleus; the substance of the band swells up, and presents, on transverse section, a cylindrical or oval form. The oligodynamic poisoning may begin to manifest itself in a period as short as from three to six minutes.

Prof. C. Cramer † has repeated the experiments of Prof. Nägeli, and has confirmed the more important results obtained by him.

Cell-nucleus of Spirogyra.‡—Using Flemming's chromo-aceto-osmic fluid as a fixing reagent, M. C. Decagny states that in *Spirogyra setiformis* the nucleole produces a substance which it expels, sometimes through openings, sometimes by a complete rupture, the result being to bring into contact with the nuclear fluid a substance which immediately coagulates and takes a definite form. The nucleolar substances are, in *Spirogyra*, differentiated in the form of a large central body which, instead of disappearing, as in other nuclei, at the moment of division, persists after division has taken place. These substances bring about the reconstitution of the two halves of the nucleus by the assistance of a directing force located within the primitive nucleus.

* Denkschr. Schweiz. Naturf. Gesell., xxxiii. (1893) 43 pp. † Tom. cit., 8 pp.
‡ Comptes Rendus, cxvi. (1893) pp. 269–72, 535–7. Cf. this Journal, 1891, p. 360.

Division of the Nucleus in the Asci of Peziza.*—Herr S. Gjurasin finds, in the formation of the ascospores of *Peziza vesiculosa*, a mode of indirect division of the nucleus differing somewhat from that in the Exoasceæ, the only group of fungi in which karyokinesis has at present been definitely detected. The method of staining employed was that of Flemming and Herrmann. The chief point in which the process differs from that in *Endomyces* is that the nucleole remains in existence until the division of the nucleus is complete. There is also less divergence of the elements of the spindle from one another, and the chromatic elements are less strongly differentiated.

Wall of Vacuoles.†—By the use of a 1 p. m. solution of coffein, which causes slow contraction of the membrane, Dr. T. Bokorny has obtained further evidence of the invariable presence of a membrane or tonoplast surrounding the vacuoles in living cells. It is a portion of the protoplasmic contents of the cell, and is comparable in its properties to the parietal utricle. The best objects for observations are epidermal cells of the petals of *Primula sinensis*, *Cyclamen europæum*, and *Tulipa*, especially the red cells.

(2) Other Cell-contents (including Secretions).

Distribution of Mannite and Dulcite.‡—According to Herr A. N. Monteverde, the presence of these substances is especially characteristic of the order Scrophulariaceæ. Of 797 species belonging to 109 genera of this order, mannite was found in 272 species and 36 genera, dulcite in 26 species and 4 genera. They never occur together in the same species, and only in two instances in the same genus. Mannite was also found in a few Orobanchaceæ, in Jasminieæ, and in two species of Umbelliferæ; dulcite in several Celastraceæ. In *Rhinanthus*, *Euphrasia*, and *Melampyrum* they are distinctly plastic substances, resulting from the transformation of sugar.

Distribution of Calcium oxalate.—Prof. J. Borodin § distinguishes between two modes of deposition of calcium oxalate, differentiated and diffused; the former where it takes place in special cells, the latter where it is distributed in all the cells of a tissue. In leaves diffused calcium oxalate occurs especially in the epiderm; when present in the mesophyll, it is usually confined to palisade-parenchyme. It may occur in the form of separate crystals, clusters, or sphæritic structures. Out of 913 (Russian) species of Angiosperms examined, 318 contained differentiated, and 40 diffused calcium oxalate, while in 548 this salt was entirely wanting in the leaves. The greater number in which the diffused form was present belonged to the Gamopetalæ.

Prof. R. Chodat and M. G. Hochrentiner ‖ record the occurrence of crystals of calcium oxalate in cells of the stem of *Comesperma scandens*, the internal coating of which is completely cutinized.

* Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 113–7 (1 pl.).
† Biol. Centralbl., xiii. (1893) pp. 271–5.
‡ 'Ueb. d. Verbreitung d. Mannits u. Dulcits,' 37 pp. See Bot. Centralbl., 1893, Beih., p. 199.
§ Arb. St. Petersb. Naturf. Gesell., 1892, 56 pp. and 1 pl. See Bot. Centralbl., liv. (1893) p. 210.
‖ Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 495–6.

Perfume of the Orchideæ.*—M. E. Mesnard finds that the substance which gives the perfume to the flowers of Orchideæ is generally localized in the epidermal cells of the inner surface of the petals or of the sepals, sometimes also in the cells of the outer surface.

(3) Structure of Tissues.

Secondary Tissues of Monocotyledons.†—Dr. D. H. Scott and Mr. G. Brebner have carried on a series of investigations, chiefly on the following points:—The development of the secondary tracheids in *Yucca* and *Dracæna;* the secondary growth in thickness of the roots of *Dracæna;* and the secondary growth in thickness of *Aristea corymbosa* (Irideæ).

Under the first head the point which the authors set themselves to determine was the nature of the water-conducting elements in the secondary wood; whether, according to the older view, they are tracheids, i.e. single cells grown to an enormous length, or whether, according to the statement of some recent writers, they are true vessels resulting from cell-fusion. The observations of the authors, made on both *Yucca* and *Dracæna*, and both by microtome-sections and by maceration, completely established the older view. The elements in question are tracheids, formed by sliding growth, each arising from a single cell, which may grow to from 30 to 40 times its original length, but remains uninucleate throughout its whole development.

In the adventitious roots of *Dracæna* the secondary growth in thickness starts from a number of distinct points, the chief formation of secondary tissue beginning at the base of rootlets. At the base of the rootlet the thickening takes place entirely by means of a pericyclic cambium. The connection between the vascular tissues inside and outside the endoderm is maintained by special bundles which traverse the endoderm at various points.

Aristea corymbosa forms an indefinite amount of secondary tissue by means of cambium which continues active during the whole life of the plant. The xylem of the secondary bundles consists chiefly of tracheids arising from the enormous elongation of a single cell. The cambium arises in the pericycle, and is a new formation.

Curvature of the Cell-wall of the Endoderm of Roots.‡—Herr A. Rimpach discusses the cause of the frequent curvature of the radial walls of the endoderm of roots, which he thinks cannot in all cases be assigned to the causes to which it has hitherto been attributed, viz. tensions which take place only in the preparation of the object, and decrease of volume accompanying suberization. His own observations and measurements lead the author to the conclusion that the phenomenon is due to a shrinking of the cell-walls caused by contraction of the root. This contraction is most marked in the basal portion of the root, diminishing towards the apex, and is much feebler in the secondary roots. It is frequently also altogether wanting in the primary root, especially in certain orders of Monocotyledons.

* Comptes Rendus, cxvi. (1893) pp. 526–9. Cf. this Journal, *ante*, p. 214.
† Ann. Bot., vii. (1893) pp. 21–62 (3 pls.).
‡ Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 94–113.

Anatomy of the Begoniaceæ.*—M. C. Fellerer describes in detail the anatomical structure of the Begoniaceæ, particularly in reference to the light it throws on their systematic position. Especial stress is laid on the structure of the cystolith-like structures, the nature of which differs in different species. The structure and distribution of these bodies favours the theory of the relationship of the Begoniaceæ to the Cucurbitaceæ.

Anatomy of Phaseoleæ.†—From an examination of 44 out of the 47 genera of this tribe of Papilionaceæ, and of nearly 300 species, Herr R. Debold states that they are distinguished by several anatomical characteristics from the rest of the order. The whole tribe is characterized by three-celled hairs and spherical or club-shaped glandular hairs. The stomates are always surrounded by two border-cells parallel to the fissure. The vascular bundles are always accompanied by crystals of calcium oxalate; clusters of crystals are wanting, and raphides have not been observed in the Leguminosæ.

(4) Structure of Organs.

Passage of Organs into one another.‡—M. D. Clos insists that there is no sharp line of demarcation between organs in the vegetable kingdom; even the distinction between stem and leaf is not an absolute one. The author classifies the various organs into elementary, filiform, and compound. Of intermediate organs he enumerates as many as twenty-three kinds.

Seeds of Orchideæ.§—Mr. C. C. Curtiss describes the appearance and structure of the seeds of a number of American Orchideæ. The more important differences noted are not correlated with those at present used in defining the genera, or even the tribes. The embryo possesses neither cotyledon nor radicle, resembling in this respect that of many saprophytes, such as *Monotropa*. On germination, the cells of the nucellus divide, and eventually form tuber-like buds, which ultimately give rise to the new plant. Two extreme types are described, one characterized by an elongated tapering testa and the elongated cells of the nucellus (e. g. *Tipularia*), the other by an obovoid or inflated testa, and shorter, often equilateral cells (e. g. *Corallorhiza*, *Hexalectris*).

Testa of the Seed of Lythrarieæ.‖—Herr W. Grütter describes the structure of the seed of a number of species of Lythrarieæ belonging especially to the genera *Cuphea*, *Lythrum*, *Heimia*, *Nesæa*, *Peplis*, and *Ammannia*. The seeds of the first two genera are especially characterized by the presence of mucilaginous hairs in the epidermal cells, often coiled up and of great length, which swell up greatly and emerge from the cell on absorption of water. These hairs were shown by their chemical reactions to be composed of pure cellulose. In the forma-

* 'Beitr. z. Anat. u. Syst. d. Begoniaceen,' München, 1892, xii. and 239 pp., 3 pls. See Bot. Centralbl., liv. (1893) p. 215.

† 'Beitr. z. Anatom. Charakt. d. Phaseoleen,' Offenburg, 1892, 77 pp., 1 pl. See Bot. Centralbl., liv. (1893) p. 302.

‡ Mém. Acad. Sci. Toulouse, iv. (1892) 23 pp. and 1 pl. See Bot. Centralbl., liv. (1893) p. 239.

§ Bull. Torrey Bot. Club, xx. (1893) pp. 183–92 (3 pls.).

‖ Bot. Ztg., li. (1893) 1te Abth., pp. 1–26 (1 pl.).

tion of the testa of the seed the nucleus of the anatropous ovule takes part, as well as the two integuments. The mucilaginous layer is the epiderm, the power of swelling residing chiefly in the elongated hairs or sacs which spring from the inner side of the cuticle. These hairs have often a very delicate flagel attached to their apex, and they escape from the cells in which they are formed by the raising up in the form of a lid of the portion of the cell-wall to which they are attached. Their function is to fix the germinating seed firmly in the soil.

Achenes and Seedlings of Compositæ.*—Mr. W. W. Rowlee describes the peculiarities of the achene and seed, and of the mode of germination, in the case of a large number of American Compositæ. The proportion of the apparently good seeds which germinate varies greatly in the different species; it is often very small, largest in the most abundant species.

Biology of the Pericarp.†—Referring to the fact of the necessity of a free access of air to seeds during the period which intervenes between their maturity and their germination in order to maintain them in an active condition, Prof. A. Borzì describes the mode in which this is effected in the structure of the pericarp of a number of fruits, especially those of Leguminosæ. A very good example is furnished by the legumes of *Phaseolus Caracalla*, the seeds of which maintain their power of germination for as long a period as five years. The aeration of the seeds is here effected by two minute apertures in the ventral suture. Similar contrivances are presented by many other Papilionaceæ. In the ripe drupe of the cherry and plum, access of air to the kernel is provided by the disappearance of the vascular bundle which before maturity connects the ovule with its placenta; its place is supplied by a substance which absorbs water with great avidity.

Structure of Runners and Stolons.‡—Herr A. O. Noelle describes in detail the peculiarities of structure of runners and stolons, both underground and aerial. In underground stolons the formation of hairs and of stomates disappears altogether, and the epiderm is more or less replaced by a layer of cork. The hypoderm becomes collenchymatous; the cortical parenchyme is more strongly developed; the vascular-bundle-system occupies a more central position than in aerial stems, tending towards the formation of a closed cylinder. The development of pith is, on the other hand, greatly reduced.

Cotyledons of Tropæolum.§—Herr A. Winkler points out that the pair of leaves which first emerge above the soil in the germination of *Tropæolum majus* are not, as has usually been described, the cotyledons. These remain buried in the earth. The first pair of leaves are opposite to one another and alternate with the cotyledons. In several other plants it is also the case that the first pair of leaves are opposite, while the subsequent ones are arranged spirally. The mode of germination is similar in *T. minus*, *peregrinum*, *tricolor*, and *brachyceras*, and probably in all other species of *Tropæolum*.

* Journ. Torrey Bot. Club, xx. (1893) pp. 1–17 (5 pls.).
† Malpighia, vii. (1893) pp. 3–14.
‡ 'Beitr. z. vergleichend anat. Unters. d. Ausläufer,' Freiburg-i.-B., 1892, 72 pp. See Bot. Centralbl., 1893, Beih., p. 94.
§ Abhandl. Bot. Ver. Prov. Brandenburg, 1892, pp. 60–2.

Wool-climbers.*—Herr E. Huth enumerates a large number of plants, belonging to many natural orders, in which a facility for dissemination is afforded by the seeds or fruits being provided with stiff hairs or bristles, by which they become attached to the fur or wool of mammals, or to the plumage of birds.

Prickles of Rosa sericea.†—M. P. Duchartre describes a remarkable form of prickle in this rare rose from India. In addition to the ordinary prickles, which resemble those of other species, and originate in quite the same way, there are found beneath each leaf a pair which broaden out into a remarkable laminated structure, not resembling anything known elsewhere in the vegetable kingdom. The author does not regard them as of a stipular character.

Glandular Hairs of Brasenia.‡—The thick coating of jelly which covers the surface, especially of the younger leaves, in *Brasenia peltata* (Nymphæaceæ), has been examined by Miss Ida A. Keller, and found to proceed from glandular hairs of the nature of colleters. They are either branched or unbranched, and proceed from the under surface only of the leaf.

Root-tubercles of Elæagnus angustifolius.§—Herren F. Nobbe, E. Schmid, L. Hiltner, and E. Hotter have obtained root-tubercles on cultivated plants of *Elæagnus* by inoculation, and state that they are not produced by *Bacterium radicicola*, but by a totally different organism, of which pure cultivations were obtained, and of which a more complete description is promised later on.

β. Physiology.

(1) Reproduction and Embryology.

Process of Impregnation.‖—An investigation of the processes in *Taxus baccata* leads Prof. E. Strasburger to the same conclusions as Belajieff ¶ with regard to the mode of impregnation in the Coniferæ, but the number and period of the cell-divisions seem to vary even with nearly allied species. The large cells, which are first divided off from the pollen-cell, appear often to be subsequently resorbed. In the case of *Welwitschia* he confirms the statements of Juranyi ** on *Ephedra*. He asserts that in Gymnosperms the cell which is last of all divided off from the large cell of the pollen-grain is the true generative cell. In *Biota* and *Juniperus*, as well as in *Taxus*, the passage of this cell into the pollen-tube, and its final bipartition, were clearly followed out. In the Abietineæ this division takes place within the pollen-grain. In *Larix* and *Pinus* the number of chromosomes amounts to twelve.

The author believes that the erythrophilous or cyanophilous character of the different nuclei depends on the conditions of nutrition. When

* Abhandl. a. d. Gesammtgebiete d. Naturwissenschaften, iv. (1892) 24 pp. and 63 figs. See Bot. Centralbl., 1893, Beih. p. 100. Cf. this Journal, 1888, p. 253.

† Rev. Gén. de Bot. (Bonnier), v. (1893) pp. 5–11 (3 figs.).

‡ Proc. Acad. Nat. Sci. Philadelphia, 1893, pp. 188–93 (1 pl.).

§ Mittheil. Pflanzenphys. Versuchsst. Tharand. Die Landw. Versuchsstation, xli. (1892) p. 138. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 195–6.

‖ Histologische Beiträge, iv. (1892) pp 1–158. See Bot. Centralbl., liv. (1893) p. 78.

¶ Cf. this Journal, 1892, p. 231.

** Tom. cit., 1885, p. 484.

well-nourished they are erythrophilous, while a stoppage of the absorption of nutriment from the cytoplasm renders them cyanophilous. The sexual cells of Gymnosperms are erythrophilous in proportion to the mass of cytoplasm by which they are surrounded. The nuclei enclosed in the small prothallium-cells are mainly cyanophilous, while the nucleus of the pollen-grain is erythrophilous, where the protoplasm, with the generative cell, makes up only a small portion of the pollen-grain; in *Ephedra*, where it occupies three-quarters of the pollen-grain, it is cyanophilous.

For the attractive spheres the author proposes the term *astrosphere*, and for the astrosphere, together with the surrounding centrosome, *centrosphere*. Astrospheres were detected in *Sphacelaria*, but they differed from those of higher plants in not doubling in number during karyokinesis. The term *kinoplasm* is applied to the hyaline constituents of protoplasm, which take part in active movements, but under the influence of kinetic centres. In *Œdogonium* it is especially the kinoplasm which collects at the mouth of the archegone. The bladder, which encloses the swarmspore as it escapes, is the modified parietal utricle of the sporange. In other Algæ also, and in some Fungi, the kinoplasm and astrospheres play an important part.

In the formation of the antherozoids of *Chara*, the author agrees with the statement of Belajieff,* the cytoplasm taking part in their formation, especially in the production of the cilia. In ferns also the two anterior coils of the antherozoids are of cytoplasmic origin, and the same is true of the cilia in the Muscineæ. Neither in Characeæ nor in Muscineæ can he detect the spiral structure described by Schottländer.†

As a general conclusion, the author states that three constituents of the protoplasm take part in the process of impregnation, viz. the nucleus, the centrospheres, and the kinoplasm.

Embryogeny of the Birch.‡—According to M. S. Nawaschin, the mode of impregnation of the birch differs in several points from that of typical Angiosperms, approaching the mode seen in the Chalazogams.§ The nucleus is differentiated into an outer tissue composed of short, and an inner one of elongated cells; one cell of the latter becomes the embryo-sac. The pollen-tube never enters the cavity of the ovary, but grows into the tissue of the upper part of the suspensor, forces itself through the chalaza, and finally reaches the tissue of the nucleus at the apex of the embryo-sac. In the formation of short lateral branches, and in the constrictions, the pollen-tube of *Betula* also resembles that of *Casuarina*.

Dr. C. Fritsch ‖ argues from this discovery the inadequacy of the mode of impregnation as a character for separating off the Casuarineæ as a distinct class of Angiosperms.

Distribution of Sexual Organs in Plants.—Herr F. Hildebrand ¶ records examples of the replacement of male by female flowers in

* Cf. this Journal, 1892, p. 237.

† Cf. this Journal, *ante*, p. 203.

‡ Bull. Acad. Imp. Sci. St. Pétersbourg, xiii. pp. 345–8. See Bot. Centralbl., liv. (1893) p. 237.

§ Cf. this Journal, 1892, p. 230.

‖ SB. K. K. Zool.-Bot. Gesell. Wien, xliii. (1893) pp. 15–6.

¶ Bot. Ztg., li. (1893) 1te Abtheil., pp. 27–35 (1 fig.).

monœcious plants in the following species:—*Ecbalium elaterium*, *Bryonia alba*, *Quercus ilicifolia*, *Sagittaria sagittæfolia*; also of the occurrence of both male and female flowers in *Urtica dioica*, and in *Juniperus*, which are normally diœcious. From these abnormal instances he seeks to establish the following laws:—That the sex is determined before impregnation; that external conditions at the time of impregnation have a powerful influence on the sex of the offspring; that up to a certain period the descendants may be influenced by external conditions as to the sex of the flowers which they will produce; and that these influences may be brought to bear on every single flower on the plant.

M. L. Trabut * gives an instance of a male date-palm producing a large number of dates which reached an advanced stage of maturity, but were entirely destitute of ovules.

Fertilization of the Date-palm.†—M. C. Naudin calls attention to the fact that the female date-trees grown in Provence until recently produced, in warm summers, half-ripe fruits which contained no seed and which had not been impregnated; while during the last few years dates have been produced obviously containing an impregnated ovule. This he believes to be due to intercrossing by the pollen, carried by bees and other insects, of a different species, *Phœnix canariensis*, which has been recently introduced into the district.

Sexuality of Ceratonia Siliqua.‡—According to M. E. Heckel the usual statement that the carob is polygamous-diœcious (i. e. has on one plant hermaphrodite, on another male and female flowers) is inaccurate. On a large number of specimens examined he was unable to find any true female flowers, those which have this appearance being really hermaphrodite and brachystemonous, i. e. they have sessile anthers concealed at the base of the calyx, and like it, of a dark red colour. The pollen-grains of these stamens are slightly smaller, but otherwise neither the anther nor the pollen-grains differ in structure from those of the male or of the dolichostemonous hermaphrodite flowers. These brachystemonous flowers are frequently abundantly fertile. They appear to be on the road to become female, but have not yet reached that stage, The author states that the apparent parthenogenesis of *Cœlebogyne paradoxa* is explicable in the same way.

Hermaphrodite Flowers in the Larch.§—Dr. F. Noll describes hermaphrodite flowers found on *Larix europæa*. At the base of the female inflorescence the tuft of leaves was completely transformed into normal stamens containing pollen.

Pollination by Insects.‖—From observations, made on flowering plants in the Netherlands, Herr H. W. Heinsius comes to the following general conclusions with regard to the part played by different classes of insects in their pollination. Allotropous diptera have a strong preference for flowers with exposed or half-concealed honey; hemi-

* Bull. Soc. Bot. France, xxxix. (1892) Sess. Extraord., p. xxxviii. (1 pl.).
† Rev. Gén. de Bot. (Bonnier), v. (1893) pp. 97–9.
‡ Bull. Soc. Bot. France, xxxix. (1893) pp. 354–9 (4 figs.).
§ Verhandl. Naturh. Ver. Preuss. Rheinlande, xlix. (1892) p. 57.
‖ Bot. Jaarb. (Gent), iv. (1892) pp. 54–144 (11 pls.). See Bot. Centralbl., 1893, Beih. p. 203.

tropous diptera for flowers with half-concealed honey; hemitropous hymenoptera for flowers with half-concealed honey, and especially for clustered flowers; eutropous hymenoptera for bee-flowers, and less decidedly for clustered flowers; lepidoptera for flowers with concealed honey, and for clustered flowers, less decidedly for bee-flowers.

Anemophilous and Entomophilous Plants.*—Herr O. Kirchner claims to have observed that several plants usually described as anemophilous are occasionally entomophilous. The vine, though generally self-pollinated, is sometimes abundantly visited by insects, and may accidentally be wind-pollinated. The flowers of the mistletoe are visited by insects. The male flowers of the sweet-chestnut are abundantly visited by honey-bees, diptera, and coleoptera. *Chenopodium Vulvaria* and *album* sometimes secrete nectar, and are visited by insects, as also are *Blitum virgatum* and *capitatum*.

Perforation of Flowers by Insects.†—Prof. L. H. Pammel gives an account of the species of plants, wild or cultivated in America, the flowers of which are perforated, either by insects or humming-birds, for the purpose of obtaining the honey. The most frequent perforators of flowers are species of *Bombus*, both females and workers; but the honey-bee also occasionally obtains honey in this way. In southern latitudes, the carpenter-bees belonging to the genus *Xylocopa* also do considerable injury to flowers, as also do wasps; but these latter more often visit flowers already perforated by species of *Bombus*. The humming-bird *Trochilus colubris* obtains honey in this way from several flowers. Occasionally the perforation assists rather than hinders pollination.

The author also describes the contrivances for cross-pollination in *Phlomis tuberosa* and *P. Russelliana*.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Energetics of Plant-life.‡—By the term "energetics" Prof. W. Pfeffer expresses the transformation of energy or force on which depends the power of an organism to perform its functions. He discusses in detail the mode in which energy can be rendered useful to the plant in carrying on its various vital processes. The manifestations of this energy are taken up in succession, as displayed in the processes of growth and movement, in the movements of water, and in the local transport of nutritive substances.

When the movements concern imponderable molecules, the phenomenon takes the form of chemical energy. Chemical energy becomes directly transformed into mechanical when a chemical reaction causes a change in volume or the elimination of some substance, as, for example, when crystals of calcium oxalate are formed in the cell-wall, and, by their growth, force apart the particles of which the wall is composed. Chemical energy is the source of electricity in plants, and also of the

* Jahrhft. Ver. Vaterl. Naturk. Württemberg, 1893, pp. 96–111. See Bot. Centralbl., liv. (1893) p. 367.

† Trans. St. Louis Acad. Sci., v. (1892) pp. 241–77 (2 pls.).

‡ Abhandl. Math.-Phys. Klasse K. Sächs. Gesell. Wiss., xviii. (1892) pp. 151–276. See Biol. Centralbl., xiii. (1893) p. 98.

phenomenon of luminosity, dependent on respiration. When growth is simply the result of swelling, the resulting increase in size can be only limited; active growth must be the result also of intussusception or the intercalation of particles of a solid substance. Neither imbibition nor capillarity nor air-pressure is sufficient to account for the raising of water to any considerable height in the vascular bundles; it can only be explained by the action of forces which are constantly acting afresh at distinct points in the path of conduction of the water.

Germination of the Cocoa-nut.*—M. L. Trabut describes the mode of germination of the seed of *Cocos nucifera*, which agrees in essential points with that of palms. When the embryo begins to germinate the cotyledon directs itself towards the cavity in the albumen, where it grows to an enormous size, and entirely fills it up, consuming the whole of the milky fluid which it previously contained. The whole of the endosperm is then also absorbed, commencing from within outwards.

Relationship between Specific Size and Organization.†—Prof. J. Sachs discusses the questions of the limits of variation in size in any one species of plant, independently of variations in the supply of nutriment, and the correlation between the average size and the degree of complexity of the organizations. He lays it down as a general law that homologous organs of the same or of different species consist of cells of nearly uniform size, even when the organs themselves are of very different dimensions; that there is no proportion between the size of an organ and that of the cells of which it is composed, the relative size of homologous organs being dependent on the number, and not on the size, of the cells.

Nutrition of Insectivorous Plants.‡—According to M. N. Tischutkin, in the secretion of insectivorous plants—*Drosera rotundifolia* and *longifolia*, *Dionæa muscipula*, *Pinguicula vulgaris*, and *Nepenthes Mastersi*—the process of digestion is entirely dependent on the presence of bacteria in the secretion, the part performed by the plant being only the furnishing of a substratum in which the micro-organisms can live.

Increase in Girth of Stems.§—From observations made on trees in the Botanic Garden at Edinburgh, Mr. D. Christison states that in favourable years the growth in girth extends over six months, from April to September, though usually the growing period is considerably shorter than this, both with Conifers and with Exogens. The months of greatest growth are almost invariably June and July, but with the tulip-tree August. The period of greatest development of the foliage does not always correspond with that of the greatest development of stem.

Growth of the Leaf-stalk of Nymphæaceæ.‖—Prof. G. Arcangeli has determined that, in several species of Nymphæaceæ—*Nuphar lutea*, *Euryale ferox*—the leaf-stalks of the leaves which are still entirely submerged grow faster than those of the floating leaves. This he attributes

* Bull. Soc. Bot. France, xxxix. (1892) Sess. Extraord., pp. xxxvi.–vii. (1 fig.).
† Flora, lxxvii. (1893) pp. 49–81.
‡ Acta Horti Petropolitani, xii. pp. 1–19. See Bot. Gazette, xviii. (1893) p. 105.
§ Trans. Bot. Sci. Edinburgh, xix. (1892) pp. 101–20, 261–333. See Bot. Centralbl., 1893, Beih., p. 196.
‖ Bull. Soc. Bot. Ital., 1893, pp. 191–4. Cf. this Journal, 1890, p. 630.

to the vertical pressure of the water on the upper surface of the submerged leaves due to the lower specific gravity of the leaf.

Transport of Starch in the Potato.*—M. A. Girard confirms the statement of Prunet that the starch which is originally formed in the primitive cells of the tuber of the potato is dissolved as the shoots develope, and is transported towards the cells of these shoots, filling them up and becoming fixed in the normal form.

Graft-hybrid.†—Mr. H. L. Jones records an instance of a graft-hybrid between two varieties of geranium, a pure white and a pure red one. Some of the flowers had two red and three white petals; in others, some or all of the petals were red mottled with white.

(3) Irritability.

Irritability of the Tendrils of Passiflora.‡—Mr. D. T. McDougal thus sums up his observations on the movements of the tendrils of *Passiflora cœrulea* and *Pfordti*. The tendrils and terminal internodes show circumnutation. The tendrils are extremely sensitive to contact with solids and with liquids at a temperature of 40° C., but are not sensitive to liquids at ordinary and low temperatures, unless they are so applied as to induce direct osmotic action, nor to slight electrical stimuli. Coiling round an object takes place on contact, while the formation of spirals takes place on maturity. The formation of the spirals exerts a tension of 3–20 grm., shortening the tendril one-third of its length; a mature tendril can withstand a strain of 350–750 grm. Contrary to the experience of Darwin with *Bryonia* and *Echinocystis*, the tendrils of *Passiflora* are sensitive to contact with one another.

(4) Chemical Changes (including Respiration and Fermentation).

Physiology of Leaves.§—Mr. H. T. Brown and Dr. G. H. Morris give a historical *résumé* of researches on the occurrence and formation of starch in plants, and then the result of experiments of their own, chiefly on *Tropæolum* and *Helianthus*. They believe that starch is not a necessary link between the sugars of assimilation and the sugars of translocation, a large portion of the assimilated products not passing through this condition at all. The occurrence of diastase was found to be universal in quantity sufficient to transform the whole of the starch present in the leaf. It is to the presence of diastase, and not to the action of living protoplasm, that the disappearance of starch is due. The only sugars found in the leaves of *Tropæolum* were cane-sugar, levulose, dextrose, and maltose, and of these maltose and dextrose appear to be the sugars which contribute most to the respiratory requirements of the leaf-cell. It is probably in the form of maltose that most of the starch passes from cell to cell.

Function of Salts of Calcium and Magnesium.‖—According to Herr C. Wehmer, the relative amount of salts of calcium and magnesium

* Comptes Rendus, cxvi. (1893) pp. 1148–51. Cf. this Journal, *ante*, p. 355.
† Bot. Gazette, xviii. (1893) p. 111.
‡ Tom. cit., pp. 123–30. Cf. this Journal, 1892, p. 817.
§ Journ. Chem. Soc., 1893, pp. 604–77.
‖ Landwirthsch. Jahrb., 1892, pp. 573–70. See Biol. Centralbl., xiii. (1893) p. 257.

in the ash varies greatly in different organs of the same plant, the proportion of magnesium being generally much the largest in the seed. Both elements are indispensable to the healthy growth of the plant; but if no calcium is present, a very small proportion of magnesium is poisonous. Free oxalic acid in the tissues prevents the formation of diastase, and hence the conversion of starch into glucose and the transport of reserve materials; the principal object of the calcium appears to be the removal of this injurious oxalic acid. To fungi, in which there is no formation of glucose from starch, oxalic acid is not poisonous. Calcium salts hence play an important part in the formation of chlorophyll-bodies and of the nucleus.

Production of Albumin in Plants.*—Herr A. Mayer maintains that the formation of albumin in plants is not due so much to the action of phosphorus as to the supply of highly nitrogenous food-material. The production of proteids is very rapid, and intermediate products, such as amides, do not exist for any length of time.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Axis of Vascular Cryptogams.†—According to M. J. Velenovský, the branching of the axis of vascular cryptogams presents a greater resemblance to that of cellular cryptogams than to that of phanerogams. In the latter, with a few exceptional cases, there is no true dichotomy; the branching is always monopodial. Among vascular cryptogams this is the case only in *Equisetum;* in all others the axis can develope new branches at any spot, and there can be no regular acropetal succession. When the two branches into which the axis divides are alike, we have a dichotomy; when they are dissimilar, the appearance of a monopode. The axis of vascular cryptogams is not segmented by the leaves like that of phanerogams, but is a unit which can divide at any spot without reference to the leaves. The Equisetaceæ may be compared to the Characeæ, the Lycopodiaceæ to the Hepaticæ. Cellular cryptogams differ from vascular in never producing true leaves; those of mosses are only emergences of the thallus; the homologue of the true leaf in mosses is the sporange. There are no transitional forms known between the existing vascular cryptogams and the gymnosperms.

Calcium oxalate in Vascular Cryptogams.‡—M. G. Poirault disputes the statement made by several authorities that calcium oxalate is comparatively rare in Vascular Cryptogams. Out of upwards of 500 species of Ferns examined, he finds this salt present in by far the larger number belonging to a great variety of different genera. It occurs also in the Hydropterideæ, but has not yet been detected in *Equisetum*, *Selaginella*, or *Psilotum*.

* Landwirthsch. Vers.-Stat., xli. pp. 433-41. See Journ. Chem. Soc., 1893, Abstr., p. 224.
† Rozpravy ceské Acad., ii. (1892) 22 pp. and 2 pls. See Bot. Centralbl., liv. (1893) p. 299.
‡ Journ. de Bot. (Morot), vii. (1893) pp. 72-5.

Sporocarp of Pilularia.*—Prof. D. H. Campbell has followed out the development of the sporocarp of *Pilularia americana*, the structure of which presents a very close resemblance to that of *P. globulifera*, even in the number of loculi, which is four, and not three, as often stated. The resemblance to *Marsilea* is also very strong. The author regards the sporocarp as simply a modified portion of a leaf, and compares it to the fertile portion of the frond of *Ophioglossum*, *Osmunda*, or *Onoclea*. The main difference between the sporocarp of *Pilularia* and the spore-bearing leaf-segments of *Onoclea sensibilis* is that in the former the sporanges are formed on the upper, in the latter on the under side of the leaf.

Development of the Sporange in Polypodiaceæ.†—Herr C. Müller describes in detail the succession of cell-divisions in the formation of the sporange of several ferns; his conclusions differ in some points from those of Reess and Kündig.

Cambial Development in Equisetaceæ.‡—Mr. B. G. Cormack has investigated the development of the cambium in recent Equisetaceæ (*Equisetum maximum*), especially in connection with the systematic position of the extinct Calamitæ. He finds a cambial activity in the nodes of the recent Equisetaceæ, and a corresponding secondary thickening in all the Calamitæ. The types of Calamitæ whose structure is known form a closely connected series constituting a united group. In the Calamitæ the cambial activity begins in the nodes and extends to the internodes; while in living species of *Equisetum* it does not reach the internodes. The author considers that the evidence is strongly in favour of regarding the Calamitæ as nearly allied to the Equisetaceæ; rather than of placing them among the Gymnosperms.

Fossil Vascular Cryptogams.§—The late carboniferous fossils of the basin of the Gard have been carefully studied by M. C. Grand'Eury. He divides the Calamariæ into three sections, of which one comprises *Annularia*, while the two others include the Calamites and the Asterophyllites. *Stigmariopsis* is distinct from the true *Stigmariæ*, and consists, not of the rhizomes or stolons, but of the true roots of the Sigillarieæ. The ferns of the Gard belong almost entirely to the Marattiaceæ, and to the genera *Asterotheca*, *Scolecopteris*, *Phycocarpus*, *Danæites*, &c. *Megaphyton* and *Caulopteris* are the arborescent stems of these ferns, of which the internal and subcortical portions have been termed *Psaronius* and *Ptychopteris*.

Characeæ.

Antherozoids of Characeæ.‖—Herr W. Belajieff has examined the structure and development of the antherozoids of several species of *Chara* and of *Nitella flexilis*, with the view of settling some points on which

* Bull. Torrey Bot. Club, xx. (1893) pp. 141-8 (1 pl.). Cf. this Journal, 1892, p. 825.

† Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 54–71 (1 pl. and 3 figs.).

‡ Ann. Bot., vii. (1893) pp. 63–82 (1 pl.).

§ 'Sur la nature, la végétation et le port des Asterophyllites, Calamites et Arthropitus.' See Bonnier's Rev. Gén. de Bot., v. (1893) p. 230.

‖ 'Ueb. Bau u. Entwickelung d. Antherozoiden. I. *Characeen*,' Warschau, 1892, 49 pp., 1 pl. See Bot. Centralbl., liv. (1893) p. 200. Cf. this Journal, 1885, p. 484.

previous observers differ. The material was fixed with osmic acid and alcohol, or with Flemming's mixture, and double-stained with fuchsin and iodine-green.

The author distinguishes three portions of the antherozoid—a slender anterior, a central, and a thicker posterior portion, the first and last each including about half a coil, or rather more. The anterior part is stained red by the mixture; the cilia which it bears are also stained red; these are not placed, as is usually stated, at the apex of the antherozoid, but near the base of the anterior portion. The central portion is stained blue-green, but has an extremely delicate rose-coloured envelope. The posterior portion is stained red, but less intensely than the anterior part. From these reactions the author concludes that only the central portion of the antherozoid is formed from the nucleus of the mother-cell.

The mode of development and the structure of the mother-cells of the antherozoids are described in detail, and direct observation supports the conclusion derived from the staining reactions, that the protoplasm, independently of the nucleus, plays an important part in the formation of the antherozoid. The cilia are from the first entirely free from the body of the antherozoid.

Algæ.

Reinke's Atlas of German Seaweeds.—Three more parts (iii.–v.) of the second volume of this valuable work are now published, and include 15 plates. The genera treated of are—*Stilophora*, *Halorhiza*, *Chordaria*, *Rhodocorton*, *Ectocarpus*, *Pogotrichum*, *Sphacelaria*, and *Stypocaulon*.

Plurilocular Sporanges of Chorda filum.*—Mr. T. H. Buffham describes the plurilocular sporanges in this genus of seaweeds. The axis of the plants on which they occur was always found to be twisted spirally.

Variability of Desmidieæ.†—From the examination of a large number of individuals of a species of *Cosmarium* Herr W. Schmidle comes to the following conclusions with regard to the limits of specific variability, which are probably true of all desmids, viz.:—The structure of the chlorophyll is constant in the same species; the form of the cell varies within narrow limits; the apical appearance is constant; the granulation is very variable.

Apiocystis.‡—Under special conditions of growth, Herr C. Correns finds, in *Apiocystis Brauniana*, besides megazoospores, microzoospores formed by repeated division of the vegetative cells; no conjugation between them was observed. He describes also the occurrence, on the fixed colonies, of "pseudo-cilia," motionless cilium-like bodies, proceeding in pairs from each cell. These have no connection with the true cilia of the zoospores, and take no part in their formation; they are more akin to the hair-like structures of other algæ. They are formed after the zoospore has come to rest, and each consists of a gelatinous sheath and a central thread of protoplasmic nature. When a cell divides,

* Grevillea, xxi. (1893) pp. 86–8 (4 figs.).
† Hedwigia, xxxii. (1893) pp. 109–15 (11 figs.).
‡ Beitr. z. Morph. u. Phys. d. Pflanzenzelle (Zimmermann), Heft iii. pp. 241–59 (2 figs.). See Bot. Centralbl., liv. (1893) p. 146.

one pseudocilium goes to each daughter-cell, and a second is subsequently formed. Similar pseudocilia were observed also in *Tetraspora*. According to the author, the enormous growth of the vesicle of *Apiocystis* (increasing 1715 times in volume) takes place neither by apposition nor by simple swelling, but by the intercalation of fresh substance from the side of the envelope.

Fossil Algæ.—Dr. A. Schenk * gives an account of the fossil organisms at present known which undoubtedly belong to the Algæ, from which he excludes *Oldhamia*, *Eophyton*, the Chondriteæ, and a portion of the Sphærococciteæ, the Fucoideæ, the Spongiophyceæ, the Dictyophyceæ, and many others.

Diatoms make their appearance for the first time in the upper Cretaceous strata; the *Bactryllia* of the Trias may possibly be their ancestors. The cretaceous genera are identical with ours; but the number of species appears to have increased enormously. The verticillate Siphoneæ do not appear to have existed before the Tertiary epoch, while the Corallineæ may date from the Jurassic period.

M. O. Borge † has found in the glacial clays of the Isle of Gothland a number of fossil Desmids apparently belonging to existing Arctic types.

Receptaculites and Bornetella.‡—Dr. Rauff describes in detail the known species of the genus of fossil calcareous algæ *Bornetella*, and compares with them the structure of *Receptaculites*. He concludes in favour of the inclusion of this latter genus in the Siphoneæ.

Fungi.

Effect of Parasitic Fungi on the Flower.§—Herr P. Magnus describes the effect of a number of parasitic fungi on the parts of the flower of the host-plant. *Cystopus candidus* on *Sinapis* and *Brassica* causes swelling of all the parts of the flower attacked; while *Peronospora violacea* on *Knautia arvensis*, and *P. Linariæ* on *Linaria minor* produce no such result. *Taphrina Pruni* not only induces the familiar bladder-like swelling of the ovary, but also sometimes causes the filaments to swell up into a pear-like form. *Ustilago antherarum* incites the rudimentary stamens in the male flowers of *Lychnis dioica* to perfect development. *Æcidium leucospermum* produces no alteration in the flowers of *Anemone nemorosa*; while *Æ. punctatum* on *A. ranunculoides* causes more or less abortion in the different parts of the flower. *Æ. Magelhænicum* appears to exercise but little injurious influence on the development of the flowers of *Berberis vulgaris*.

Effect of Poisons on the Spores of Fungi.‖—According to experiments made by Herr Wütherlich, the spores of different fungi exhibit a very different power of resistance to the poisonous effects of the solutions of mineral salts or of acids. 124 parts by weight of cupric sulphide

* 'Handb. d. Palaeontologie,' 2te Abth., Munich, 1890, 69 pp. See Bonnier's Rev. Gén. de Bot., v. (1893) p. 186.

† Bot. Notiser, 1892, pp. 55–8. See tom. cit., p. 188.

‡ Verhandl. Naturh. Ver. Preuss. Rheinlande, xlix. (1892) pp. 74–90 (7 figs.).

§ Verhandl. Bot. Ver. Prov. Brandenburg, 1892, pp. vi.–viii.

‖ 'Ueb. d. Einwirkung v. Metallsalzen u. Säuren a. d. Keimfähigkeit d. Sporen einiger parasitischer Pilze.' See Biol. Centralbl., xiii. (1893) p. 265.

in 10,000,000 of water will prevent the germination or the formation of the spores of *Peronospora viticola.* In most cases the toxic property of the salt is its power of withdrawing water from the organism.

Pythium and Saprolegnia.*—Mr. T. W. Galloway finds that the fungus which causes the disease known as "damping off" in cultivated plants is *Pythium De Baryanum.* It invariably attacks the roots first of all. It produces "monosporous" oogones, antherids, and zoosporanges within the tissue of the root and stem, and the hyphæ sometimes extend to the leaves.

In *Saprolegnia monoica* the author was unable to confirm the statement of Hartog † that the nuclei unite in pairs to form the so-called vacuoles. The mode of formation of the resting zoosporanges is described.

Kryptosporium leptostromiforme.‡—This name was given by Kühn to an ascomycetous fungus found on lupins which had formed the food of sheep attacked by lupinose. Dr. M. Fischer has now traced out the life-history of this fungus on *Lupinus luteus* and *angustifolius* var. *leucospermus.* The only reproductive organs found were pycnids and pycnospores, the fructification differing somewhat in size and other particulars, according as the fungus carried on a parasitic or saprophytic existence on the lupin stem. No formation of asci was observed; this appears to take place very rarely, and possibly on a different host-plant.

Structure and Biology of Lichens.§—Dr. A. Minx propounds a modification of Schwendener's view of the dual nature of lichens. The relation of the endophytic structures (gonids) to the lichen-tissue in which they are imbedded is not one of parasitism, but of what he terms *syntrophism.* The relationship of the former to the latter is rather that of a lodger (*Miether*); they do not live at the expense of the host, but rather dwell there for their own convenience, paying a tax to the host. The matrix is the true lichen, and many lichens have no such lodgers. A list of 133 lichens is given which are true "syntrophs," arranged under the five tribes:—Parmeliacei, Calyciacei, Gyalectacei, Graphidacei, and Verrucariacei, by far the greater number belonging to the Calyciacei.

That the lichen does not consist necessarily of two distinct organisms is confirmed by the fact that the gonids are frequently found not only in the thallus but also in the apotheces. Another fact which supports the same view is that the same host will frequently entertain two lodgers belonging to different species. According as lichens carry on their existence with or without these lodgers, the author places them respectively under the head of "autotrophic" or "heterotrophic" lichens. The degree of influence of the lodger on the life of the host varies greatly, and often increases as time goes on; that the cortical layer can be completely thrown off is strong evidence against the theory of parasitism. There are cases, on the other hand, in which the syntrophy appears to be entirely without effect on the host.

* Trans. Massachusetts Hort. Soc., 1891, 10 pp. and 2 pls.
† Cf. this Journal, 1887, p. 444.
‡ Bot. Centralbl., liv. (1893) pp. 289-92.
§ Abhandl. Zool.-bot. Gesell. Wien, xlii. (1893) pp. 377-505.

Saccharomyces membranæfaciens.*—Dr. J. Koehler isolated from dirty well water a yeast which he identified as *Saccharomyces membranæfaciens* Hansen. The fact is interesting, inasmuch as hitherto this organism had been lighted on only once before, and that by its discoverer. Flasks of sterile beer-wort inoculated by Hansen's method with a drop of the water were incubated at 25°, and after two days a delicate whitish-grey scum formed on the surface. This scum was composed of much-branched hyphæ, amongst which were imbedded yeast-like cells, mostly elliptical, often elongated, and but rarely round; these were aggregated partly into irregular heaps, partly arranged in long chains. The majority of the yeast-cells contained small strongly refracting ascospores.

The observation previously made by Hansen that there was considerable difference between the superficial and the deep-lying colonies when cultivated on wort-gelatin or pepton-gelatin plates was confirmed. In the former the gelatin becomes slightly liquefied, the colony sinking down and assuming a reddish-yellow hue. On pepton-gelatin this Saccharomycete grows badly, and its development in liquid media is only pronounced when they contain carbohydrates. This is interesting, inasmuch as the organism is unable to ferment dextrose, lactose, maltose, or saccharose, or to invert saccharose. This was confirmed by fermentation experiments, for which purpose sterile solutions containing known quantities of dextrose or saccharose were infected with the fungus and incubated at 25°. After seven days the solutions, which were covered with a thick scum of *S. membranæfaciens*, were found to contain the same quantity of sugar as had been added (polarization). No alcohol was detected by the iodoform test. The scum developes best on beer wort, next on sugar or starch solution, but not at all on media devoid of carbohydrates. In the rapidity with which the scum forms on wort, *S. membranæfaciens* is only exceeded by *Mycoderma cerevisiæ*.

The author determined by Hansen's method that at 25° spores were formed in forty-one hours, at 9° in ten days.

Red Barley.†—Herr K. Klein has investigated the fungus which causes red spots or streaks in barley,—a species of *Fusarium*. The red pigment is contained in the cells themselves. The conids are sickle-shaped and may be either uni- or multicellular. Free oxygen is indispensable for the formation of the conids, but not for their germination. Gemmæ are formed, especially when the conids do not develope fully; and the middle cell of a multicellular conid may develope into a resting-spore. The author did not find these reproductive forms to be capable of causing fermentation.

Histology of the Uredineæ.‡—MM. P. A. Dangeard and Sapin-Trouffy contest the statement that the mycele of the Uredineæ is composed of typical uninucleated cells. The number of nuclei in each cell is seldom less than two, and it very commonly exceeds that number. A

* Mittheil. Oesterr. Versuchs-Station f. Brauerei u. Mälzerei in Wien, v. (1892). See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 131–2.

† Mittheil. Oesterr. Vers.-Stat. f. Brauerei u. Mälzerei in Wien, v. (1892). See Bot. Centralbl., liii. (1893) p. 42.

‡ Comptes Rendus, cxvi. (1893) pp. 211–3, 267–9, 1304–6, and Le Botaniste (Dangeard), iii. (1893), pp. 119–25.

nucleole is never present. The nucleus is composed of a hyaloplasm enclosing minute granulations of chromatin. Haustoria are present, and are as well developed as in the Peronosporeæ; they have from two to six nuclei. In the pseudoperidium each cell has two nuclei, and the same is the case with the basids, the æcidiospores, the uredospores, and the teleutospores; four were observed in the uredospores of *Uromyces Betæ*.

In a number of species belonging to various genera, the same authors observed a coalescence of the two nuclei of the cells of the teleutospores, which they regard as a kind of pseudo-impregnation, a conjugation of rudimentary male and female elements similar to what takes place in *Spirogyra*. A similar fusion of nuclei takes place in the æcidiospores.

This process of pseudo-impregnation is described more in detail in the case of *Gymnosporangium Sabinæ*. It consists essentially in the fusion of the two nucleoles, which are, in these nuclei, large and sharply defined.

Triphragmium.*—Mr. G. Massee gives a monograph of the known species of this genus of Uredineæ, and remarks that three forms of spore belonging to the teleutospore stage are to be met with in every species, viz. a radiately three-celled spore, which is by far the most abundant in nearly every species; a spore composed of two superposed cells, each cell having a lateral germ-pore; and a one-celled spore with lateral germ-pore.

Parasitic Fungi.—In his report for 1892, Prof. J. E. Humphrey † describes the fungi which cause the following diseases in cultivated plants:—The sclerote disease of cucumbers, by *Sclerotinia Libertiana*, which probably possesses a conidial form of the *Botrytis* type; powdery mildew by *Erysiphe Cichoracearum;* downy mildew by *Plasmopora cubensis;* damping off by *Pythium De Baryanum;* leaf-blight by *Cladosporium cucumerinum;* leaf-glaze by *Acremonium* sp.; a violet disease by *Phyllosticta Violæ;* black-knot of the plum, by *Plowrightia morbosa;* powdery mildew of the strawberry by *Sphærotheca Castagnei;* powdery mildew of the gooseberry by *S. moro-uvæ;* cluster-cup of the gooseberry by *Æcidium Grossulariæ;* a disease of the hazel, by *Cryptosporella anomala.*

Herr D. Iwanowsky ‡ finds the tobacco-plant in cultivation to be subject to two diseases, one due to the attacks of *Oidium Tabaci*, the other to bacteria.

M. E. Prillieux § describes a disease which attacks the endive, caused by the sclerotes of a fungus nearly allied to *Sclerotinia Libertiana.*

According to Prof. J. C. Arthur and Miss K. E. Golden,‖ the sugar-beet-root is liable to two parasitic diseases, one due to a bacterium, the other to a fungus, *Oospora scabies*, identical with that which produces scab in the potato.

* Grevillea, xxi. (1893) pp. 100–19 (7 figs.).
† Rep. Massachusetts State Agric. Exp.-Stat., 1892, 39 pp. and 5 pls. Cf. this Journal, 1892, p. 831.
‡ Land. u. Forstwirthsch., 1892. See Bot. Centralbl., 1893, Beih., p. 266.
§ Comptes Rendus, cxvi. (1893) pp. 532–4.
‖ Bull. Purdue Univ. Agric. Exp. Stat., iii. (1892) pp. 54–62 (1 pl.).

Fungus-parasite of Spirogyra.*—Herr V. Chmielewskij attributes the formation of the "stellate bodies" in cells of *Spirogyra* to a fungus which he names *Micromyces Spirogyræ*. They are a resting-stage, and were made to germinate in hanging drops. The contents escape, and form a spherical body, surrounded by a very delicate membrane; this divides into a number of wedge-shaped cells, which are no doubt zoosporanges, though the formation of zoospores was not actually observed. The infected filaments soon die; the zoospores attack other filaments; the germinating fungus puts out pseudopodes, and the whole organism then becomes encysted, and passes into the resting stellate condition.

Classification of the Basidiomycetes.—M. P. Van Tieghem † proposes the following classification of the Basidiomycetes:—

I. Acrospores:—ACROSPOREÆ.	
A. Undivided (holobasids).	
a. Direct (euthybasids).	
α. Internal (angiospores).	*Lycoperdaceæ.*
β. External (gymnospores).	*Agaricaceæ.*
b. With probasids.	*Tilletieæ.*
B. Septated (phragmobasids).	*Tremelleæ.*
II. Pleurospores:—PLEUROSPOREÆ.	
A. Undivided (holobasids)	*Tylostomeæ.*
B. Septated (phragmobasids).	
a. Direct (euthybasids).	
α. Internal (angiospores).	*Ecchyneæ.*
β. External (gymnospores).	*Auricularieæ.*
b. With probasids.	
α. Spores determinate.	*Puccinaceæ.*
β. Spores indeterminate.	*Ustilageæ.*

The Basidiomycetes include all those fungi which have a thallus septated into immotile cells provided with a membrane of cellulose, and which produce their spores, usually in a definite number, on mother-cells specially called basids. The spores may be termed *acrospores* if formed at the summit, *pleurospores* if formed at the side of the basid. Dividing the Basidiomycetes into the two primary divisions of ACROSPOREÆ and PLEUROSPOREÆ, each of these may again be subdivided into *Holobasideæ* and *Phragmobasideæ*, depending on the absence or presence of septa. The next character is derived from the circumstance whether the basids spring directly from the filaments of the sporiferous apparatus, *euthybasids*, or whether through the intervention of a *probasid* on a kind of cyst, as in the Uredineæ. In the ordinary literature of mycology such spores are erroneously called sporids, and the probasids, sporidia; the basids being also incorrectly denominated a promycele.

The Lycoperdaceæ comprise the Gasteromycetes, with the exception of the Tylostomeæ and the Ecchyneæ (the Pilacreæ of Brefeld), which are erected into distinct families. The Agaricaceæ include the Hymenomycetes and the Dacryomycetes. The Ustilagineæ and the Tilletieæ

* 'Ueb. d. Sternkörper in *Spirogyra*-Zellen,' 6 pp., 1892. See Bot. Centralbl., liv. (1893) p. 262.
† Journ. de Bot. (Morot), vii. (1893) pp. 77–87.

make up the Hemibasidii of Brefeld. The Pucciniaceæ correspond to the Uredineæ of authors, and are removed from the Ascomycetes.

M. P. Vuillemin,* while accepting Van Tieghem's classification in some important points, criticizes it in others. He dissents from the inclusion of the Ustilagineæ in the Basidiomycetes, because they possess neither true protobasids nor basids. He also defends the separation of the Uredineæ, and the use of the term teleutospore, that of probasid resting on an illusory homology.

Pilose Tubercles of Agaricineæ.†—M. Boudier has investigated the nature of the pilose tubercles frequently found on the pileus of *Pleurotus ostreatus* and some other Agaricineæ, inaccurately called glands by some writers. He states that they are always caused by humidity, but not simply by the humidity of the air. The inciting cause appears to be invariably the egg of some dipterous insect deposited upon the pileus. Several species which have been founded on this accidental character must be abolished.

Trichophyton megalosporon pyogenes.‡—M. R. Sabouraud maintains that the tinea tonsurans of children, known under the name of kerion celsi, the tinea affecting the beard or sycosis circiné, and the disease termed "perifolliculite agminée" (Herpes circinatus), are the same disease, the localization alone being different. The disorder is of fungoid origin, due to a special trichophyton, and in man is usually derived from contact with animals, more particularly the horse. In the horse the parasite causes a lesion closely resembling that in the human subject—a circinate folliculitis.

In about 80 per cent. of human ringworm the hairy scalp is affected, the remaining 20 per cent. are cases affecting the smooth surface. About 2–3 per cent. are cases of sycosis menti. Microscopical examination reveals two kinds of parasites, one having spores 8–9 μ in diameter, and obviously contained within a mycelium, the other having spores 2–3 μ only in diameter, and without any distinct mycelium. The latter parasite, *Trichophyton microsporon*, causes the tinea tonsurans of children, the former, *T. megalosporon*, affects the hair of the scalp and beard and the smooth skin of all ages. That *T. megalosporon* affects the horse is proved from the case of a stableman attending horses suffering with a malady of similar appearance, and found to contain the same fungus. In all cases the presence of suppuration is a marked phenomenon, so that this class of parasite is termed pyogenic; in the pus, however, the quantity of parasitic elements is small.

Microscopical examination of the hair is best made by immersing it in a 40 per cent. solution of caustic potash, and inspecting the preparation under a magnification of 300 with powerful illumination. Not only are the hairs invaded by the parasite, but the hair-sheaths also, and another point of diagnostic importance will be found in the presence of giant spores—spores having a diameter of 15–18 μ.

The fungus was cultivated on gelose-beer-wort, pure or diluted to 1/5 or 1/10, and on potato. The optimum temperature was 18°. The

* Tom. cit., pp. 164–74.
† Rev. Gén. de Bot. (Bonnier), v. (1893) pp. 29–35.
‡ Ann. Inst. Pasteur., vii. (1893) pp. 497–528 (2 pls. and 3 figs.).

growth has a white, powdery look, and attains its majority in about two weeks. Inoculation experiments made on man and animals were attended with positive results.

Observation of cultures from a single spore showed that this first produced a mycelium, in which spores might be observed. The mycele network goes on increasing, and about the sixth day masses of spores arranged like bunches of grapes are observable. The peculiarities common to *Trichophyta* in general are the spirals, the result of a mycele filament turning on itself, like a spiral spring on a vine tendril. The spindle, the third characteristic, is about 1/20 mm. long, and about 15 μ broad, and is divided up into compartments by transverse septa.

Two Red Mycodermata.*—Herr A. Lasché found on hop-leaves two interesting yeast fungi, which belong to the Mycodermata, because they very quickly form a mouldy scum, and they are not able to produce spores in their interior. He lays it down therefore that *Mycoderma* is a kind of yeast which can form a scum, but no membrane, a definition hitherto unknown.

(1) *Mycoderma humuli.* Cells oval, sausage-shaped, often very irregular. The cells sprout in the following way. From the side of the cell the development of a mycel-filament begins. When this has attained a certain length sprouts begin to form. The sprouts may appear either at the side or the ends of the filament, and from one cell several mycel-filaments may develope.

On wort-gelatin the colonies of *M. humuli* showed short processes from the margins. Gelatin is liquefied in proportions of 10, 15, 20, and 40 per cent., and the degree of concentration exerted no influence on the rapidity of development. Saccharose, maltose, and dextrose were not fermented. In fermented beer this species will not develope, but will in beer-wort. It therefore differs from *M. cerevisiæ* and *M. vini* to which beer and wort are equally acceptable. No examination was made to ascertain if *M. humuli* possessed pathogenic properties.

(2) *Mycoderma rubrum.* This species occurred as an accidental impurity on gelatin plates, and therefore came from the air. Formation of a promycelium was rare. Its behaviour on gelatin was similar to that of *M. humuli*: neither dextrose, saccharose, nor maltose was fermented. The principal differences are that *M. humuli* frequently forms a promycelium. Its cells have a diameter of 1·0—2·5 μ. *M. rubrum* rarely forms a promycelium and its cells measure from 1·5–3 μ. Both forms are stained red.

The nine known Species of Favus.†—Drs. Neebe and Nuna define the genus *Achorion* to be colourless hyphomycetes consisting of septate hyphæ which produce colourless fruit without the aid of fruit-hyphæ. On their natural medium, cuticle, hair, nail, the fruit-hyphæ are transformed into spore-chains from which develope roundish or angular unicellular spores. On artificial media unicellular spores are developed under similar circumstances, and also aërial spores, after the formation

* Der Braumeister, 1892, p. 278. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 485–7.

† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 1–13.

of a free aërial mycele. Here and there bladders also are formed, and from these yellow masses are produced. The species of *Achorion* are parasitic on the horny layers of man and animals, whereon they form after a period the characteristic cups or scutulæ. The nine species enumerated are: *A. euthythrix* (F. griseus); *A. atacton* (F. sulfureus celerior); *A. radians* (F. sardiniensis); *A. dichroon* (F. sulfureus tardus); *A. akromegalicum* (F. scoticus); *A. demergens* (F. Batavus); *A. cysticum* (F. Hamburgensis); *A. moniliforme* (F. Bohemicus); *A. tarsiferon* (F. Polonicus).

The general differences of these species are then given in tabular form, after which are discussed their growth relations, and the classification founded thereon. The authors conclude their remarks by relating their cultivation and preparation methods, the results of which are massed together in tabular form.

In most of their cultivation experiments the medium used was composed of 2 to 4 per cent. agar, 1/2 per cent common salt, 1 per cent. pepton, and 5 per cent. levulose.

Mycetozoa.

Hymenobolus, a new Genus of Myxomycetes.*—Under the name *Hymenobolus parasiticus*, Herr H. Zukal describes the type of a new genus of Myxomycetes belonging to the Perichænaceæ, with the following diagnosis:—Sporangium singulare, regulariter circumlineatum, non pediculatum, fuligineum, minutum; peridium simplex, sine incrustatione calcis; capillitium in toto exigue formatum v. desideratum, lævigatum, hyalinum; sporidia majuscula, globosa, cum amplificato exosporio ab uno latere; plasmodia miniata v. incarnata, in thallo lichenorum aliquorum parasitice sedentia, sæpius in sclerotia, rarius in macrocystas v. microcystas mutantur. The sclerotes were first observed as bright red spots on lichens growing on a willow-tree. The young plasmodes creep along the bark of the tree till they reach the lichen, to which they attach themselves by the action of trophotropism, and on which they carry on a true parasitic existence, boring holes in the thallus often as far as the lower cortical layer. The plasmodes then become converted either into sclerotes or into megacysts and microcysts; the ripe plasmodes expel their ingesta, and either become transformed into sporanges or move their position and then fructify. The parasitic habit, although it is only a facultative parasitism, distinguishes *Hymenobolus* from all the higher Myxomycetes. The pigment appears to be a lipochrome.

Protophyta.

α. Schizophyceæ.

Scenedesmus.—Herr R. Franzé † describes the structure of the membrane, chromatophores, and nucleus of *Scenedesmus*, especially of *S. obtusus* and *acutus*. The membrane has a very delicate rhomboidal areolation. Beneath this is a delicate layer of protoplasm, the granulations of which appear to form a continuous spiral; and beneath this two

* Oesterr. Bot. Zeitschr., xliii. (1893) pp. 73–7, 133–7 (1 pl.).
† Beitr. z. Morph. d. *Scenedesmus*, 1892, 1 pl. See Bot. Centralbl., 1893, Beih., p. 161.

other layers, the arrangement of the granules in which recalls the elaters of the Hepaticæ. The chromatophore is also spiral, having sometimes the form of a figure of 8, while it is sometimes twisted like the chlorophyll-bands of *Spirogyra*. Each chromatophore contains a pyrenoid. The nucleus is fusiform, and is surrounded by an envelope composed of intercrossing threads, and contains a nucleole. The protoplasm is therefore composed of distinct spirosparts.

Prof. R. Chodat and M. O. Malinesco * regard *Scenedesmus* and *Dactylococcus* as belonging to one and the same polymorphic genus, which may also occur in *Pleurococcus*, *Glœocystis*, and *Raphidium* forms. From the absence of ciliated zoospores, the authors prefer to place *Scenedesmus* among the Pleurococcaceæ rather than among the Hydrodictyaceæ.

Genera of Diatoms.†—M. J. Tempère gives a complete list of all generic names of diatoms employed since 1786, distinguishing those which he regards as well established. The name of one new genus, *Leudugeria*, is included.

Atlas der Diatomaceen-Kunde.—Heft 46 of this magnificent work by Dr. A. Schmidt contains four beautiful folio plates (181–4). The species depicted belong mostly to the genus *Melosira*; but there are some also belonging to *Podosira*, *Rutilaria*, *Actinodiscus*, *Actinoptychus*, *Craspedodiscus*, *Coscinodiscus*, and *Lepidodiscus*.

β. Schizomycetes.

Bacteria in Vegetable Tissues.‡—Mr. H. L. Russell asserts that vegetable, like animal, tissues are normally free from micro-organisms, but that many species of bacteria may live in healthy tissues for a considerable time. A series of injection experiments showed that species which are pathogenic for the animal body—such as *Bacillus anthracis*, *B. diphtheriæ*, *B. choleræ-gallinarum*, *Micrococcus tetragenus*, *M. cereus flavus*, *Staphylococcus epidermis albus*, and *S. pyogenes aureus*—are killed in a few days by living vegetable tissues, with the exception of *S. pyocyaneus*, which may live for many days, and even increase. With regard to saprophytic species,—while some, like *B. megaterium* and *B. lactis aerogenes*, do not increase; others were found after from 20 to 50 days in large numbers, and extending to some distance from the point of inoculation; among these were *B. prodigiosus*, *B. butyricus*, *B. luteus*, *B. coli communis*, and *B. fluorescens*.

Diseases caused by Bacteria.§—Herr W. Migula enumerates five diseases of plants caused by bacteria, viz.:—the pear-blight and apple-blight of the United States, caused by *Micrococcus amylivorus*; the *Sorghum*-blight of America, due to *Bacillus Sorghi*; the disease which attacks young maize-plants in America, due to an undetermined bacterium; the disease of hyacinths; and the damp rot of potatoes, caused by an aerobic bacterium, formerly confounded with *Bacillus amylobacter*.

* Bull. de l'Herbier Bossier, i. p. 184. See Morot's Journ. de Bot., vii. (1893) Bull. Bibl., p. lvii.

† Le Diatomiste, ii. (1893) pp. 17–20.

‡ Bot. Gazette, xviii. (1893) pp. 93–6.

§ Med. Proefstat. Midden-Java, 1892, 18 pp. See Morot's Journ. de Bot., vii. (1893) Bull. Bibl., p. vi.

Behaviour of Bacteria in small Intestine of Man.*—Dr. A. Macfadyen gives an account of an investigation carried out in conjunction with Prof. Nencki and Dr. Sieber, on the contents of the human small intestine. The contents were obtained from an artificial anus, after excision of the ileum where it opens into the cæcum.

The object of the investigation was partly chemical, but specially to isolate the bacteria present in the normal small intestine and to study their action on proteids and carbohydrates. Three series of experiments were made, (1) during a meat diet, (2) during a mainly vegetable diet, (3) again during a meat diet. Numerous bacteria were isolated, and besides Schizomycetes, the intestinal contents were always crowded with fungi and yeasts. Most of the bacteria appear to have been aerobic, and of the anaerobic all were facultative.

No putrefactive bacteria were isolated, and the reason for this is probably to be found in the acid reaction of the contents of the small intestine. The chief decomposition was found to be that of the carbohydrates, and not of the proteids, and the principal products were CO_2, H, acetic, succinic, and lactic acids, and alcohol. By comparing the results of the action of pure cultivations of seven bacteria isolated from the intestinal juice with the products obtained from the juice itself it was concluded that the fermentation of the carbohydrates is the result of bacterial action. The constant presence of alcohol in the small intestine and in the pure cultivations of the bacteria seems very interesting from a physiological point of view.

The characteristic of the bacteria of the colon is the decomposition of proteids. Herein the reaction is alkaline and hence favourable to their action.

Resistance of the Spores of Bacillus megaterium to dryness.†—From experiments he has made Mr. A. P. Swan, has come to the conclusion that spores of *Bacillus megaterium* will not retain their vitality when dried up for more than 4½ years, a period far below that of *B. subtilis* or *anthracis*.

Action of Light on Bacillus anthracis.‡—By a series of experiments on anthrax spores, Prof. H. M. Ward has determined that the action of sunlight not only has an inhibitory influence on the multiplication of bacilli; but that the direct rays of the sun actually kill the spores; and that this action is quite independent of temperature; the effect is chiefly, if not entirely, due to the rays of higher refrangibility in the blue-violet of the spectrum. The electric light has the same effect. Other bacteria and some fungi are affected in the same way.

White Corpuscles as Protectors of the Blood.§—Dr. Werigo observed that in rabbits almost all the leucocytes disappeared from the blood a few minutes after they had been injected with a cultivation of *B. prodigiosus* in a vein of the ear.

* Trans. 7th Internat. Congress Hygiene, ii. (1892) pp. 60–4.
† Ann. Bot., vii. (1893) pp. 153–4.
‡ Proc. Roy. Soc., lii. (1893) pp. 393–400 (2 figs.); liii. (1893) pp. 23–44.
§ Ann. Inst. Pasteur, 1892, p. 478. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 241–3.

Systematic experiments with *B. prodigiosus*, *B. pyocyaneus*, hog cholera, fowl tubercle, and anthrax, usually showed that immediately after injection of living or dead bacteria into the circulation there was an immediate and often considerable diminution of the leucocytes. The decrease was most manifest in the large multinucleated cells, the lymphocytes being less affected. If the animals survived, at not earlier than 15 hours after injection, the number of leucocytes increased until there were 3–4 times as many as at first. If the cultivations of *B. pyocyaneus* were filtered before injection, then leucocytosis occurred without previous diminution. Injection of carmine into the circulation also had the effect of causing a considerable diminution in the number of leucocytes for some hours.

In order to explain the sudden and extraordinary diminution of the blood leucocytes after intravenous injections, the author suggests that the leucocytes immediately consume those elements and transport them to (internal) viscera; for examination of the liver of rabbits, killed directly after carmine injection, showed that in this case leucocytes laden with carmine were met with mostly in the liver capillaries and in extremely intimate relation with the endothelial cells. According to the author's description, the leucocytes are at once eaten up by the hepatic endothelial cells, so that giant cell forms arise. Quite similar appearances are presented after injection with anthrax, and the author surmises that it is of general occurrence for bacteria when injected into the circulation to be eaten up by leucocytes and carried off into the viscera. Attention is called to the fact that these results are opposed to the theory of Metschnikoff, according to which leucocytes possess a kind of selective power, and, on account of the negative chemotactic action of the tissues, should be incapable of consuming virulent bacteria. The author strives to minimise the force of this objection to phagocytosis by remarking that Metschnikoff may have made his observations either on infections having a fatal termination or at the height of the process, while here we have to deal with appearances at the very beginning, or when as yet the tissues have not had time to make their influence felt on the organism. Nevertheless, it is quite clear that the author's statements are opposed to the theory of phagocytosis, for if all the bacteria which may get into the blood are at once eaten up, then phagocytosis cannot be said to possess any decisive action on the course of the infective process.

New Bacillus pathogenic to Animals.*—Dr. H. Laser describes a new micro-organism isolated from calves which died at a certain farm two or three days after birth. On agar plates inoculated from liver and lung of the diseased animals, large white colonies grew up in 24 hours. The bacteria when examined in hanging drops were seen to be short mobile bacilli. In intensity their movements were very variable. The bacilli stained easily with the usual anilin dyes. Cultivated on gelatin the organism grew along the inoculation track either continuously or in separate colonies. There was no liquefaction of the medium. On agar the surface was covered with a greasy slimy overlay. In puncture cultivations on agar and grape-sugar gelatin the growth was luxuriant,

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 217–23.

but the remarkable feature was the copious evolution of gas, which was so great that it would push the agar up 2 cm. In bouillon the bacteria sink and no scum forms. The bacillus was found to grow equally well in the presence or absence of oxygen.

Injection experiments showed that the micro-organism was pathogenic to rabbits, guinea-pigs, mice, and pigeons. The most constant post-mortem phenomenon was enlargement of the spleen, from which pure cultivations were made. In those animals which survived for a week, suppurative peritonitis occurred, and if they lasted still longer, large masses of fat were found in the abdominal organs.

Presence of Micro-organisms in the organs of those dead of Cholera.*—Dr. L. de Rekowski has made a number of experiments on cholera corpses to ascertain if the cholera bacillus be present in the tissues or organs. The author's results are conclusive. In a very large number of trials cholera bacilli were found in parts of the body other than the intestinal canal. The method adopted was to cut out with the necessary precautions a piece about the size of a nut, and cultivate it in a liquid medium for 20–30 hours. The cultivation medium was Buchner's fluid and a 2 per cent. solution of peptone. The latter formed about one-tenth of the bulk in each test-tube. Buchner's fluid is composed of one part of bouillon in which cholera bacilli have been cultivated for two or three weeks. This is sterilized and then mixed with 10 parts of a half per cent. solution of sea-salt. After mixing, the solution is sterilized anew for half an hour at 120°.

After the lapse of 20–30 hours the test-tubes were examined to see if they contained bacteria. If they did, four plates were inoculated and the colonies which grew up were re-implanted in gelatin, potato, and bouillon. Examination of brain, spinal subarachnoid fluid, heart, clot in heart, liver, bile, spleen, kidney, and voluntary muscle showed the presence of cholera bacilli, together with other bacteria in a large percentage of cases. From this the author concludes that the prevalent opinion about the cholera bacilli being restricted to the gastro-intestinal tract is unfounded.

Pathogenesis of Anthrax in Guinea-pigs and Rabbits.†—It has been held by many that in its pathogenesis anthrax in man and cattle is a local disorder with slight extension into the circulation and the rest of the body, while in other animals it has a more hæmatogenous character. Drs. G. Frank and O. Lubarsch have made experiments with the view of finding out how soon post infectionem anthrax can be demonstrated by cultivation methods in the blood and internal organs. In guinea-pigs the micro-organisms were never found before seventeen hours, and were never absent after twenty-two hours. Within this period, therefore, the bacilli pass into the circulation first of all, and in greatest numbers into spleen, lungs, and liver. Rabbits evinced considerable individual differences in the resistance to infection, and the number of micro-organisms present in the internal organs was subject to great variations, but they were hardly ever absent.

* Arch. Sci. Biol. Inst. Imp. de Méd. Exp. à St. Pétersbourg, i. (1892) pp. 517–31.

† Zeitschr. f. Hygiene, xi. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 283–4.

The authors came to the conclusion that anthrax in small animals—mice, guinea-pigs, rabbits—is at first a local disorder, and if, owing to diffusion of their toxic products from the bacilli at the inoculation site, the bactericidal influence of the blood be overcome, then a free dissemination in the blood may ensue.

Pleomorphism of Tubercle Bacillus.*—In connection with a communication of Fischel, who states that his investigations into the morphology and biology of the tubercle bacillus lead him to the conclusion that what is now known as tubercle bacillus is the parasitic form of a micro-organism originally saprophytic, forming branched filaments, and also club-shaped elements having resemblance to *Actinomyces*, Dr. E. Klein claims that, in 1890, he pointed out that in some cultivations in glycerin-agar and bouillon, the tubercle bacilli were found with branched mycele-like filaments and bulbous end-expansions. Between these filaments and the typical tubercle bacilli all kinds of intermediate forms were found. All these forms assumed the typical tubercle stain, and about the purity of the cultivations there was no doubt. The author then stated, "The tubercle bacillus as met with in the human and (other) animal bodies, in serum cultures, and in the first months in glycerin-agar and bouillon cultures, is but a phase in the life-cycle of a micro-organism morphologically allied to mycele-fungi."

Hog-Cholera and Phagocytosis.†—Prof. E. Metschnikoff pursues his studies on immunity, and from experiments made with the bacteria of hog-cholera, finds that protection against this disease is due to the active interference of phagocytes. His conclusions are that:—(1) The serum of rabbits vaccinated against hog-cholera does not possess bactericidal or antitoxic properties. (2) The same serum does not possess the power of attenuating the virulence of the microbe of hog-cholera. (3) Despite the absence of the foregoing properties, the serum of vaccinated rabbits preserved fresh unvaccinated rabbits against fatal infection from the bacteria of hog-cholera. (4) This property is not found in the liquid œdema set up by stoppage of the circulation. (5) The bactericidal property of the organism of vaccinated rabbits resides in the phagocytes. (6) The pus of vaccinated rabbits retains for a long time virulent microbes. (7) The organism of vaccinated rabbits is very sensitive to the toxines of hog-cholera, and is not possessed of any antitoxic property. (8) Phagocytes play a very important part in the resistance of vaccinated rabbits. (9) Phagocytes also play a very important part in the resistance of rabbits unvaccinated, but treated with the preservative serum. Under these circumstances it is probable that this liquid exerts a stimulating influence on the phagocytes.

Clasmatocytes and their Relation to Suppuration.‡—Prof. L. Ranvier detected the existence of clasmatocytes by treating the femoral aponeurosis of the frog successively with osmic acid and methyl-violet 5 B. Side by side with the fixed cells were other cells stained deep violet, and having all the morphological characters of the migratory

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 905–6.
† Ann. Inst. Pasteur, 1892, p. 269.
‡ Comptes Rendus, cxvi. (1893) pp. 295–7.

cells of the cornea prepared with gold chloride. Similar cells were found in other parts of the frog, when the tissues were examined after the same method. Analogous cells were observed in the mesentery of the crested Triton, and when examined in their own plasma were found to be devoid of movement and incapable of amœboid prolongation. If a non-microbic peritonitis be induced, as by the injection of a dilute solution of silver nitrate into the sac, the clasmatocytes become changed, *in situ*, into lymphatic cells, they reassume their embryonic form, and multiply rapidly by direct division. Hence they are the principal source of suppuration. The clasmatocytes are neither fixed connective tissue-corpuscles, nor are they leucocytes.

Toxic Principle of Bacillus lactis aerogenes.*—Prof. J. Denys and M. E. Brion record experiments made with *B. lactis aerogenes* (*B. pyogenes* d'Albarran and Hallé), an organism first found almost in a state of purity in the stools of suckling infants by Escherich. Recently, A. Morelle has shown that this organism plays an important part in urinary affections, and though much of importance as to its morphology and biology are known, its toxic principles have been little studied. The organism was grown on potato, whereon it forms a thickish layer, which is easily scraped off and can be weighed and mixed with fluids. As a cultivation medium potato has the further advantage of being free from pepton, sugar, and other substances entering into the composition of bouillon and gelatin. The pale yellow-brown growth was weighed and mixed up to 10 per cent. with distilled water or physiological solution, and then ether or chloroform added to kill the microbe.

The effect of large doses on the rabbit was an energetic action on the central nervous system. After an extremely short stage of excitement, general paralysis set in, and this might be accompanied by tetanus. In smaller doses the most striking phenomenon was emaciation. The poison was obtained by passing the aqueous emulsion through a Chamberland or Nordtmeyer filter, and using the filtrate or simply the clear supernatant fluid; and in course of these observations it was determined that the poison was extremely diffusible in water, and that 2–3 cubic centimetres of the fluid obtained either by filtration or deposit are about equivalent to one cubic centimetre of the emulsion. The poison showed a remarkable resistance to high temperatures, there being no apparent diminution of its virulence after exposure to 100° for 15–20 minutes. After 45 minutes to 3 hours at the same temperature, there is manifest diminution, and after an exposure of 6 hours the dose requires to be four times as large.

The nature of the poison was examined by Brieger's method, but no ptomaines from potato cultivations were obtained. Gautier's method and attempts to extract an alkaloid by solvents such as chloroform, ether, and alcohol, either simply or after acidification with acetic or hydrochloric acid, were equally unsuccessful. The poison hitherto suspected of being a toxin was afterwards determined to be a toxalbumin. It is soluble in water; it is precipitated from this solution by alcohol; it is of a colloid nature and non-dialysable; it becomes incorporated with precipitates such as calcic phosphate.

The authors further find that neither the gastric nor the pancreatic

* La Cellule, viii. (1892) pp. 305-32.

juice has any action on the toxalbumin, that it is not destroyed by oxygen nor affected by the action of light. Though the alkaloidal nature of the toxin is negatived, the authors do not definitely class it among the toxalbumins, to which it is allied by its insolubility in alcohol, and its colloidal nature on account of its resistance to heat and the digestive juices.

Bacillus pluviatilis.*—Dr. A. B. Griffiths describes under this name a microbe discovered in rain water which had been stored in an open barrel during a mild winter. When cultivated on gelatin plates it forms yellow colonies 2–10 mm. in diameter. It liquefies gelatin, and developes rapidly, when grown on a piece of potato, colouring it orange, and transforming the starch into glucose. It is a true bacillus, and is not formed from spores; it is 2–4 μ long, 0·6–0·8 μ broad, and is stained by anilin colours. It can live only in water containing organic matter; the cultures may be dried, but are killed by heating to 100° C. for 15 minutes. It does not appear to be pathogenic.

Bacillus typhosus and Bacillus coli communis.—MM. A. Rodet and G. Roux † were the first to point out that the bacillus of enteric fever may, under certain circumstances, produce suppuration, and that *Bacterium coli* plays a part in affections of the bile ducts. They further showed that, while *Bacillus typhosus* is found in the splenic blood of enteric fever cases, *B. coli* exists in the intestine of these patients, almost in pure cultivation. From examinations of water suspected of typhoid, micro-organisms which could be positively identified with *B. entericus* were never found, while *B. coli* was often present. The position of the authors is that the typhoid bacillus is merely a variety of *Bact. coli*, and they now give the result of their experiments on animals. In the anatomical lesions found in rabbits and guinea-pigs there was a striking resemblance, although those produced by *Bact. coli* were perhaps more intense. The temperature changes resulting from intra-peritoneal and intravenous injection of both organisms point to the conclusion that these organisms cannot be easily distinguished from the standpoint of experimental infection.

MM. Chantemesse and Widal ‡ find that the typhoid fever bacillus cannot set up an alcoholic or a lactic acid fermentation in nutritive media. Coagulation of milk does not occur even if a typhoid milk cultivation be kept longer than two months. The observations are a direct contradiction of the statements of Dubief, who found that the fermentative action of typhoid bacillus and of the common bacterium of the large intestine was equally great, that the quantitative difference between the formed products of fermentation was very slight, and that *Bacillus typhosus* was able to coagulate milk even after a long period. The objections raised by Rodet and Roux are also controverted. The authors left *B. coli* for two months in an incubator until it was almost dried up, yet the colon bacterium had lost none of its characteris-

* Bull. Soc. Chim., vii. pp. 332–4. See Journ. Chem. Soc., 1893, Abstr. p. 83.

† Arch. Méd. Exp. et d'Anat. Pathol., iv. No. 3. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 139–40. Cf. this Journal, *ante*, p. 86.

‡ La Semaine Méd., 1891, No. 45, p. 451. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 730–1.

tic properties or of its coagulative power. *Bact. coli* cultivated in media to which 1/800 phenylic acid or 1/400 tartaric acid had been added and kept for six weeks at 37°, showed many microbes, which corresponded morphologically and biologically with *B. coli*. The authors have further determined that *B. coli* is killed in a few seconds by the action of a temperature of 80°.

Rodet and Roux regard the typhoid bacillus as a variety of *B. coli* produced in the organism of the typhoid patient. Yet when *B. coli* is pathogenic to man, and has been the cause of a local or general infection, its peculiar characters are retained, and do not resemble those of typhoid bacillus. In typhoid fever secondary infections set up by *B. coli* are not uncommon, and these are manifested by certain symptoms. In such cases *B. coli* is demonstrable with all its characters. When passed through the body of sensitive animals, such as rabbits and guinea-pigs, the typical characters of *B. coli* remain unaltered.

Dr. A. Péré * cultivated the Escherich bacillus in various albuminous media, and found that its growth in bouillon mixed with syntonin pepton-glucose or dextrin was extraordinarily rapid, but slower if cane or milk sugar were added. The growth of Eberth's bacillus was strikingly inhibited in the presence of the sugars. In albuminous media the reaction of the media for both bacteria was at first acid, afterwards becoming alkaline. In fresh meat-bouillon the growth of *B. coli* only excites an acid reaction, while in typhoid bacillus this reaction changes after five days to alkaline.

The indol reaction was obtained in all those cases where *B. coli* was cultivated in presence of pepton or of albumen associated with peptonizing ferments. *B. coli* can decompose glucose and saccharose in peptonized media if access of air be unimpeded, while Eberth's bacillus never gives the indol reaction under the above-mentioned conditions, nor is it able to decompose the sugars, except cane and milk sugar.

Virulence of Streptococci.†—Dr. H. de Marbaix, after a historical critique of the unicist and dualist views of pathogenic streptococci, avows himself a unicist, on the ground that the separatists had not taken into account two facts which the author considers are established by his experiments. First, the virulence of a given streptococcus varies considerably, according to its origin. Secondly, the primitive virulence is subject to considerable oscillations, sometimes more, sometimes less.

The monograph is too long to quote more than the general features and conclusions. The author is chiefly concerned in controverting the position of Von Lingelsheim and Kurth, who divided streptococci into three chief classes—pyogenic, erysipelatous, and scarlatinal. These observers attached considerable importance to the differences in the appearances of the cultures, and more especially of the deposits, but no part of their diagnosis was based on the results of injecting animals with the cultivations.

On this deficiency the author lays much stress, and thinks his objections are fatal to the dualist view.

The conclusions arrived at are:—(1) The virulence of streptococci varies considerably, according to the disease from which it comes.

* Ann. Inst. Pasteur, vi. 1892, No. 7. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 285.

† La Cellule, viii. (1892) pp. 257–301.

(2) In a general sense, the more severe the disease, the more virulent is the streptococcus. (3) The virulence is easily measured (*a*) by inoculation on a rabbit's ear; (*b*) by inoculation on a serous membrane. (4) The virulence of one and the same streptococcus is liable to variation. It is increased by being passed through the rabbit; it is diminished or lost if not resown. (5) Any particular streptococcus will acquire a high degree of virulence so much the more quickly according as it is already possessed of a greater degree of virulence. (6) Non-virulent streptococci acquire pathogenic properties if they be associated with irritant liquids such as the bile. (7) Streptococci from the mouth are habitually less virulent, but their virulence may be increased by passage through animals. (8) Virulence is not associated with any special kind of development in bouillon. (9) The works of Von Lingelsheim and of Kurth on the classification of streptococci are fundamentally defective, inasmuch as they did not take into account the variation of virulence.

Bacillus mucosus ozænæ.*—Dr. R. Abel describes a bacillus which he isolated from cases of Rhinitis atrophicans fœtida or Ozæna vera, a catarrhal inflammation of the nasal mucosa leading to atrophy, in which the secretion soon dries and exhales a very unpleasant odour. The bacilli are short and plump, frequently arranged in pairs or in chains, and have much resemblance to Friedländer's pneumobacillus. Not unfrequently they are surrounded by a capsule which may be twice as broad as the rodlet. The organism was cultivated with facility on all the usual media, and succeeded best at incubation temperatures and with free access of air, although its growth was not materially interfered with at room temperature and in the absence of oxygen. On all media a peculiar smell likened to the odour from fermenting malt was perceptible. The development of the bacilli was but little interfered with by differences in the reaction of the medium. The bacilli were easily stained with all the usual anilin dyes, and on heating cover-glass preparations with alkaline methylen-blue or phenol fuchsin, the capsules were so deeply stained that the bacilli were hidden. Gram's method failed. The microbe is pathogenic to white mice, the greatest change being found in the spleen, which is much enlarged and congested. The blood reeks with ozæna bacilli.

Rats and mice were refractory to subcutaneous injection, but succumbed to injections into abdominal cavity and into lungs.

The author then points out, at considerable length, the characters which distinguish *B. mucosus ozænæ* from other bacteria of somewhat similar appearance.

Micro-organisms of the Mouth.†—Dr. E. W. Roughton has brought together, in an interesting and useful form, an account of the micro-organisms of the mouth, and their effects on the mouth and other parts of the body. Many of the troubles to which the mouth is subject are undoubtedly due to them, and they are found in great numbers and considerable variety.

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 161–73.
† Trans. Odontol. Soc. Great Britain, xxv. (1893) pp. 71–88 (6 pls.).

Growth of the Comma Bacillus on Potato.*—Dr. H. Krannhals records the results of numerous cultivations on potato of the comma bacillus made during the last epidemic at Riga. The varieties used were the "Oschlapping," a "red" and a "white," all three having been grown on a sandy soil.

The potatoes were prepared in the usual way, and some pieces (105) were alkalized with 1/2 per cent. aqueous solution of bicarbonate of soda; the rest (136) remained in their natural or "acid" condition. On the alkalized potatoes the growth of the fungus was invariably luxuriant, and that not only at incubation but at ordinary or room temperature. On the unalkalized or acid potato no growth took place in the majority (about two-thirds) of cases. In some instances the potato was found to have undergone a spontaneous alteration of reaction, being alkaline to litmus paper. Under these circumstances the colonies formed greyish-brown tufts. If, however, the potato remained acid, either no growth occurred at all, or if it did it was very poor, the colonies being almost confined to the inoculation site, and of a dirty white or pale yellow colour.

The spontaneous change of reaction from acid to alkaline seems somewhat mysterious, but is not assignable to the growth of the fungus; for, although an alkali-maker, the fungus would hardly be capable of producing an amount of alkali sufficient to change the reaction of the potato throughout the whole piece.

Chinese Yeast and Amylomyces Rouxii.†—M. Calmette describes the yeast used in China and Indo-China for making wine and brandy from rice. It is sold in flat cakes about the size of five-franc pieces, and consists of a mixture of micro-organisms and various spices added for the purpose of imparting a flavour to the fermented liquid. The commercial yeast contains three kinds of micro-organisms, a fungus acting on and saccharizing starch, alcoholizing yeasts, and deleterious bacteria and moulds. By taking a piece of the "yeast" about the size of a pin's head, rubbing it up with distilled water, dividing it into five equal parts, and then distributing these over five wort-gelatin plates, there developed eight colonies of the saccharizing fungus, 18 to 25 yeasts, two moulds, and thirty different kinds of bacteria. One of the last is called the bacillus of stringy rice, and is characterized by turning starch into a sticky pasty mass and preventing the formation of sugar by stifling with its zooglœa the saccharizing fungus, *Amylomyces Rouxii.* The exact morphological position of this schizomycete is left in doubt. It thrives on and in all the usual media, but beer-wort suits it best. In the presence of air the mycele of *Amylomyces* uses up the sugar formed out of the starch; but when the fungus penetrates into the depth of a starchy medium dextrine and glucose are formed. The penetration of the mycele into the starch-granules is followed by the excretion of an enzyme (amylose) having the properties of malt diastase. Besides amylase the fungus also secretes sucrase. The optimum temperature was found to be between 35°–38°, and the diastatic power was lost when the temperature reached 72°.

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 33–42.

† Ann. Inst. Pasteur, vi. (1892) p. 604. See Bot. Centralbl., liii. (1892) pp. 246–8.

According to the author the rice chaff is the peculiar residence of *Amylomyces Rouxii*.

Choleroid Vibrio from Well-water.*—Dr. E. Weibel isolated a form of *Vibrio* from a well which had some time before been infected with cholera. The colonies liquefied gelatin and somewhat resembled those of cholera. Morphologically it was very like cholera, Finkler-Prior vibrio, *V. saprophiles* α, and had many characters in common with Günther's *V. aquatilis*. It was successfully cultivated in all the usual media except on potato. The colonies on gelatin are circular sharp-edged homogeneous discs, by which the gelatin was liquefied in the presence of air. The movements as seen on hanging drops are described as molecular, though at times some pass rapidly across the field. The vibrio is killed at 55° C. No experiments on animals were made.

Bacillus choleroides α and β.†—Dr. O. Bujwid has isolated from Vistula water two new *Spirilla* which were at first thought to be cholera bacilli. The first of these grew somewhat slowly on plates at from 10°–12° R., the colonies having a remarkable resemblance to those of cholera, but at higher temperatures they were broader, more superficial, never sank in so deep, and gradually rendered the liquefied gelatin turbid, while the odour from the plates recalled methyl-mercaptan and not indol. Under a low power the contour of the colonies is sharp and regular and their surface smooth or finely granular. In puncture cultivations in gelatin their growth was quite superficial and the surface only was liquefied; at low temperatures, 10°–12° R., the gelatin was liquefied more slowly, and gas-bubbles like those of cholera were developed. Deep down the growth was scanty. On oblique agar these bacteria throve luxuriantly, giving off the methyl-mercaptan odour. Bouillon was rendered only slightly turbid and no scum was formed. In hanging drops at 37° this species bore great resemblance to cholera *Vibrio*, curved short and long *Spirilla* being seen, though their movements are not so lively. Under the Microscope, no obvious differences were detectable.

The second species was found in well-water from a place in which there had been a good many cases of cholera. The characters of *B. choleroides* β resemble those of α, except that it is more anaerobic and the funnel of the liquefied gelatin is deeper.

Bacterium vernicosum.‡—Prof. W. Zopf has isolated from American cotton-seed meal which, as fodder, caused disease, a suspiciously pathogenic Schizomycete, termed, on account of its gelatin-cultivation appearance, *Bacterium vernicosum* sp. n. The author's account is chiefly devoted to the physiological properties of *B. vernicosum*, its morphological characters receiving only scant notice. Experiments on sheep and calves showed that the suspicion of pathogenesis was unfounded. The ferment action of the organism is examined in greatest detail; in presence of carbohydrate solutions carbonic acid is evolved and lactic acid formed. Cane-sugar is fermented without inversion. No

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 117–20.
† Tom. cit., pp. 120-1.
‡ Beitr. z. Physiol. u. Morphol. niederer Organismen, i. (1892) pp. 57–95.

diastatic ferments are produced, and gelatin is liquefied very slowly. Urea is decomposed through the agency of an unisolated ferment into ammonium carbonate.

The vegetative cells pass through a swarming condition: these cells are short rodlets united occasionally into filaments. The swarming state passes after a time into a resting condition, in which the cells do not alter in form. Many of these cells are "arthrospores," as is evinced by their greater resistance to heat and drying.

Streptococcus pyogenes.*—Prof. E. M. Crookshank points out that *Streptococcus pyogenes* is found not only in abscesses, but in scarlet fever, diphtheria, and other diseases associated with septic complications. Cultivations made under different conditions, chiefly of the medium, showed striking variations in the cultures and subcultures, not only macroscopically, but microscopically. It is evident, therefore, that such differences should be recognized and taken into consideration. The author's conclusions were derived from the examination of cultures made from a single source, a case of *Str. pyogenes hominis.*

Analogous results were obtained in cultivating *Str. py. bovis*, but when grown under exactly identical conditions the differences between these two organisms were very marked, and the author therefore concludes that they are distinct varieties.

Non-identity of Streptococcus pyogenes and Streptococcus erysipelatosus.†—From a series of experiments made with *Str. pyogenes* and *Str. erysipelatosus*, Prof. E. M. Crookshank finds that primary cultures of the two micro-organisms cultivated under precisely the same conditions differed in the size and character of the chains, in the size of the individual elements, in the greater opacity of the colonies of *Str. erysipelatosus*, in a greater tendency to confluence, and in a more rapid growth.

The author found that the difference was most marked in broth-cultures. Abundant flocculi were formed by *Str. pyogenes*, and a powdery deposit, with a special tendency to form a granular adhesive film at the bottom of the culture-flask in the case of *Str. erysipelatosus.* Lastly, they differed in their power of resisting germicides.

Products of Staphylococcus pyogenes.‡—MM. A. Rodet and J. Courmont have obtained the following results from examining the properties of the soluble toxic products of *St. pyogenes*:—Cultures sterilized by heat kill dogs in a few hours; all the organs are much congested, and death is preceded by dyspnœa and lowering of the arterial pressure. Very small doses are able to produce a chronic intoxication in rabbits, and the animals die in eight to ten days in an advanced cachectic condition. Cultivations filtered through porcelain are less poisonous, and their toxicity varies with the age of the culture, the time of filtration, and the length of the interval between filtration and application. A culture filtered a long time before is three or four times less virulent than when used directly after filtration. Notwithstanding this vanishing

* Trans. 7th Internat. Congress Hygiene, ii. (1892) pp. 67–8.
† Tom. cit., pp. 68–9.
‡ Le Bulletin Méd., 1892, p. 84. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 532–3.

toxicity, the predisposing power of the filtered culture remains unchanged; hence it may be concluded that there are several soluble products, and that the toxic substances are not identical with the predisposing substances. The substances precipitable by alcohol from bouillon cultures will in doses of a few centigrammes kill a dog in 1–2 hours. The chief symptoms are choreic and tetanic, with an extreme condition of excitability. Rabbits are more resistant, but they die after a few days with less severe symptoms. Substances soluble in alcohol act as an anæsthetizing poison. Dogs die in a condition of general muscular relaxation, with failure of the heart and respiration in 1½ hours. Rabbits last out ten days, but the phenomena are much the same. The substances soluble in alcohol and the alcoholic precipitate of *St. pyogenes* are accordingly antagonistic.

The poisoned animals show a parenchymatous nephritis produced by the substances precipitated by alcohol.

Asporogenous Heredity of Anthrax.*—M. C. Phisalix inoculated two fresh flasks from an anthrax culture several days old which had been developed at 42°. One of the flasks was incubated at 42°, and the other at 30°. The cultivations at 42° served for making several subcultures, and the transfers were continued until development did not take place at 42°. The cultures at 30° at first throve very well, and did not apparently differ from the 42° cultures; but after a time their morphological characters altered considerably, the disappearance of spore-formation being the most easily induced. When sowing the 42° cultures for the first time, blood was taken from a wether dead of anthrax. In five months, twenty-five generations were propagated at intervals of two to fourteen days. Up to the twelfth generation there was but little morphological or physiological alteration; then spore-formation failed, and the fourteenth generation had no effect when inoculated on mice, and seemed to be definitely asporogenous. As the power of forming spores disappeared the cultures lost their virulence, and by the twentieth generation the organism had become innocuous.

Asporogenous anthrax can therefore be produced by the action of heat as well as by antiseptic solutions, and the morphological alterations thus effected become inherited after a certain number of generations.

Vitality of Bacillus anthracis.†—In their second report to the Royal Society Water Research Committee, Professors P. F. Frankland and H. Marshall Ward deal with the vitality and virulence of *Bacillus anthracis* and its spores in potable waters. The spore of anthrax may be regarded as representative of the extreme limit of endurance possessed by pathogenic bacteria. The authors find that there is one natural agency at least which is capable of destroying the spores in surface waters to which they may have gained access, and that is the action of direct sunshine on the organism. It is not definitely determined whether the activity of water bacteria may be added as a second bactericidal agent, but at any rate sunshine is much more rapid and potent an influence. There does not appear to be sufficient evidence to support the view that *Bacillus anthracis* can live and multiply like a water-bacterium in ordinary waters.

* Le Bulletin Méd., 1892, p. 293. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1893) pp. 533–4.

† Proc. Roy. Soc., liii. (1893) pp. 164–317.

Ætiology of Cholera.*—During the last epidemic of cholera in Baku Herren Blackstein and G. Schubenko made some experiments for the purpose of ascertaining whether other organisms besides the cholera vibrio might not play an effective part in the causation of this disease, or, in other words, they desired to find what influence was exerted by the locality and the contagion in determining an outbreak of cholera. Rabbits were subcutaneously injected with 1 ccm. of the supernatant clear fluid obtained from fresh rice-water stools which had been allowed to stand a while. The number of cholera vibrios in this fluid to all other organisms was found to be as 4–1. The animals died in three to five days with fits of cramps of the extremities and opisthotonus. The autopsy showed considerable œdema round about the injection place and fatty liver. Cultivations were also made of minute quantities of rice-water stools in 2 per cent. pepton solution, and having been incubated for twenty-four hours at 33°, 1/2 ccm. was injected subcutaneously. The rabbits died in about twelve hours. Microscopical examination of this cultivation showed that the number of cholera vibrios to other bacteria was as 1–10.

Besides the cholera vibrio there were present *Bact. coli commune* and a new bacillus called *B. caspicus.* This microbe is about as thick as *B. coli commune*, and 2–5 times longer than broad. It is a mobile organism, and found both in the direct and indirect cultivations in company with the cholera spirochæte and some liquefying bacteria. Hence in the intestine the cholera bacillus predominates over the *B. coli commune* and *B. caspicus*, while in the transfer cultivations the reverse is the case.

Subcutaneous injections on white mice and rabbits, made with mixtures of the two organisms and with each kind separately, both with dejecta and cultivations therefrom, gave the following results:—(1) That the dejecta transferred to bouillon and incubated had a stronger action than the dejecta by itself. (2) That the mixture of the bacteria had a stronger action than the pure cultivations.

Saline Constituents of Well Water and the Cholera bacillus.†—Dr. Trenkmann records the results of some preliminary experiments relative to the growth and viability of the cholera bacillus in natural waters. A well water, 100 ccm. of which reduced 3·1 ccm. of 1/100 permanganate of potash solution, and of which 1 litre contained 35 mg. chlorine, served as the basis. A definite quantity of this was mixed with dilute solutions of various salts, chiefly sodium salts, inoculated with comma bacilli, and plate-cultivations were made from which the number of bacilli was determined.

Speaking generally, it was found that the presence of sodium chloride and some other salts of the same base was very favourable to the development of the bacillus. Such results are only of scientific value for the particular spring water experimented with.

Involution Form of Tubercle Bacilli.‡—Dr. S. G. Dixon observed, in 1889, that tubercle bacilli cultivated in agar and glycerin exhibited

* Wratsch, 1892, No. 41, p. 1029. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 441–2.
† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 313–20.
‡ Proc. Acad. Nat. Sci. Philadelphia, 1893, pp. 100–3.

buddings in one or more places along the rod, the angle at which the branches came off being very variable. Some of these branches were quite as long as the original rod. Since then several observers have described the branching of tubercle bacilli. In the summer of 1892 the author found this form of the bacillus in the liver of the green jay of Mexico, *Xanthoura luxosa.*

The author inclines to the view that the branched form represents an involution life-cycle of this germ, chiefly because young bacilli when introduced into the animal tissues produce tuberculosis, while older cultures gradually lose their virulence, probably owing to their inability to reproduce themselves.

Spread of Leguminosæ-Bacteria in the Soil.*—It had been frequently remarked by Herren F. Nobbe, E. Schmid, L. Hiltner, and E. Hotter, that in top-inoculation only in the uppermost layers of the soil did root-tubercles develope, the rootlets extending more deeply being free. This fact might receive its explanation either in the deficiency of air in the deeper layers of the soil, or in that the bacteria, retained by the upper layers and roots, were withdrawn from the disseminating influence of the irrigation-water. Experiments were made with marrow-fats (Laxton's Prolific) to determine which of these alternatives was the correct one, and also to ascertain if the plants were only liable to infection in the youthful condition.

Inoculations were made (May 16) fourteen days after sowing the plants in sterilized non-azotized soil enriched with mineral manure by introducing in a sterilized glass tube an emulsion (5 ccm. per plant) of a pure cultivation of Leguminosæ-bacteria 20 cm. below the surface. On October 2 the plants were examined, and the washed roots showed tubercles only at the deeper parts, the upper parts being quite free. Another experiment, where the inoculation was made in the middle of the pot (about 12 cm. deep), showed that the tubercles were confined to the neighbourhood of the inoculation site. If two inoculations were made, one at the surface and one 1/2 cm. below, there were two tuberculous zones separated by a non-tuberculous stratum. Assuming that root-formation is normal, the age of the plant is not in itself determinative of tubercle formation; young rootlets are only capable of infection so long as they possess sensitive hairs.

Bacteriology of Artificial Mineral Waters.†—Mr. C. Slater, who has made a bacteriological investigation of various artificial mineral waters, finds that they contain a considerable number of micro-organisms; the number present in the finished waters gives no clue to the original purity of the source of supply, or to the efficacy of the methods of purification. When these waters are kept there is a decided decrease in the number of micro-organisms present; and this decrease is most noticeable after about three weeks. The decrease is due to the presence of carbon dioxide which arrests the development of the bacteria, but does not always kill them.

Aëration undoubtedly increases the safety of water; it offers a practically absolute safeguard against cholera, since *Spirillum choleræ*

* Mittheil. Pflanz. Phys. Versuchsstat. Tharand. Die Landwirths. Versuchsstat. xli. (1892) p. 137. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 194–5.
† Journal of Pathol. and Bacteriol., i. (1893) pp. 468–88.

and *S. Finkleri* are both so rapidly killed, that the water could hardly be used before these germs were dead. On the whole, it may be concluded than an aërated water made from a good source, and kept for more than fourteen days, would appear to offer complete safety from the usual water-carried diseases.

Jörgensen's Micro-organisms and Brewing.*—The third edition of this happy union of science and practice has recently appeared, enlarged and improved. It now consists of 230 pages, illustrated by 56 wood engravings intercalated in the text, which has been thoroughly revised and brought up to date.

BEHREND, H.—**Cattle Tuberculosis and Tuberculous Meat.** London, 8vo, 1893.

BRUHL, J.—**Contribution à l'étude du vibrion avicide (Vibrio Metschnikovianus).** (Contribution to the Study of the Bird-killing *Vibrio*.) *Arch. Méd. Expér.*, 1893, pp. 38–62.

D'ARSONVAL & CHARRIN—**Action des microbes pathogènes sur la cellule végétale.** (Action of Pathogenic Microbes on the Vegetable Cell.) *Compt. Rend. Soc. Biol.*, 1893, p. 37.

GARCIA, S. A.—**Ueber Ptomaine.** *Zeitschr. f. Physiol. Chemie*, XVII. (1893) pp. 570–95.

GILBERT, A.—**Des poisons produits par le bacille intestinal d'Escherich.** (Poisons produced by the Intestinal Bacillus of Escherich.) *Compt. Rend. Soc. Biol.*, 1893, pp. 214–7.

GILBERT, A., & G. LION—**Contribution à l'étude des bactéries intestinales.** (Contribution to the Study of Intestinal Bacteria.) *Mém. Soc. Biol.*, 1893, pp. 55–61.

HALLÉ, N., & A. DISSARD—**Note sur la culture du bacterium coli dans l'urine.** (Note on the Cultivation of *B. coli* in Urine.) *Compt. Rend. Soc. Biol.*, 1893, pp. 320–4.

HENKEMANS, D. S.—**Bacterium coli commune.** Nijkerk, 1892, 74 pp.

KITT, TH.—**Bakterienkunde und Pathologische Mikroskopie für Tierärzte und Studierende der Tiermedizin.** (Bacteriology and Pathological Microscopy for Veterinarians.) Wien, 8vo, 1893, xiv. and 450 pp., 140 figs. and 2 colrd. pls.

MAUMUS—**Sur la transformation de l'amidon végétal en sucre par le bacille du charbon.** (On the Transformation of Vegetable Starch into Sugar by the Bacillus of Anthrax.) *Compt. Rend. Soc. Biol.*, 1893, pp. 107–9.

PANE, N.—**Sulla proprietà del bacillus coli communis di sviluppare gas, e sua importanza diagnostica per distinguerlo dal bacillo del tifo in rapporto ad altri caratteri.** (On the power of *Bacillus coli communis* to develope gas, and its importance as a diagnostic in distinguishing the *Bacillus* of typhus.) *Gazz. d. Clin.*, 1892, pp. 369–76.

PANTLEN—**Bericht über einen Bakteriologischen Kurs.** (Report on a Course of Bacteriology.) *Med. Korrespondenzbl. d. Württemb. Ärztl. Landesver.*, 1893, pp. 73–4, 84–6.

ROTH, A.—**Ueber das Verhalten beweglicher Mikroorganismen in strömender Flüssigkeit.** (On the Characters of mobile Micro-organisms in streaming fluid.) *Deutsch. Med. Wochenschr.*, 1893, pp. 351–2.

WYTHE, J. H.—**Recent Discussions respecting Bacteria.** *Pacific Med. Journ.*, 1893, No. 2, pp. 74–6.

ZÖRKENDÖRFER—**Ueber die im Hühnerei vorkommenden Bakterienarten nebst Vorschlägen zu rationellen Verfahren der Eikonservierung.** (On the Species of Bacteria found in Fowls' Eggs, with suggestions for a Rational Method of Preserving Eggs.) *Arch. f. Hygiene*, XVI. (1893) pp. 369–401.

* Berlin, 1892. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 795.

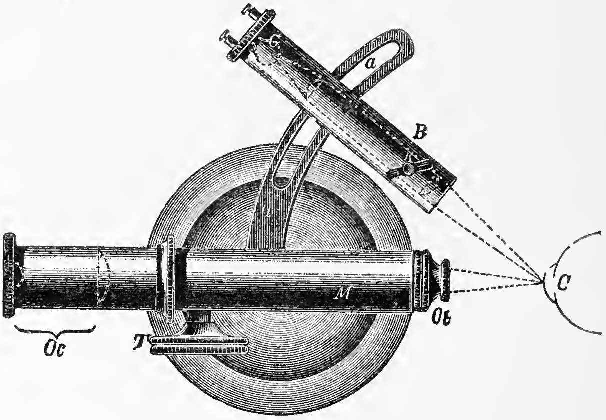
MICROSCOPY.

a. Instruments, Accessories, &c.*

(1) Stands.

A Cornea-Microscope.†—Dr. S. Czapski and Dr. F. Schanz have devised an instrument with which it is possible to adjust a Microscope upon the cornea, and at the same time keep the spot under observation intensely illuminated from the side.

Fig. 95.



The instrument consists of a Microscope M and an illuminating tube B in rigid connection with it (fig. 95). The Microscope M is adjustable by rack and pinion T. To the body-tube M is attached an arc *a*, on which the illuminating tube B can be firmly fixed by a clamping screw in different positions so as to vary the angle of incidence of the light, while the point of convergence C remains always the same.

The illuminating tube contains at one end a glow-lamp G, which is fixed in the focus of a condensing lens in the interior of the tube. A second lens near the other end of the tube is fastened in a small tube and can be displaced by the knob *k* in the direction of the axis so that the point of convergence of the light can be regulated.

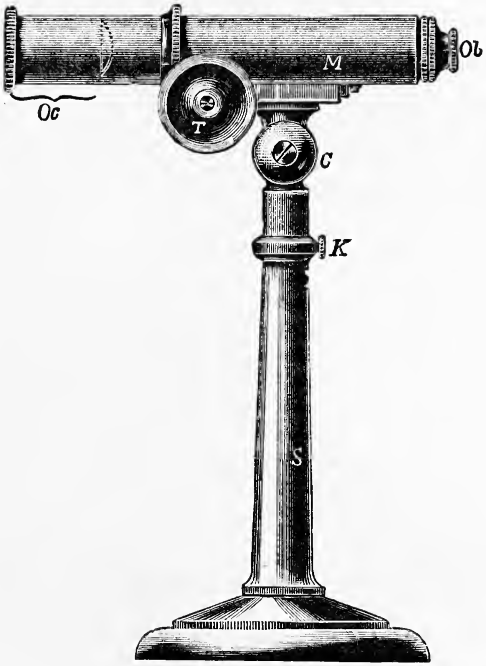
The instrument is mounted on a pillar which stands on a heavy

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

† Zeitschr. f. Instrumentenk., xiii. (1893) pp. 250–2; Klein. Monatsblätter f. Augenheilkunde, 1893.

round foot. It can be adjusted in height by drawing a rod connected with it out of the pillar and clamping with a screw; it can, also, be rotated about a hinge.

FIG. 96.



(3) Illuminating and other Apparatus.

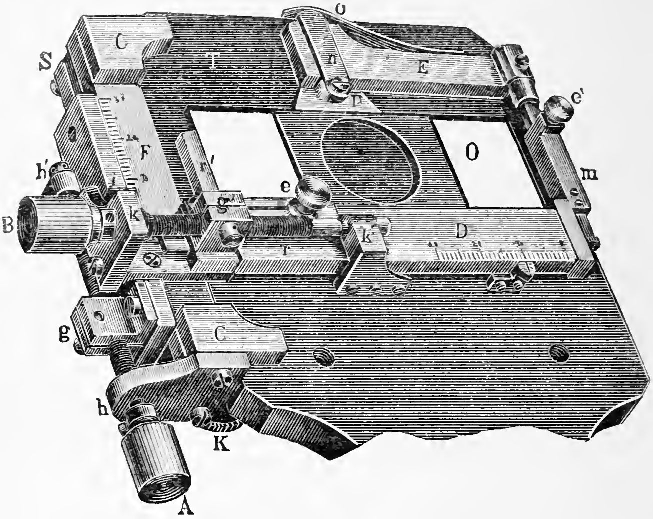
Winkel's Movable Object-stage.*—Dr. W. Behrens describes the new movable stage of the firm of R. Winkel of Göttingen. One peculiarity, in which it differs from most other stages, is that it is attached to the side of the stage-plate instead of to the pillar of the Microscope. It also possesses a new arrangement for fixing the object-holder on the stage. As seen in fig. 97, which represents the apparatus in 0·6 of its natural size, it is attached to the left side of the object-stage T T. For this purpose it possesses a plate F, with end-cheeks C C resting on the stage-plate, which is fastened to the edge of the stage by two clamping screws, the front one of which at *k* is visible in the figure.

On the side of F, visible at S, is a swallow-tail groove in which moves a sliding-piece *i*. Through the nut *g* on this slide passes the screw A, which is attached to F at *h h'*, so that by turning the screw-head A the nut *g* is moved backwards or forwards, and with it the slide *i*. The amount of displacement is read off on the millimeter division on F by means of the index *i*.

* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 433–8.

Projecting from *i* at right angles is the metal-piece *k i* on which, in a groove, not visible in the figure, moves the slide D. This movement is effected by the screw B which is attached to *i* at *k* and *k'* and works in the nut *g'* fixed to D. The amount of displacement, as before, is read off on the millimeter division on D by means of the index *i'*.

Fig. 97.



The object-holder O is firmly clamped against the inner edge of the slide D by the arrangement *r r' e* on the one side, and *m* E *p* on the other. At *r* is a cross-piece sliding on D, and this is moved forward to a position corresponding to the size of the object-holder, where it is clamped by the screw *e*; the left small side of the object-holder is then pressed against the projecting-piece *r'*. In rigid connection with the slide on the right is the piece *m*, and sliding in this is the angle-arm E, which can be clamped by the screw *e'*. In E slides the metal-piece *n* which carries at one end the movable square piece *p*, while it is pressed at the other by the steel spring *o*. Thus by loosening the screw *e'*, pressing E up against the object-holder and then again clamping *e'*, the object-holder is firmly fixed in the apparatus, so that its displacement can then only be effected by means of the screws A and B.

The right small side of the object-holder is free, so that any strain upon it is prevented.

The apparatus can be easily fitted to any rectangular stage the side of which exceeds 80 mm. in length.

The method of using the apparatus as a "finder" needs no explanation, except that it must be fixed to the stage-plate in such a way that the projecting piece seen at S shall be flush with the front edge, and that the plate *r r'* must be moved back as far as it will go to the left before the object-holder is clamped in.

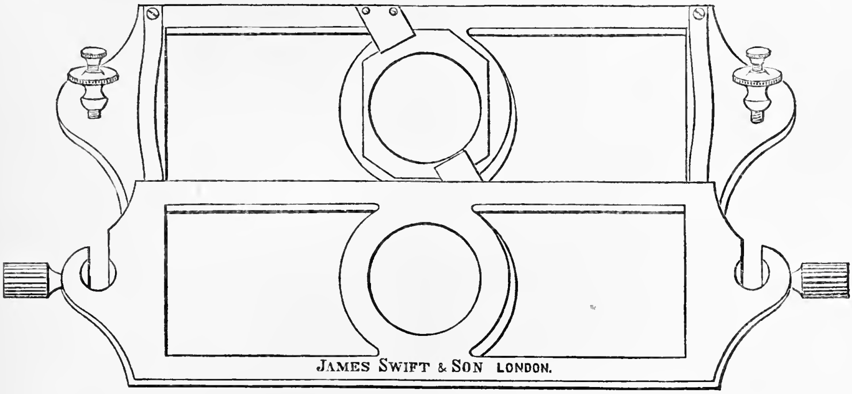
According to experiments made by the author, the apparatus may be used as a finder, even with high magnifications, although in these cases it is on many grounds preferable to mark the desired point with a medium system, and having found it again by means of this, to replace the latter by a higher system.

Value of Artificial Sources of Light.*—Prof. Rogers has recently made a series of new experiments on the value of different sources of light as regards white light and illuminating effect; the result is in favour of the light of burning magnesium.

In the experiments the spectra were produced and the intensities of the individual colours of the different sources were compared by measurement with one another. The results were represented by curves, and it was seen that the curve generally corresponded with that of daylight with a more or less cloudy sky. With a cloudless sky, on the other hand, daylight had a considerably higher effect on the more refractive parts of the spectrum in the green, blue, and violet. The electric arc-light, according to Nichols, is in these parts weaker than the sun or magnesium light, but increases in intensity very strongly in the violet and ultra-violet parts. Gaslight naturally showed itself brightest in the less refractive parts.

The temperature of burning magnesium is much lower than one would expect, viz. about 1340°, or between the temperature of the so-called luminous flame and that of the Bunsen flame. The radiation effect is greater with magnesium than with any other artificial light, being forty times greater than that of gaslight. Only the electric discharge in vacuo is superior to it in this respect.

Fig. 98.



Macer's Reversible Compressorium.—Mr. R. Macer has devised a reversible compressorium which can be worked with a high-angle condenser and high-power objectives (fig. 98). It has a vertical compression, and the smallest object can be fixed and examined on both sides. It is simple in its use and construction, and is made as follows:—In the

* Central-Ztg. f. Optik u. Mechanik, xii. (1893) p. 143.

centre of two flat brass plates, long enough to extend beyond the stage, is a 3/4-in. hole slightly recessed to receive a 7/8-in. No. 2 cover-glass, and at each end a screwed stud is fixed to receive mill-edged nuts for compression. The holes in top-plate are slotted through on one side in order to remove the plate by unscrewing the milled-edged nuts and lifting the plate above the steady-pins which are fixed at each end to prevent any lateral or longitudinal motion; the bottom plate (or both plates) has a transverse chase cut in to receive two springs to keep the plates apart, but sufficiently flexible to allow them to come into contact. The above plates may be made solid or perforated in order to lighten them, and the cover-glasses may be oblong and slipped under spring clips, two on each plate. The steady-pins may be dispensed with by having the under side of milled-edged nuts made conical and the top-plate coned to receive the same. These compressors may be made any length, to suit different stages.

Application of Polarized Light to Histological Investigations.*— Dr. H. Ambronn suggests, in the modest little work he has just published, that polarized light might be occasionally useful for histological purposes. This is quite possible, but it would be well to show what practical results, however small these may be, have been obtained in addition to describing polarization phenomena.

(4) Photomicrography.

Apparatus for the Projection of Microscopic Images.†—The firm of Carl Zeiss publish details of the latest changes in the construction of their photomicrographic apparatus, by which it is rendered more suitable for purposes of the *projection of images on a screen.*

As source of light they recommend the electric arc projection lamp of S. Schuckert and Co. of Nürnberg which, with a current of 16 amperes and 60 volts, gives a light of about 2500 candle power. The regulation of the distance of the carbons is effected very readily at any moment by means of two screws. The special feature of the lamp is that the carbons are not placed vertically but obliquely. The advantage of this is that the light of the glowing hollow in the positive carbon, which is generally lost, is to a large extent utilized; so that such lamps give in the direction of projection, for the same current, a more intense illumination than other systems. The projection table (fig. 99) carries at one end the lamp C, and at the other the Microscope M, with the optical bank D D between.

The Microscope is attached to a base-plate which can be adjusted in height, and also to the right and left, by means of a rod passing beneath the table, so that the axis of the Microscope can easily be brought into coincidence with that of the apparatus on the bank.

The chief requirements of a Microscope for projection work are:—

(1) A mechanical movable stage with micrometer movements.

(2) A sliding objective changer.

(3) A condenser which can be adjusted in two directions at right

* 'Introduction to the Use of Polarized Light for Histological Research,' Leipzig, 1892, 59 pp., 8 pls., 27 figs. See Bot. Ztg., li. (1893) pp. 122–3.

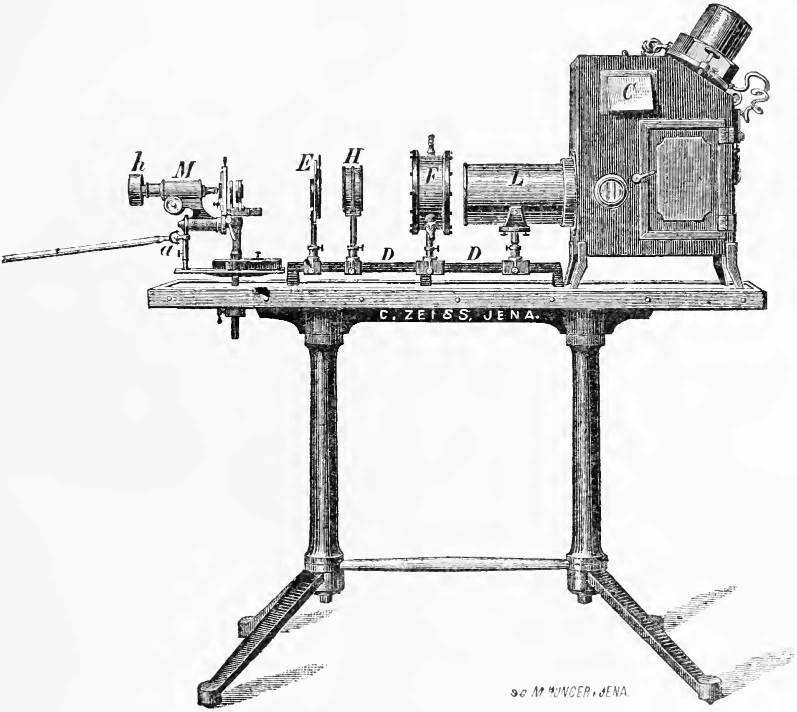
† 'Carl Zeiss Optische Werkstätte,' Jena, 1892, 17 pp., 9 figs.

angles to the optic axis, so that a change in position of the light may be within certain limits compensated for without the necessity of altering the illumination.

The achromatic centering condenser shown in fig. 100, which answers to these requirements, can be fitted into the socket of the illuminating apparatus in place of the ordinary condenser.

(4) An illuminating apparatus (fig. 101) adjustable in the direction of the axis.

Fig. 99.



(5) For projection with very low magnifications (system of 70 mm. focal length without eye-piece) a body-tube of extra width.

(6) Of especial importance is a good micrometer movement on the stand.

(7) A Hooke's key for the fine-adjustment if the operator prefers to be nearer the screen than the Microscope. In this case the base-plate of the Microscope is provided with an arrangement (*a*, fig. 99) for readily connecting the Hooke's key with the micrometer screw of the stand.

As answering to the above requirements the firm of Zeiss offer their stand for photomicrography which was described and figured in this Journal, 1889, p. 278.

The accessory apparatus on the optical bank are, the condensing lens L which makes light-proof connection with the lamp, the heat-absorption apparatus F, and the two iris diaphragms, one between F and M, and the other between L and F. As regards the centering of the apparatus, the height above the table of the positive carbon for mean adjustment is first determined. The centres of the two iris diaphragms are then brought approximately to the same height. The axis of the condensing system has then to be adjusted. For this purpose the iris diaphragms are brought near the ends of the optical bank, one on each side of the condenser. One of them is then illuminated from behind by a lamp, and the condensing system is displaced until the image of one diaphragm falls in the plane of the other. The condensing system is then adjusted so that the image is concentric with the aperture of the diaphragm. By interchanging the positions of the diaphragms, they can be brought to exactly the same height.

Fig. 100.

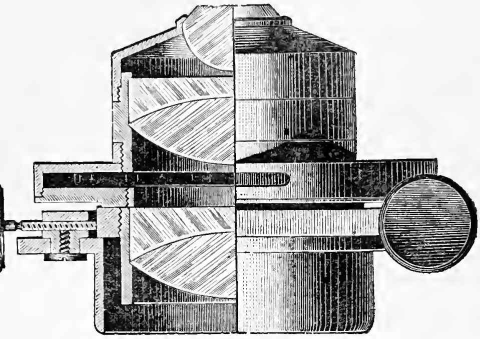
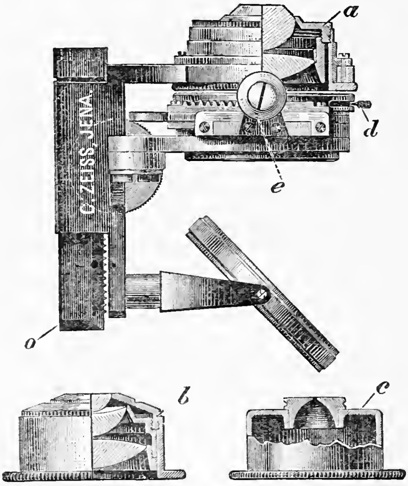


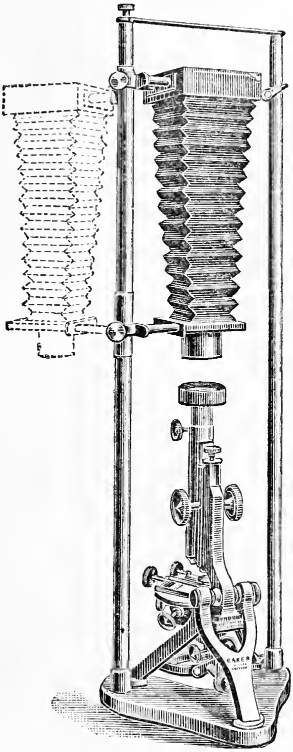
Fig. 101.



The arc lamp is then brought into its place and connected with the condensing system. Its position is regulated by adjusting the screws so that the light passes centrically through the two diaphragms. The axis of the Microscope has then to be brought into the same direction. For this purpose the condenser of the Microscope is removed, but its iris diaphragm retained. The base-plate is adjusted until the light passing through the diaphragms on the bank falls centrically on the diaphragm of the Microscope. To determine whether the axis of the Microscope is in the same straight line as the centres of the diaphragms, a low power, about 70 mm., is used, and a piece of ground glass is fitted on to the eye-piece end of the body-tube. The Microscope diaphragm is then opened to its full extent, but those on the bank to a few millimetres only. The latter are then displaced until a sharp image is formed on the glass. The position of this image is adjusted by turning the base-plate about its axis.

For low powers the condensing system on the bank is sufficient. For projection work apochromatics are not essential. Low and medium systems can be used direct without eye-piece. With high powers the image of the source of light should be thrown upon the preparation; with low powers, on the objective, so that the preparation is illuminated by a convergent pencil. An important point is the exclusion of all extraneous light. This is effected by the use of paper covers over the optical bank, &c.

Fig. 102.



Pringle's Vertical Photomicrographic Apparatus.—Mr. Andrew Pringle's vertical photomicrographic apparatus (fig. 102) consists of a 1/4-plate bellows-body camera, 18 in. long, sliding between two metal uprights which are fixed to a heavy iron base upon which the Microscope stands. The camera can be turned aside, if wished, while the Microscope is being adjusted, and clamped at any part of the uprights. The usual ground- and plane-glass focusing-screens are supplied with the apparatus.

Practical Photomicrography.*—After stating that his photomicrography was of a peculiarly utilitarian nature, his object being, not to perform a difficult feat for the sake of overcoming difficulties, but rather to produce a lasting record of appearances presented by some special microscopical preparation, Mr. A. F. Stanley Kent went on to remark that, one of the first essentials to good microscopic work is a stand of first-class workmanship; for, while it is quite true that work with low powers may be done with low-priced instruments, it is, nevertheless, a fact that for really good work, and more especially for work with the higher powers, the very best of everything in the way of apparatus is absolutely essential.

So far as the stage is concerned, Mr. Kent thinks that individual tastes play a large part in the selection, the simple stage being held to be amply sufficient by some workers, while others regard a mechanical arrangement as almost a *sine qua non*. Personally, he is inclined to recommend that, in a case of a Microscope to be entirely devoted to photography, and more especially if any considerable amount of high-power work be contemplated, a mechanical stage of the best construction should be selected.

The length of the Microscope-tube is an important matter, and one about which there has been much discussion; but, inasmuch as several

* Anthony's Photographic Bulletin, xxiii. (1892) pp. 621-4, 660-3.

makers are now making Microscope-stands with a series of draw-tubes, which enable one to vary the tube-length from something less than the Continental to something greater than the English length of tube, it is possible so to arrange the apparatus as to work at any length that seems to give the best results.

If a large amount of difficult high power work is contemplated there cannot be the slightest doubt that it is true economy to buy the very best objectives that can be procured. And it may here be stated generally that objectives having as high an angular aperture as possible, and, in fact, giving the best possible image when used in the ordinary manner, will be found best adapted for photographic work.

A form of apparatus that Mr. Kent has largely used, consists of the following parts:—A bracket is fixed upon a wall just below an aperture through which light enters. Upon the bracket the Microscope is supported in a vertical position, and the entering light is thrown upwards and through the Microscope by means of a mirror. Immediately above the bracket is fitted a support for the photographic plate, and this support can be placed nearer to or farther from the Microscope as a less or greater amplification is desired. Around the whole of the Microscope and bracket an opaque cloth is arranged to prevent the light entering by the aperture in the wall from escaping into the room. The eye-piece of the Microscope projects through a hole in the cloth. The plate support is provided with three points upon which the plate rests. Thus, there is no possibility of want of register between the focusing plate and sensitive surface as in the camera slide. Exposure is effected by means of a plate of ruby glass. The focusing is accomplished by placing the focusing screen upon the three points of the plate-holder. A general idea of the image is gained by using an unexposed gelatino-bromide plate as a focusing screen, and the final touches are given by replacing this with a piece of plate glass, and examining the image upon it by means of a double convex lens of long focus, or what does equally well, the field lens from an ordinary eye-piece of low power. All adjustments of the fine focusing screw are made through opaque cloth with ease. In an apparatus of this kind one is working inside the camera, and it is essential that all white light shall be excluded. The apparatus is equally well adapted for photographing either wet or dry preparations; and while admitting that for constant work with the highest powers and dry specimens, one of the horizontal forms of apparatus would probably prove more satisfactory, yet for doing work which is only taken up at intervals, and where the Microscope cannot be devoted exclusively to photomicrography, it will be found an arrangement possessing many advantages.

Whatever the form of apparatus decided upon, an efficient form of illuminant is a necessity; and while many good workers prefer still to use the common paraffin lamp, perhaps the best illuminant for all-round work is the oxy-hydrogen limelight, and particularly that form of the light in which the gases are mixed before ignition. In this form of illuminating apparatus an extremely small point of very high brilliancy is obtained, and the diffusion of brilliancy observable in the blow-through form of jet is absent. With proper care it is quite possible to use hydrogen for the mixed jet direct from the main, i. e. from the nearest gas bracket, so that only one bottle is necessary, and with proper management such a light is very economical, though, of course, it cannot compare with the paraffin light in this respect.

The electric light, both arc and incandescent, has been extensively tried, but with disappointing results, and Mr. Kent has practically given it up, except in cases where it is necessary to take instantaneous photographs of moving objects. Even under such circumstances, direct sunlight, controlled by a suitable heliostat, is quite as efficient if the weather happens to be favourable.

Whatever illuminant is ultimately chosen, a great deal depends on the condenser that is used. Rack and pinion for focusing the condenser is necessary, as also is some form of centering adjustment for placing the condenser accurately in the optic axis of the Microscope. Far too little attention has hitherto been given to the advantages resulting from an intelligent use of the condenser, and it is not at all unusual to see, even in first-class laboratories, microscopists who keep their condenser invariably in one position and never think of focusing it accurately upon the object under examination.

Very often, too, the stops or diaphragms are most unintelligently managed, and the result is an unsatisfactory visual image; and if such an image is photographed, it must result in an unsatisfactory photograph, for one of the first things to be thoroughly understood, and one of the most important lessons that a photomicrographer can learn, is that the best visual image gives the photograph and no satisfactory negative can be hoped for unless a satisfactory visual image has first been obtained.

Having then made certain that the image is accurately focused, another difficulty arises, viz. that of the exposure. And for exposure in photomicrography, just as for exposure in landscape work, no definite rules can be given. Practice only can teach the correct amount to be given to each preparation under different conditions of magnification and illumination. It is far better to use up a few plates at the beginning by making experiments than to attempt to be economical and learn exposure from books.

FULLER, R. M.—**An Improved Method of Photomicrography of Bacteria and other Micro-organisms.** *Med. Record*, 1892, pp. 698–9.

(5) Microscopical Optics and Manipulation.

New Method for the Determination of the Refractive Indices of Anisotropic Microscopic Objects.*—Herr H. Ambronn gives a new method for determining the refractive indices of anisotropic microscopic objects. It consists in finding two liquids with refractive indices intermediate between the two refractive indices of the mineral section under examination. When immersed in such liquids and observed in polarized light, the object does not lose its outline when the axes of elasticity are parallel to the plane of polarization; but between these positions an azimuth may be found in which a complete disappearance of outline does take place. This azimuth is determined in the case of the two

* Ber. Verhandl. K. Sächs. Gesell. zu Leipzig, iii. (1893) pp. 316–8.

different liquids, and from these two angular measurements the refractive index can be readily found by calculation by means of the well-known formula

$$e_m = \frac{e_o\, e_e}{e_o \cos^2 \alpha \times e_e \sin^2 \alpha}.$$

On Work with a Polarization Microscope and a Simple Method for the Determination of the Sign of the Double-refraction.*—Prof. C. Klein gives a critical and historical account of the various methods which have been devised for determining the sign of double-refraction both in convergent and parallel light. In treating of the modes of observation of the interference figure in convergent light in the Microscope, he shows that he was the first to make use of the method in which the figure is observed by means of a lens held above the ordinary eye-piece of the Microscope.

Having passed in review the various methods which have been proposed for determining the sign of double-refraction, such as comparison with a plate of known optical character cut at right angles to the optic axis, use of Biot's compensation quartz and gypsum wedges, and of retardation plates of gypsum and mica, including the usual quarter-wave plate, he comes to the conclusion that the succession of colours obtained by the use of a wedge of quartz or gypsum affords the most general, the simplest and the most convenient process for determining the character of the double-refraction; because in this succession of colours we have the means of replacing, not only for the observation in parallel light, all gypsum and mica plates of different tints, but also for observation in convergent light, all plates devised in order to give the various and distinctive interference phenomena in the different quadrants of the interference figure.

For this purpose the polarization Microscope should be provided beneath the upper nicol and above the objective, with a slit running from the right in front to the left behind. In the slit can be inserted either:—

(1) A gypsum wedge giving colours of the first order in which the smaller axis of elasticity is in the plane of the plate and parallel to the edge.

(2) A similar or quartz wedge giving colours from the first to higher orders with similar optic orientation.

(6) Miscellaneous.

Progress in Microscopy.—We are glad to read the following note in the Journal of the British Dental Association:†—"Our Association has recently shown its appreciation of the value of microscopical research in connection with dental histology by authorizing, at our last annual meeting, the formation of a Microscopical Section (as an experiment for that occasion). We think that the success of that experiment is undoubted. The opening address by the president, Mr. Charles Tomes, as well as the special discussion and lantern demonstrations which followed, were very fully attended, and it is to be hoped that the

* SB. K. Preuss. Akad. Berlin, xviii. (1893) pp. 221–45. † xiv. (1893) p. 465.

success of the Microscopical Section may ensure it a permanent place in all our future annual meetings."

Microscopy at the Columbian Exhibition.*—Mr. H. L. Tolman has the following interesting notice of that part of the great exhibition at Chicago which ought most to interest our readers:—"The display of Microscopes and accessories at the World's Fair, though so scattered as to be difficult to see without considerable trouble, is probably the largest ever made at any exposition, and well worth all the trouble necessary to find it. The displays are scattered among the American, English, French, German, and Italian exhibits, most of them being in the great Liberal Arts Building. The American displays of scientific instruments are in the north gallery of this building, and the finest show of Microscopes is that of the Bausch and Lomb Optical Company. They have a good place in section E, and display forty Microscopes, microtomes and magnifying glasses, besides sterilizers and numerous specimens of prisms, condensers, and photographic lenses. Their newest form of Microscope-stand is an imitation of the well-known German horse-shoe model, which seems to be liked very much notwithstanding its inherent awkwardness. Another style which they have begun to make is the Wenham radial, which seems to have some striking advantages, though it is slow in coming into popularity.

Next to the Bausch and Lomb Company is the Gundlach Optical Company, with an excellent assortment of lenses, and a collection of stands on the German model. A little to the west is the McIntosh Optical Company, with a good selection of the lower-priced grade of instruments. Near them is the booth of Queen & Co., with their well-known style of stands, and also some specimens of Carl Reichert of Vienna, for whom they are American agents. The house of E. B. Myrowitz of New York, who manufactures the handsome form of stand made popular by the late W. H. Bulloch, is represented by three excellent specimens, which are displayed in the exhibit of the section of Microscopy of the Chicago Academy of Sciences. Among Microscope-makers, Joseph Zentmayer of Philadelphia, one of the oldest and best-known men of his line, is unfortunately not represented. Grunow and McAllister, once so well known, are also absent, but for better reason, as they no longer make either instruments or objectives. Of objective-makers, Spencer and Wales are both conspicuous for their absence, so that there is a serious gap in the list of Microscope-makers of the country which ought to be best represented.

Of English makers, three are represented:—Beck and Beck, W. Watson and Sons, and Ross. The first named has the largest exhibit and makes a really fine display, adhering in all material points to the styles so long known. Watson's exhibit is smaller, but he has a novelty, the Van Heurck pattern, which combines a number of conveniences, and partakes more of the English than of the German model. Ross only shows three instruments of the well-known Ross-Jackson model of stand.

In the French department, Nachet makes by far the best showing, but his exhibit is scarcely worthy of him. He makes fine stands and

* Amer. Mon. Micr. Journ., xiv. (1893) pp. 219–22.

accessories, and they were worthily shown at the Paris Photographic Convention last September, but here the large photomicrographic camera is absent, and its place is supplied by a small and ill-constructed one. The stands are badly arranged, and the objectives are limited to a single series shut up in a case. There are, however, a few novelties, one being a stand with a stage nearly 6 by 9 in., for examination of sections across a whole brain and the like, and another being specimens of "palladiumized" stand or of brass plated with palladium. They resemble oxidized brass and give a fine effect. Vion Frères have a large number of cheap stands, Teigne and Moreau show a few of the conventional forms, and J. Duboscq, the well-known instrument-maker, exhibits a fine vertical and projecting Microscope.

Italy also appears in the list with a case of stands and objectives manufactured by F. Koristka of Milan. The objectives include an apochromatic of 2 mm. of 140 N.A., but both lenses and stands are a close and servile imitation of German patterns.

But by far the most scientific display of Microscopes and accessories of all kinds at the Fair, is that of the famous Zeiss establishment of Jena. It is located in the north-west portion of the gallery in the Electricity Building with the exhibit of the German Society for Mechanics and Optics of Berlin, the Society not being able to get the necessary space in the Liberal Arts Buildings. There seems to be something of the proverbial "yankee" energy and push in the way the Zeiss business is conducted, and it is shown in the exhibit. Every kind of instrument made by the firm is to be seen here, from the simplest hand-lens to the most complex outfit for photomicrography and complete sets of achromatic and apochromatic objectives.

In the way of stands there is nothing specially new which has not been exhibited for several years, but there are some novelties in accessories. One is a mechanical stage, square in form, attached to the main stem of the instrument and removed by unscrewing a screw and raising a bar. It could be easily attached to almost any instrument and ought to offer a good hint to American makers. The photomicrographic apparatus is very complete, and has many peculiarities. The tube of the Microscope is very wide (50 mm.) and only 3 in. long, but has of course a draw-tube. The camera is designed to be used with electric light, and a beautifully designed lamp for the arc light is attached. The whole apparatus with achromatic condenser, monochromatic light attachment, centering apparatus, stand, camera, &c., costs 500 dollars in Germany or 750 dollars with duty and freight paid. There are other interesting specimens in the exhibit, such as the microspectroscope, the microspectral photometer for quantitative microspectrum analysis, the microspectral objective for observing and measuring the effects of the colours of the spectrum on microscopical objects, the spectropolarizer for determining the character of double refraction in microscopical specimens for particular wave-lengths, and the refractometer for determining the refractive index of glass and liquids.

F. W. Schieck of Berlin, one of the oldest Microscope-makers in Europe, makes a neat exhibit of cheap instruments, two of them being of an old pattern, rarely seen at present. One of these is designed to have the specimens mounted on a large circular glass which are successively seen by revolving the glass. This form is sometimes used for class demonstration. In the other instrument, the objects are mounted in the rim of a brass barrel, which is turned around for each specimen to be shown.

F. Leitz of Wetzlar has a fair exhibit of his stands under the charge of his American agents, Richards & Co. It is located in the south end of the Mines and Mining Building, but the exhibit is not in a place where it can be seen to advantage. He has also a few instruments in the German Educational Exhibit, where Hartnack of Potsdam, Seibert of Wetzlar, and a few other minor makers are also represented. The only foreign makers of note who do not exhibit are Crouch and Swift of London, and Klönne and Müller of Berlin, so that the foreign representation as a whole is very complete.

In order to bring together microscopists and Microscopes, and promote discussion and acquaintance, the members of the Section of Microscopy of the Chicago Academy of Sciences, formerly the Illinois State Microscopical Society, have made an exhibit, where they have on exhibition not only specimens of the leading kinds of Microscopes, but a large number of mounted objects and photomicrographs made by their members. Demonstrations of methods of mounting, and instruction in the use of the Microscope and testing of lenses are given every other day by experts, and the exhibit, which is in section E of the north gallery of the Liberal Arts Building next to the Bausch and Lomb display, is designed for headquarters for all interested in microscopy, when attending the Fair."

The late Mr. George Brook, F.R.M.S.—Mr. Brook had lived for so comparatively short a time in London that he was not known to the Fellows who attend the meetings of the Society, but it was hoped that he might soon have become a regular attendant. While resident in Edinburgh, at the University of which he was Lecturer on Embryology, he took a large share in the formation of the Scottish Microscopical Society. His work on the development of fish, his report on the Antipatharia of the "Challenger" Expedition, and his splendidly illustrated Catalogue of the specimens of *Madrepora* in the collection of the British Museum, were all of a high order of merit, and bear testimony to his great intellectual powers. By his death, at the early age of thirty-six, Zoology has lost a valuable worker, and his many friends have been deprived of a man of sterling worth.

The Microscope in Public Schools.*—Mr. W. W. Weir says, "I am using a Microscope in my school. I have a regular hour set apart, when each pupil comes to the glass and makes his observation, passes quietly to his seat, and the next comes, and so on, till all have made an observation. From the outset great interest has been manifest. A great majority are enthusiastic. During the noon and recess hour there is a throng at my desk seeking admission to the glass.

In the higher grades, I use the glass mostly for technical purposes. In the lower grades, the main purpose is to please, but even here I find appreciation. It is amusing to see the primary children crowd round the table, exultant with joy, when the glass goes to their room. I believe that there is more disciplining power in the Microscope than in iron-clad rules or rods. Bring the Microscope into a room where all is confusion, and instantly the scene is changed."

* Microscope, i. (1893) pp. 39–40. From 'The Naturalist Teacher.'

β. Technique.*

(1) Collecting Objects, including Culture Processes.

Collecting Mollusca.†—Mr. W. H. Dall has put his great experience at the service of his fellow-workers in a pamphlet entitled 'Instructions for Collecting Mollusks, and other useful hints for the Conchologist.' Land-shells, freshwater species, and marine species are considered separately. Our ignorance with regard to the eggs of most marine Mollusca is pointed out, and there is here certainly an interesting field for study and observation. The hints on the use of the dredging apparatus and the tow-net will, no doubt, be useful to naturalists at large.

Collecting and Preserving Insects.‡—Dr. C. V. Riley has published a very full handbook of this subject. Not only are general methods of collecting described, but special hints are given for each large group. The chief drawbacks to the use of alcohol as a preservative agent appear to be that all hairy specimens are liable to spoil in it, and that Coleoptera with soft integuments, if kept too long in it, spread the wing-cases apart. Under the head of entomotaxy is considered the preparation of insects for the cabinet. After dealing with various other subjects, including Museum pests, insect boxes, and economic displays, directions are given for rearing, packing, and transmitting insects. There are a few hints for the collectors of Arachnids and Myriopoda, and some bibliographical hints conclude a work which should be widely useful.

Examining for Influenza Bacilli.§—Dr. E. Klein records some observations on the influenza bacillus, made in December 1889 and January 1891. The blood was examined on cover-glass films, and in cultivations on gelatin and agar. The blood films were stained with rubin and methyl-blue anilin water. In one out of six cases examined, a few minute bacilli resembling those described by Pfeiffer and Canon were found. The remaining five, as well as the blood-cultivations, were negative.

Microscopical examination of the bronchial sputum showed minute thin bacilli, about the thickness of the bacilli of mouse-septicæmia, half their length, and most exhibiting the characteristic polar staining. Cultivations from the sputum were made by inoculating a few ccm. of salt solution with a particle of sputum, and shaking the mixture in a test-tube. From this, gelatin-agar and broth tube-cultivations were made. In some of the broth tubes incubated at 37°, there appeared in from 24–48 hours glassy, fluffy masses at the bottom of the fluid, the supernatant broth remaining quite clear. In the agar tubes there were a few translucent colonies looking like droplets of water, and some other opaque white colonies. In the gelatin tubes there were only white liquefying colonies.

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

† Bull. U.S. Nat. Mus., No. 39, part G. Washington, 1892, 56 pp.

‡ Bull. U.S. Nat. Mus., No. 39, part F. Washington, 1892, 147 pp. and 1 pl.

§ Brit. Med. Journ., 1892, No. 1621, pp. 170–1.

Subcultures from the fluffy glassy growth at the bottom of the broth cultivations were made on agar-gelatin and on broth. On agar at 37° developed circular small translucent droplets, having no tendency to become confluent. In the broth subcultures at 37° glassy fluffy masses developed at the bottom of the tubes, the supernatant fluid remaining quite clear. The gelatin tubes incubated at 20° failed. Cover-glass specimens of the broth cultures stained with rubin (2 per cent. watery solution), methyl-blue-anilin water, and in gentian-violet-anilin water, showed the growth to be made up of strings and filaments; the filaments were composed of short, thin rods, most of which had a granule at each end. The growth in agar also showed filaments, but also many groups of minute bacilli resembling those found in the sputum.

Method of Examining Saliva for Pathogenic Organisms.*—Dr. W. D. Miller finds that, owing to the large number and different sorts of micro-organisms infesting the mouth, it is almost impossible to arrive at any conclusion regarding the presence or absence of any particular kind by a simple microscopical examination. Agar-cultures also often fail, first, because many pathogenic mouth bacteria do not grow on this culture medium; or, secondly, they grow so slowly that they are soon overgrown and hidden by the more proliferous oral saprophytes. Gelatin is still less adapted to the purpose. Pathogenic organisms must therefore be isolated through the medium of an animal body.

The person whose saliva is to be examined should be instructed to rub the tongue against the cheeks and gums, so as to make the saliva mix with the dead epithelium and other deposits. One or two drops thus obtained were injected into the abdominal cavity of a white mouse. When the mouse died within five days the cause of death was found to be acute peritonitis, or blood poisoning, or a combination of both; if later, death was nearly always due to the local suppuration processes. Thus, from these experiments the author (111 mice were injected) was able to divide the pathogenic mouth bacteria into two classes, and he also found that injections made with the blood or peritoneal exudations of the dead mice produced the same results as injections with saliva.

Preparing the Antitoxic Serum of Tetanus.†—MM. E. Roux and L. Vaillard, in a contribution to the study of tetanus, in which they deal with the prevention and treatment of this disease, state their method of obtaining an antitoxic serum.

They use tetanus cultures in peptonized bouillon about four or five weeks old; these cultures, filtered through unglazed porcelain, furnish a clear liquid. This liquid is the author's tetanotoxin in a condition of extreme activity, as 1/4000 ccm. kills a mouse. This toxin mixed with a solution of iodine loses in great measure its harmful properties, and forms the vaccinal fluid, which is in no way caustic.

The serum is obtained from a rabbit (say of 2½ kilo. weight). On the first day the animal is injected subcutaneously with a mixture of 3 ccm. of toxin and 1 ccm. of Gram's iodine solution. On the fifth day, 5 ccm. of toxin and 2 cc. of Gram's solution. On the ninth day, 12 ccm. of toxin and 3 ccm. of the iodide solution. Eight days after the third

* Trans. Seventh Internat. Congress Hygiene, ii. (1892) p. 46.
† Ann. Inst. Pasteur, vii. (1893) pp. 72-7.

injection the animal gives a serum which will neutralize its own volume of toxin.

The serum is preserved by drying it in vacuo and diluting it with six times its weight of distilled water when required for use.

Concentrated Must as a Nutrient Material for Fungi.*—Prof. J. Wortmann recommends the use of a specially prepared must, from ripe grapes, as a nutrient material for fungus-cultures. It has the advantage of presenting all the nutrient substances in a convenient form for assimilation.

Sterilizing Power of Porcelain Filters.†—Dr. P. Miquel compares the sterilizing power of four different kinds of unglazed porcelain filters; the names are not given, the author's object being to show that the results, good or bad, are closely connected with the construction of the filters. However good any particular system may be, the filtering power is only of comparatively short duration, and this is associated with the kind of water that is filtered and the difference in the bacteria. The author quotes some interesting facts; the typhoid bacillus does not pass through the filter under ordinary circumstances, as may be shown by immersing the filter in clear broth. At any rate the bouillon remains quite clear. But if some few drops of water from La Vanne be added to the culture, the typhoid bacteria will pass in a few days. The cholera vibrio passes in four days. Anthrax behaves like enteric. Large organisms such as Saccharomycetes never pass.

The author praises the Chamberland filter highly, though he admits that it has defects: but contends that these will eventually be remedied, possibly altogether.

Cultivating Lower Algæ in Nutrient Gelatin.‡—M. W. Beyerinck reports on the cultivation experiments he has made during the past three years with the lower algæ. *Scenedesmus acutus* was the only species which exhibited very marked loss of vitality. The others were more resistant, and though their growth was slow, the cultivations were successful. Of these there were five, and though the number seems small, yet, from morphological considerations, they are important, inasmuch as they represented the three chief forms of cell proliferation in algæ; that is to say, simple division in one direction in *Stichococcus*, sporangial division in *Chlorella*, and vegetative division and swarm-spore-formation in *Chlorosphæra* and *Chlorococcum*.

Dachnewski, P. N.—**Eine vergleichende Untersuchung der Chamberland-Pasteur'schen und Berkefeld'schen Filter.** (A Comparative Examination of the Chamberland-Pasteur and Berkefeld Filters.)
Wratsch, 1893, pp. 543–5 [Russian].

Lacour-Eymard—**Expériences sur le filtre Chamberland.** (Experiments with the Chamberland Filter.) *Rev. d. Hygiene*, 1893, pp. 486–500.

Migula, W.—**An Introduction to Practical Bacteriology.** Translated by M. Campbell and edited by H. J. Campbell. London, 8vo, 1893, 234 pp.

Pfeifer, V.—**Eine leicht sterilisierbare Aspirationsspritze zum Zwecke bakteriologischer Untersuchungen am Krankenbette.** (An easily sterilizable Injection Syringe for Bacteriological Investigations by the bedside.)
Wien. Klin. Wochenschr., 1893, pp. 293–4.

* Bot. Ztg., li. (1893) 2te Abtheil., pp. 177–84.
† Ann. de Microgr., 1893, pp. 138–44.
‡ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 368–73.

(2) Preparing Objects.

Mode of Studying Gills of Lamellibranchs.*— Dr. F. Janssens used injections of gelatin, gum arabic, and especially nitrate of silver in order to study the blood-cavities of the gills of Lamellibranchs. Immediately after injecting a 1 or 2 per cent. solution of osmic acid distilled water must be introduced by the same means, and then another solution of nitrate of silver of half the strength. It is best to wash with water and not to expose the organ to the light until it has been put in 70 per cent. alcohol.

Teasing was found to be of much use for the study of the epithelium; a solution containing a third part of alcohol, the boric and salicylic acids employed with so much success by Engelmann, and very weak osmic acid acting for two hours all gave very interesting preparations. Maceration in strong carbonate of potash in the oven at 70° for several days was very useful in the study of the skeletal part of the gill.

Gilson's was found to be the best fixing method. Staining the sections is strongly recommended; one point is that one is able to make use of various new staining reagents used in the industrial manufacture of wools; a number were tried, and one—the blue carmine (breveté N., Meister, Lucius, & Brüning, Höchst a/M) is strongly recommended. Since the author used it it has been introduced into the laboratory at Louvain, and it has been shown that it has a special predilection for those parts of the protoplasm which undergo cuticular differentiation. It has the advantage of being a solution that can be employed in alcoholic solution; it does not stain the collodion employed to fix the sections, if one is careful to wash in alcohol after staining. It is as well to add two or three drops of hydrochloric acid to every hundred ccm. of the reagent.

Preparation of Early Stages of Distichopora violacea.†—Dr. S. J. Hickson, who has tried many stains and combinations of stains, finds that the best treatment is to place the sections of *D. violacea*, when fastened to the slide, in a strong solution of eosin in 90 per cent. spirit for an hour, then to wash in 90 per cent. spirit, and stain in weak hæmatoxylin for twenty minutes. This treatment gives a beautiful double stain, which shows the nuclei and the chromatin granules better than any preparations treated with carmine.

Examination of Protozoa in Cancerous Tumours.‡—Messrs. M. A. Ruffer and H. J. Plimmer, who have confined their investigations to carcinoma of the breast, report that, for fixing purposes, they have entirely given up alcohol alone, as the results are very uncertain. Osmic acid (1 per cent.) and Foà's solution—equal parts of salinated solution of corrosive sublimate in ·75 per cent. salt solution, and of 5 per cent. solution of potassium bichromate—gave excellent results. The osmic acid preparations, stained with eosin and hæmatoxylin, were extremely instructive; those fixed with Foà's solution stained fairly well with Biondi's reagent, or with eosin and anilin-blue. Striking results have been obtained by using for fixation purposes the solution of chromic

* La Cellule, ix. (1893) pp. 8–10.
† Quart. Journ. Micr. Sci., xxxv. (1893) p. 129.
‡ Journ. of Pathol. and Bacteriol., i. (1893) pp. 397 and 9.

acid and spirit recommended by Dr. Klein for the study of karyokinetic figures. The most likely place to find the parasites is in a section passing through or near the growing edge of the cancer; indeed, care must be taken that the parts selected be really from the growing edge.

Taylor's Freezing Attachment to Microscopes.*—Dr. T. Taylor gives the following description of his apparatus:—

"This device, which I have prepared for use with the Microscope, is the result of a long experienced want of some method of crystallizing the various oils and their acids, so as to obtain microphotographic views of their respective crystalline arrangement, a knowledge of which is important in microscopic investigations relating to adulteration of food, and other oils. Another advantage offered by this invention is, that by this method objects in natural history mounted in varnish or other media may be thrown on a screen and photographed. In the use of sunlight or Drummond light the liquid soon reaches 212° Fahr., and thus renders a valuable mount useless."

Fig. 103.

The freezing-box (fig. 103) is made of brass or of German silver, and is attached to the stage of the Microscope by means of two clamps; *a a'* represent tubes, one of which supplies the freezing solution and the other carries it off. A pail to receive the waste liquid is in readiness, and is connected in the usual way by means of rubber tubing. *c* is an opening through the centre of the box to admit of the transmission of rays of light to the object under investigation. The freezing liquid may be used repeatedly, or until it ceases to be cold enough for the purpose. Any of the usual freezing liquids, or ammonia, gas, or ether may be used. The tube which carries off the liquid from the freezing-box should terminate in a small orifice, to prevent unnecessary waste. The box is provided with an air-escape, to facilitate the operation of filling the box with freezing liquid. When this is accomplished, plug the opening and secure the box in position. In using ether, remove the plug to allow the ether to escape, or insert a tube to convey it to a separate vessel, where it may be condensed."

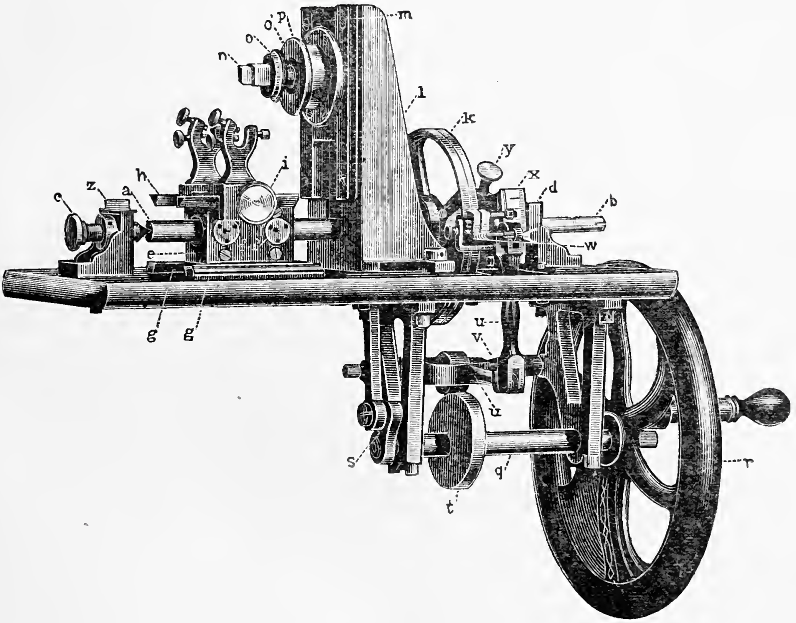
(3) Cutting, including Imbedding and Microtomes.

Reinhold-Giltay Microtome.†—Dr. J. W. Moll describes the microtome designed and constructed by Herr H. Reinhold of Amsterdam in collaboration with Herr J. W. Giltay of Delft. The main axis of the instrument *a b* (fig. 104) is supported on the left against the conical end of the screw *c*, and on the right by the metal block *d*, in which it rotates.

* St. Louis Med. and Surg. Journ., xiv. (1893) pp. 162–3 (2 figs.).
† Zeitschr. f. wiss. Mikr., ix. (1893) pp. 445–65.

That part of it which passes through the block *e*, carries the micrometer screw. The block *e* contains the nut in which the screw engages, and is therefore moved forward at each revolution of the axis. The nut is made up of three strips, two of which are fixed, while the third (in the figure facing the observer) is adjustable by the screws *f f*, so that the whole can be tightened up when the micrometer screw becomes worn after long use. The block *e* slides on two rails *g g* screwed to the base-plate of the instrument. It carries above a plate *h*, on which the knife-holder is fastened by the screw *i*. The knife can be

Fig. 104.



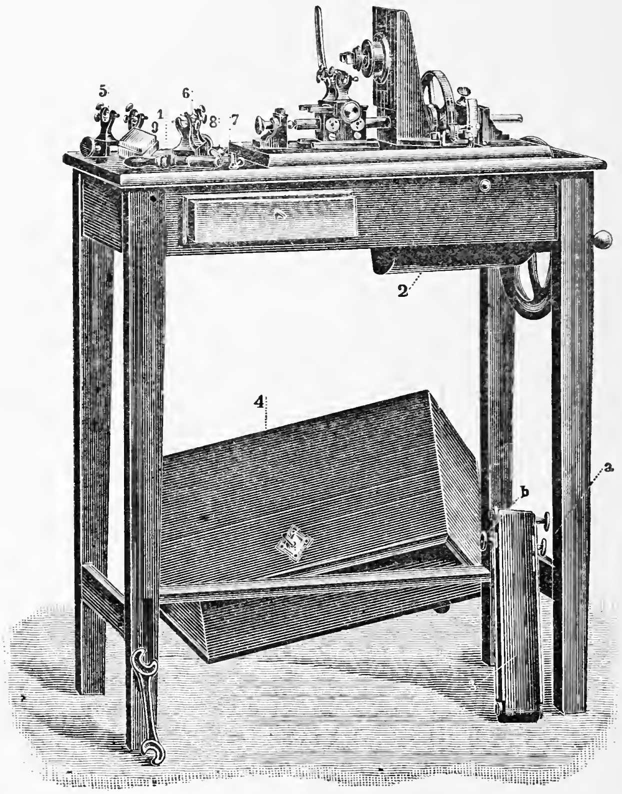
adjusted to any inclination desired by means of the three screws on the holder.

The toothed-wheel *k*, fixed to the axis on the right, has 500 teeth, and the pitch of the micrometer screw is 0·5 mm., so that by a turn of one tooth the knife is advanced 1 micron.

The plate *m* to which the object-holder is attached by a ball-and-socket joint slides in swallow-tail grooves in the vertical holder *l*. The clamping ring *p* of the ball-and-socket joint is not in direct contact with the ball, but acts upon a second ring between the two, which is only movable in the horizontal direction, so that a horizontal pressure is alone produced and the adjustment of the object is not altered on clamping up.

The movements of the various parts are effected in the following way. The axis *q* beneath the instrument is turned by the handle of the flywheel *r*. On this axis to the left is the crank *s* by which the up and down movement of the slide *m* with the paraffin block is produced. On the same axis more to the right is the excentric disc *t*, the rotation of which effects the movement of the toothed-wheel *k*. By means of the rods *u u* and the axle *v*, the piece *w* is moved by each rotation once up and down. By the pressure of a spiral spring the two pawls attached to *w* engage in the teeth of the wheel *k* on the ascending movement, but

Fig. 105.



glide over them, since they are pointed obliquely downwards, in sinking. The left pawl can be slightly raised by a screw and thus put out of action. Both pawls are regulated by the segment x which is adjusted on the main axis by the screw y. It allows of a displacement of the knife up to 40 microns. The capability of adjustment of the left pawl enables displacements of 1/2, $1\frac{1}{2}$, $2\frac{1}{2}$, &c., microns to be made. Thus by making the left pawl shorter by half a tooth and adjusting the right pawl by the segment x to half a tooth, the two pawls will act alternately in raising the wheel by half a tooth.

The length of the micrometer-screw on the main axis is 3 cm.

When this has been worked through, the screw can be drawn back by the handle shown at 1 in fig. 105.

The special table required for the microtome is seen in fig. 105. The lower mechanism is enclosed in a metal cover 2. At 3 is shown a band which can be attached to the screw *z* in fig. 104, and then stretched out above the table to the left, where it is adjusted near to the knife by the screws *a* and *b* (3 in fig. 105). At 4 is seen a wooden cover for the upper part of the instrument. At 5 and 6 are two smaller knife-holders, with corresponding object-holders at 8 or 9. At 7 are the small screw-heads which serve to adjust the screws *ff* in fig. 104.

The chief advantages offered by the instrument are as follows:—

(1) The very great stability of all its parts.

(2) Sections as large as 4 × 4 cm. can be easily prepared with it.

(3) The limits of the cutting thickness lies between 0·5 and 40 microns and 80 different thicknesses of section can be obtained.

(4) The movement of the knife begins in all cases when the paraffin block is raised above it, and ends before the knife again begins to cut.

(5) The length of the paraffin block can amount to 7 cm. and even more if necessary.

(6) The paraffin block is freely movable in all directions and can be fixed in any position without altering the adjustment.

With respect to the use of the instrument in preparing series of paraffin sections the author discusses the difficulties commonly met with. Of these the two most serious are—

(1) The pressing together of the sections.

(2) The slitting of the band along its length.

The first difficulty was found to increase regularly with the angle between the faces forming the edge of the knife.

The kind of grinding powder employed in sharpening the knife has great influence on the behaviour of the edge. The author divides such powders into two categories distinguished as "sharp" and "polishing."

Emery is a type of a "sharp" powder. Sharpened with this the edge shows beneath the Microscope a number of sharp notches, and the fault of tearing the sections is very marked with such a knife for sections thicker than 5 μ. On the other hand there is very little pressing together of the sections even with the thinnest. Vienna lime can be taken as a type of a polishing powder. With this the knife shows under the Microscope a straight edge almost without notches. With such a blade no tearing of the band is to be feared, and the pressing together of the sections is unimportant for sections thicker than 5 μ, so that it can be recommended for all ordinary work.

For very thin sections then, some sharpening material intermediate in properties between the two preceding is necessary.

The author's experiments with various materials have led him to the choice of the three following:—

(1) Oxide of iron prepared by igniting the oxalate which has been precipitated from a hot solution of ammonium oxalate by ferrous sulphate.

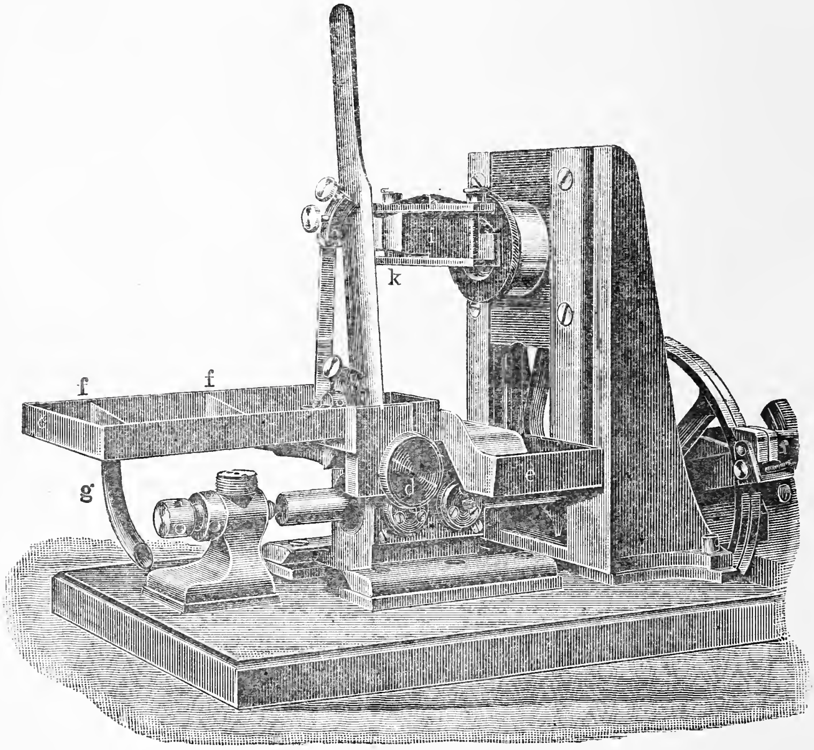
(2) Oxide of iron obtained by igniting the double sulphate of iron and ammonium.

(3) Diamantine No. 1, the composition of which is unknown to the author.

Treatment of a knife-blade which has first been sharpened by Vienna lime with either of these powders for a few moments suffices to give to the edge the extremely small notches necessary in order to prevent the pressing together of the sections.

For the preparation of celloidin sections a very obliquely set knife, which must be kept moistened with alcohol, is required. For this purpose, therefore, the form of the knife-holder and object-holder are modified as shown in fig. 106. The knife-blade is clamped above and

Fig. 106.



below. The upper clamp *a* is carried by a vertical rod, the under *b* is attached to the base of the flat reservoir *c*, and is adjustable in the horizontal direction. Both clamps are provided with screws by which the inclination of the knife can be regulated.

The knife-holder (fig. 106) is fastened to the microtome by the screw *d*. Beside the reservoir *c* there is a second one *e* more to the right, which serves to protect the instrument from the alcohol which is allowed to drop upon object and knife during the cutting.

The reservoir *e* in which the sections are collected is at first filled with alcohol, which is kept at a constant level by means of the exit tube *g*.

The object-holder *h* allows of the object being shifted horizontally. It consists of two metal plates, the upper one of which is movable in the vertical direction and can be fixed by two screws. Between these plates, therefore, the wooden block *i* on which the celloidin block is fastened can be adjusted in the horizontal direction and fixed.

With an inclination of the knife-edge to the horizontal of 60° which is sufficient for sections 50 μ thick, the size of the sections can with this instrument amount to $2 \cdot 5 \times 2 \cdot 5$ cm.; but for thinner sections of 15 to 10 μ the inclination of the knife must be increased to 80°, and in this case the maximum size of the sections is only $1 \times 2 \cdot 5$ cm.

(4) Staining and Injecting.

Nature of the Staining Process.*—Herr G. Spohn has attempted to solve the question whether the colouring of cellulose-fibres by staining reagents depends on a chemical or on a mechanical combination. Microscopical examination of cotton-wool stained by mineral pigments showed no change whatever in the structure of the fibre itself. Even when the fibres were macerated before staining with alizarin, they acted simply as a carrier of the pigment, on which the macerating fluid acts chemically. In all cases the combination of the fibre and the pigment depends entirely on mechanical causes.

New Process of Double-staining Vegetable Membranes.†—M. C. Roulet describes a method of double-staining by the successive use of cyanin and Congo-red. The sections are first decolorized by eau-de-Javelle, and then left for a quarter of an hour in a concentrated alcoholic solution of cyanin, then washed with absolute alcohol, and placed for a quarter of an hour in a 5 per cent. ammoniacal solution of Congo-red. After washing in alcohol, and mounting in xylol-Canada-balsam, the sections present a magnificent double staining, the lignified membranes are coloured an intense blue, the cellulose-membranes rose-coloured or red.

Staining living Sex-cells.‡—Dr. M. Waldner, having observed that the spermatozoids of *Marchantia* survived staining with a weak solution of eosin-red, treated the spermatozoa of the trout in the same way. They took on the stain, remained active for fifteen minutes, and were able to fertilize ova. The egg-membrane resisted the stain, so that ova similarly treated remained colourless.

Demonstrating Malaria Parasites.§—M. A. Laveran spreads thin layers of blood on cover-glasses after the manner in which a layer of sputum is obtained. The blood-films are then dried in the air, and afterwards passed thrice through the flame of a spirit-lamp. The preparations are then mounted as they are, that is in air or dry, and the edge of the cover-glass just ringed round with paraffin to keep out dust and moisture. The films may be stained with an aqueous solution of methylen-blue for 30 seconds. After this they were washed rapidly in distilled water, dried, and mounted dry. The parasites are stained, but much paler than the nuclei of the leucocytes; the red corpuscles are unaffected.

* Dingler's Polytechnisch. Journ., cclxxxvii. (1893) Heft 9. See Bot. Centralbl., liv. (1893) p. 293.
† Arch. Sci. Phys. et Nat., xxix. (1893) p. 100.
‡ Anat. Anzeig., viii. (1893) pp. 564–5.
§ Trans. Seventh Internat. Congress Hygiene, ii. (1892) pp. 12–13.

The preparations may be contrast stained with eosin in aqueous solution. In this case the cover-glasses are first stained with eosin and afterwards with methylen-blue, and finally mounted dry or in balsam. The eosin stains the red corpuscles pink, the parasites are pale-blue, and the nuclei of the leucocytes dark blue. Besides methylen-blue the author also used gentian-violet and dahlia, but the results were not so happy.

Preparing and Staining Blood-films for Examination of Leucocytes.*—The method adopted by Mdlle. C. Everard, MM. J. Demoor and J. Massart for examining the condition of the blood, and especially the modification of the leucocytes therein, was as follows:—The blood was obtained by puncturing a small superficial vein of the animal's ear. Very thin films were then spread on cover-glasses and fixed with heat. The cover-glasses were then laid on a metal plate and heated for an hour at 65°–70°. Such preparations, which would keep quite a long time, were stained by immersing them for 5–10 minutes in a mixture of equal parts of the following liquids:—(1) Eosin 1 grm., alcohol 25 grm., water 75 grm., glycerin 50 grm.; (2) Hæmatoxylin 1 grm., alcohol 10 grm., alum 20 grm., water 200 grm. The alum is dissolved by aid of heat in the water, and the solution filtered when cold. Twenty-four hours after, the alum solution is added to the alcoholic solution of hæmatoxylin, and the mixture filtered after standing for eight days.

The stained preparation, having been carefully washed in water, is passed through 90 per cent. alcohol, absolute alcohol, oil of cloves, and mounted in balsam. By this method the nuclei are stained by the hæmatoxylin, while the eosin colours the "protoplasmic granulations." The authors also employed orange, acid fuchsin, and methyl-green, but found that the first method was by far the most effective.

Mode of Investigating Retina of Vertebrates.†—Prof. S. Ramon y Cajal finds that the most satisfactory method of studying the retina is the rapid method with chromate of silver, already used by Tartuferi. As a general rule, he has employed methylen-blue to control the facts revealed by the method of Golgi; it can, also, give, as Dogiel has shown, very brilliant and quite new results. At the same time it is to be noted that methylen-blue does not stain either the fibres of the rods and cones or their lower swellings; nor does it impregnate the fibres of Müller, the centrifugal nervous prolongations, or several varieties of ganglionic cells or spongioblasts. The transparency is imperfect when the retina is fixed with picrate of ammonia, or the mixture of this reagent and osmic acid which is recommended by Dogiel. The only departures from Dogiel's method of applying methylen-blue are that the retina is stained *in situ*, and that the fixing reagent is allowed to act only for two instead of for twenty-four hours.

Apáthy's preservative fluid—a syrupy solution of gum arabic and sugar, has been found satisfactory. The valuable rapid method of Golgi does not always act in the same way on the small retinæ of Fishes, Batrachians or Reptiles; in fact, the more delicate the retina, the more difficult is it to impregnate it well. For example, more satisfactory preparations are obtained with the eyes of *Lacerta viridis* than of *L. agilis*. For small eyes a method of double impregnation is recommended: the

* Ann. Inst. Pasteur, vii. (1893) pp. 166–7.
† La Cellule, ix. (1893) pp. 126–31.

hinder hemisphere of the eye, after removal of the vitreous humour, is immersed in the ordinary osmio-bichromic mixture (bichromate of potash 3 per cent., 20 parts; 1 per cent. solution of osmic acid, 5 or 6 parts). After being for one or two days in the mixture, the mass of liquid is drawn off from the parts, which are then put for twenty-four hours in a 0·75 or 1 per cent. solution of crystallized nitrate of silver. Without any washing the parts are returned to the osmio-bichromic mixture, care being taken that there is proportionately too much osmic acid. For a day at least the parts are again placed in the silver solution. For a few minutes they are then put into 40 per cent. alcohol, loosely imbedded in paraffin and cut into thick slices. After an hour's washing with alcohol they are cleared and mounted.

(5) Mounting, including Slides, Preservative Fluids, &c.

Gum Thus.*—Dr. A. M. Edwards writes:—"I had supposed that Gum Thus was procurable in England as well as in the United States; but it is not, as I learn from an inquiry in your December number. It is Gum Thus or Frankincense, and is got here from the tree of the pine. I procured it from the L. R. Barnard Chemical Company, dealers in dye-stuffs, chemicals, acids, oils, &c., at 58, Market Street, Newark, N.Y., U.S.A. I dissolve in commercial alcohol, with moderate heat, and then pour it off from the sediment. To this, three parts, I add one part of oil of cinnamon. It is used like Canada balsam, but dissolves in weak ammonia, alkali, carbonate of ammonia, soda or potash or borax. These can be used to clean the slides from superabundant medium. Those who have tried it, speak in flattering terms of it. It is of a high refractive index, makes diatoms come out well with an ordinary one-fifth, and resolves the *Amphipleura pellucida* with a 1/12 immersion. The colour, lightish-brown, is in the way, but I will bleach it by-and-by. Chlorine does not bleach it well. Try it, is all I say."

Pneumatic Bubble-remover.†—Mr. A. P. Weaver writes as follows:—"Being annoyed with air-bubbles in my mounts, I have made a simple air-pump for removing them, as follows:—Take a small rubber syringe, the packing on the cylinder of which ought to be adjustable so as to fit the body of the syringe rather tightly; cut off the nozzle rather close to the body, and bore a hole 3 mm. in diameter near the top of the latter, so that the packing will always be below the hole. Cut from an old rubber boot two washers 2 5 cm. in diameter, and with a central aperture of 2 cm.; cement these washers together with Red Cross cement (such as is used for mending punctures in pneumatic bicycle tyres); cut from the boot two more washers of the same outside diameter and with a central hole a little wider than the nozzle of the syringe; cement these last two washers together also, and cement them to the first two prepared; you will now have a shallow chamber a little larger than the cover-glass. Force the nozzle of the syringe through the opening in the two plates and firmly cement it there. All these joints must be air-tight.

To use the instrument, place the slide on a smooth surface, wet the under surface of the rubber washers and apply the same to the slide

* Science Gossip, 1893, p. 68. † Amer. Mon. Micr. Journ., xiv. (1893) p. 126.

with the cover-glass in the shallow chamber. To make a good air-tight contact with the slide, grasp the syringe with the left hand and allow the lower side of the latter to hold the washers firmly to the slide. The hole drilled in the syringe is to act as a trap or valve, and is to be tightly covered with the first finger of the left hand (keeping the latter in position, grasping the syringe and holding the washers to the slide) at each downward stroke of the piston, and uncovered at each upward stroke. This is, of course, done to prevent the entrance of air to the vacuum chamber beneath after it has once been exhausted. I have found that three or four strokes are sufficient to bring all the bubbles to the surface of the mounting fluid and cause them to burst."

New Fixing Fluid for Animal Tissues.*—Dr. G. Mann has obtained good results (minimum shrinkage, distinctness of cell-outline, admirable fixing of cell-plasma and nuclei) by using the following mixture:—Absolute alcohol, 100 ccm.; picric acid, 4 grm.; corrosive sublimate, 15 grm.; tannic acid, 6–8 grm.

In order to obtain good results it is essential to use only living tissue; to have thin pieces (·5–1 cm.); to have an amount of fluid twenty times the bulk of the tissue; to go through an elaborate series of washing and alcohol transferences; to add chloroform very gradually; to saturate the chloroform gradually with solid paraffin, first at the ordinary temperature, then at 25° C., and lastly at 52° C., keeping the bottle well stoppered; to allow the chloroform to evaporate gradually, avoiding accelerating devices which cause shrinkage, and so on. For minuter details of a method which has certainly yielded good results reference should be made to the original paper.

(6) Miscellaneous.

Apparatus for Observing Movements in Plants.†—Dr. F. Noll describes a modification of the stroboscope (zoëtrope), by means of which the movements of a seedling plant which elevates itself by means of geotropism can be demonstrated, and exhibited in the lecture-room. The instrument may also be applied to the observation of the movements of tendrils, the periodical movements of foliar organs, &c.

Determination of Diastase in Leaves and Stems.‡—M. St. Jentys explains the failure of Wortmann to find diastase in the aqueous extract of leaves and stems on the following grounds:—It is probable that the diastase is formed only in small quantities, as it is required for the conversion of starch into sugar. The presence of tannin in the aqueous extract causes the precipitation of the starch, which is then only with great difficulty acted upon by diastase; it also precipitates the diastase itself. Finally, diastase possesses only a very feeble power of diffusion; and therefore, when contained within cells, passes into the solution only after the complete destruction of the cell-walls, and in company with the tannins which then precipitate it.

* Anat. Anzeig., viii. (1893) pp. 441–3.
† Verhandl. Naturh. Ver. Preuss. Rheinland, xlix. (1892) pp. 37–41.
‡ Verhandl. Akad. Wiss. Krakau, xxiv. (1893) 47 pp. See Bot. Centralbl., liv. (1893) p. 193.

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

F. JEFFREY BELL, M.A.,

One of the Secretaries of the Society
and Professor of Comparative Anatomy and Zoology in King's College;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

A. W. BENNETT, M.A., B.Sc., F.L.S.,
Lecturer on Botany at St. Thomas's Hospital,
R. G. HEBB, M.A., M.D. (*Cantab.*), AND

J. ARTHUR THOMSON, M.A.,
Lecturer on Zoology in the School of Medicine, Edinburgh,

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JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

DECEMBER 1893.

TRANSACTIONS OF THE SOCIETY.

XIII.—*Remarks on some Progressive Phases of Spirillum volutans.*

By R. L. Maddox, M.D., Hon. F.R.M.S., &c.

(*Read 18th October*, 1893.)

Plate X.

An opportunity lately offered of examining *Spirillum volutans*, as found in decomposing blood and garbage from the pit or well of a slaughter-house, and some of the appearances of this organism, along with others, were recorded and illustrated by figures from photomicrographs in the pages of a contemporary, 'The International Journal of Microscopy and Natural Science' for July.

But a close examination of one of the slides which had been retained for later study has proved so interesting that I venture to hope a few remarks may not be unsuited to the pages of this Journal. The period at which the mount was made was apparently that of segmentation and swarming, or the formation of colonies. Before stating the details, as it will be necessary to refer often to the accompanying figures, it may be as well to state the conditions under which they have been made. Firstly, photomicrographs were taken of the different organisms which were deemed to carry through or to cover

---

EXPLANATION OF PLATE X.

No. 1, fig. *a*, *b*, and No. 2 b^2, young *Spirillum volutans*.
„ „ *c*, a single segment becoming notched.
„ „ d, d^1, d^2, d^3, and No. 2, d, d^1, d^2, the ends or tips progressing towards segmentation.
„ „ *e*, and No. 2 e^1, e^2, segmentation completed, b th with the flagellum attached; e^3, the spore free, lying in a deep semicircular depression; e^4, still adherent.
„ „ *f*, a long filament with nuclear or spore-like formations in the central part, and near to it a smaller one, or double comma with similar changes, and a few scattered spores in the same field.
„ „ *g*, the tips of irregular shape, one with the flagellum attached and nearly segmented.
No. 3.—Photomicrograph of a group or colony, the ends of some of the commas or joints being segmented.
„ 4.—A long *Spirillum* filament with three small spirilla from fœtid water, each with marked differentiation in the entire plasm.

some of the progressive stages, up to what was regarded as a device for continuing the species under adverse conditions; but the material, or serous liquid in which the *Spirillum* was found was so unsuited for obtaining satisfactorily sharp figures that I determined, secondly, to try the pencil and camera lucida, using the same objective, a Leitz 1/12 hom. im. and an Abbe achromatic condenser, as more likely to afford a better chance for depicting the appearances. Then two photographic prints were made of the drawings, Nos. 1 and 2; No. 1 containing the same objects as shown in the photomicrographs, whilst No. 2 contains similar objects which were not firstly photographed; therefore they are intended simply as additional evidence of the similarity to those photographed. The drawings were all made at 1000 diameters, the photomicrographs at a somewhat less magnification. In making the photomicrographs the Zeiss projection ocular was used, but the photographic print No. 1, *a*, *c*, *d*, d^1, *f*, was taken at about half the magnification; also in making the drawings of some of the same objects *c*, *d*, d^1 as are in that print they were, for the sake of convenience, transposed. The purport of this double method has been to furnish proof by comparison that my utmost care was given to render the drawings correctly; only they were not always made at exactly the same point of focus as in the photomicrographs, as by slight variation such points as were not quite evident in the latter could be indicated; hence some characteristics may in either case slightly differ.

The period at which the preparation was taken was rather a peculiar one. The organisms appeared mostly in groups or colonies, sometimes surrounding a single or several infusoria, passing through three or more up to colonies of a considerable number, as seen in the photomicrograph marked No. 3, which was scarcely of the medium size; single individuals were somewhat rare, and these, whether consisting of a single joint or comma, or of several in union, were noticed to be either quiescent or motile and provided with flagella; therefore it seems to me we can scarcely consider the changes to which reference will immediately be made as entirely due to degeneration causes.

Taking a single joint with two flagella in the early comma stage or slightly beyond it, as in the figures of No. 1, lettered *a* and *b*, the organism appears as possessed of a homogeneous or very faintly granular plasm, often at the ends showing a bright or dark nuclear spot or spots according to focus, surrounded by a pale halo, and at the body side having a fine dark margin; while, generally, somewhere in the body of the plasm on either side of the centre a bright dark granule or a minute clear spot could be detected. Sometimes a broken line of fine granular matter could be traced through the central length of the organism, as in No. 2 b^2, and at a later stage some could be found where the organism showed one or more bright lines across the width of the body, marking where segmentation would occur, No.

1 d^2. Sometimes several of these lines or spaces could be seen either faintly or strongly indicated, or only as a minute notch formed in one side of the outer membrane. Passing beyond these delicate primary indications the changes become more definite, deep notches formed at the ends and sides; these might be only on one side of the convolution as in the right-hand *Spirillum* No. 2 e^4, or on opposing sides of continuous convolutions, as seen in many of the other figures in both Nos. 1 and 2, the interior plasm becoming more or less cut across, and corresponding to what may be considered a primary minute segmentation or fission stage. Following the changes further, the notch at the extremity, generally one extremity only, would be continued right across the end, as in No. 1 *e*, and No. 2 *e*, and e^1, thus converting the tip into a slightly irregular, as seen in No. 1 *g*, or a more or less round or oval little body, No. 2 e^1, the flagellum often either adhering to it or to the corner of the parent body, or else the notch became deeply semicircular and in the hollow was lodged a small bright circular body, as seen in No. 2 e^3. This I am tempted to regard as spores forming or formed by segmentation. Occasionally when such was slightly removed from that position, a very delicate membrane could be seen enclosing the vacated space.

Sometimes the small nipped-off body would be exactly at the tip, as shown in figs. No. 1 *e* and No. 2 *e*, the one remaining attached, the other separated, but both possessing a flagellum. Now and then, when incompletely segmented, the entire object would form very unusual figures, as in those marked No. 1 d^1, where both spirilla lying close together have undergone the same change at their tips at the same time. The long filaments often showed changes of rather a different character. In the middle of the body slight differentiation could be observed, and running along the centre for the greater portion of the filament minute granulation could be noted, which towards the central part became surrounded by a lighter space with a dark outline, the outer edge of the organism being slightly swollen or curved opposite these nuclear, query, spore formations. This is shown in the figure of the drawing No. 1 *f*, though in the photomicrograph of the same object this is very indistinct, as it was found impossible, from reasons previously stated, to obtain a sharp photograph. In the photomicrograph No. 3 of the colony or group, which it was not thought necessary to pencil, it will be seen that many of the outlying commas have already taken on the nipping process, and some of the tips have actually separated into small round bodies, thus showing that the colony, whatever may be the object of its formation, overtaken by the conditions possibly brought about by the presence of flagellate infusoria, and varieties of bacteria, were passing through the same changes as seen in the single organisms. What would have resulted to the minuter segments as marked off by the numerous notches indicated in many of the various figures I am unable to state, for on the following day I could only find more numerous motile commas, and not a single minute segment, such as would be produced if the deep notches had completed division across the body of the organism without further change. Nor am I able to say whether the nipped-off little bodies grew and took on the same form as the parent, or in the future might be the origin of a pleomorphism not hitherto noted, as far as my knowledge extends.

These minute details have been more particularly dwelt on for the reason that some such changes may perhaps, by constant observation under varied conditions, be shown in the spirillum of Asiatic cholera, or in other spirilla.

Dr. Henri Van Heurck has already pointed out that in the ends of the commas of the cholera bacilli he considered he could, by his objective N.A. 1·6, and by employing its attendant requirements, find a differentiated spot at each end of the comma segment, but naturally he is, when speaking of such a very minute object, cautious not to dogmatize on its nature. Possibly the observations herein recorded may tend to show that we have yet something to learn about the different spirilla.

During the time of my engagement on this subject I was fortunate to find in some water, fœtid from decomposing vegetable and infusorial matter, a spirillum which from the shape of the segments I supposed to be *Spirillum volutans*, knowing it is often found in stagnant pools. Though the water was very clouded and dirty, a photomicrograph was made of one of the long filaments having also three segments in the same field, as shown in the photomicrograph No. 4. There it can be seen that the entire plasm has become differentiated both in the long filament and single segments. All were active when first placed under the Microscope. This photograph was taken with a Gundlach 1/14 (about) water-immersion. The plan adopted to fix the objects has generally been by a saturated solution of tannic acid run under the cover, and the staining by a saturated solution of iron sulphate with 10 grains of citric acid to the ounce of solution—no heat being employed in any stage. Preference was given to this method to differentiate the delicate shadings of the interior plasm over any of the anilin dyes, especially as the resulting tint is a fair one for photographic purposes.

I have been rather puzzled to ascertain how the swarming or resting colonies were formed, so many of the organisms being placed symmetrically, when apparently there was no visible reason for such an arrangement—if not a physical one, as many of the commas were provided with flagella, therefore with the means of motion. This swarming or colonizing period, one of rest, may be one of the necessary conditions for trying to tide over adverse circumstances, if not one of necessity prior to subsequent higher biological changes. Much trouble was taken to try and obtain, at different times, a similar stock from the same slaughter-house, but without success, so that I have been unable to continue these observations, and the basin containing the fœtid water having been put back on the garden-wall, was unfortunately knocked over by some animal, much to my regret.

To resume briefly, the characters are recorded from a stage of apparently simple homogeneous plasm through a few more or less known changes, up to the point, which may be one of novelty, when the organism becomes deeply notched, and the ends segmented into a spore-like body retaining or not the flagellum.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Theories of Heredity.‡—Prof. Waldeyer in his introductory address to the German Anatomical Society critically discussed various theories of heredity, and came to the conclusion that, at present, O. Hertwig's nuclear theory is the best founded, although he cannot convince himself that the influence of protoplasm should be completely excluded.

Energy as a Factor in Organic Evolution.§—Mr. J. A. Ryder is not satisfied with Prof. Cope's term Kinetogeny as referring to the agency of energy in the modification of organisms. He proposes, therefore, as a general term *ergogeny* under which he includes kinetogeny, which refers to the energy of motion, and *statogeny* which refers to the energy of rest or equilibrium. He urges that all Metazoa pass through larval stages in which the statical condition of equilibrium of the plasma of the egg is gradually, in great measure, overridden by the hereditary energies represented by phylogeny and ontogeny. He thinks it cannot be denied that there still remain traces of the effects of kinetogeny and statogeny in the adult organism. As examples of the effects of the statogeny skeletons and egg-shells may be specially cited.

Mechanical Genesis of Form of Fowl's Egg.‖—Mr. J. A. Ryder applies the terminology proposed in the above-cited article to the fowl's egg, the genesis of which he discusses from the point of view of a

* 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, &c., 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, and Reproduction, and allied subjects.

‡ Anat. Anzeig., viii., Ergänz. Heft (1893) pp. 3–11.

§ Proc. Amer. Phil. Soc., xxxi. (1893) pp. 192–203.

‖ Tom. cit., pp. 203–9 (1 fig.).

geometer. As the shell itself is deposited by a process which involves the development of a statical equilibrium, it may be said that the shell has probably been developed statogenetically; as the development of the figure of the egg is in all probability a purely dynamical problem, or one in which energy is applied in a definite manner to the plastic surface of a mass in statical equilibrium within the oviduct, we may say that the figure of the shell has been developed kinetogenetically.

Mr. Ryder is of opinion that the origin of the egg-shell of the eggs of Birds and Reptiles may be traced to physiological causes acting automatically under the control of those instincts or intelligent efforts at self-preservation and protection extended to the young even while still in the form of the outwardly or apparently quiescent condition of the egg. He thinks that a retention of the ova in the oviduct would also distinctly tend to develope the amniote placental and viviparous forms of development, provided the retention of the eggs was from any cause prolonged. It would appear that the lines of demarcation between egg-laying and viviparous Vertebrates are in large measure arbitrary. There are now sufficient data to justify the doctrine that the various types of placentation were developed as the results of direct mechanical and physiological adaptation.

Value of Mimetic Covering in the Struggle for Existence.*—Dr. Seitz thinks that too much stress has been laid on the relation of birds as destroyers of Insects. He has made some experiments with Monkeys, and relates how *Trochilium apiforme* was shunned by *Rhesus* monkeys, while *Cebus robustus* took it. It appeared clear to him that the *Rhesus* monkeys knew wasps, respected their stings and were deceived by the mimicry. In the home of *Cebus robustus* the characteristic *Vespa* with its black and yellow rings is either absent or is very rare, and some of the mimicking Butterflies are like *T. apiforme.*

"Urmund and Spina bifida."†—Dr. M. von Davidoff points out how his own researches ‡ on the development of Ascidians support the conclusions drawn by Hertwig § from observations on abnormal ova of the frog. Hertwig found that in such eggs the edges of the primitive streak formed a "nerve-ring." Dr. M. von Davidoff finds that this condition, which persists throughout life in Actinia, and is abnormal in Amphibians, always appears temporarily in Ascidians. The central nervous system is formed by the apposition of the lips of the "Urmund"; on this observation depends the conclusion of the paired origin of the central nervous system. The conditions in Ascidians also confirm the view supported by Hertwig that the dorsal organs, notochord, nervous system, &c., have all a paired origin, their points of origin having been once separated by the whole width of the blastopore, and being united by the fusion of its lips from before backwards. Further, with regard to the origin of the gastral mesoblast from the earlier peristomial, by the fusion of the lips of the blastopore, von Davidoff shows by means of quotations how closely his own earlier conclusions agree with those of Hertwig. He concludes that these interesting coincidences of

* Zool. Anzeig., xvi. (1893) pp. 331–3.
† Anat. Anzeig., viii. (1893) pp. 397–404.
‡ MT. Zool. Stat. Neapel, ix. (1890) pp. 533–650 (1890).
§ See this Journal (1892) pp. 585–6.

opinion should tend toward the wider acceptation of the whole "Urmund" theory.

Ectodermic Origin of the Cartilages of the Head.*—Miss J. B. Platt gives a preliminary notice of her investigations on this point. She has studied the conditions found in *Necturus*, which, on account of the size of the cells and the differentiation of ectoderm and endoderm produced by differences in the quantity of yolk, is an especially favourable object. She emphasizes the importance of proliferations from the ectoderm in the formation of the rudiments of cartilage, and the consequent difficulty of grouping the tissues collectively known as mesoderm with the two primitive germ-layers.

Development of Nose and Upper Lip.†—Dr. F. Keibel sides with Hochstetter against His in regard to certain facts in the development of these structures. In cat, guinea-pig, pig, and man the nasal cavity is at an early stage a blind sac. At this stage, therefore, there is no groove connecting the primitive mouth-cavity with the primitive nasal cavity. The "Choane" arises secondarily, as Hochstetter has described. The first rudiment of the primitive palate arises from the apposition of the lateral and the median nasal process, and not from the apposition of the latter and the maxillary process. The latter union takes place subsequently in the formation of the upper lip. The author recognizes the importance of the recent work of His on human and animal physiognomy, but, taking a somewhat broader comparative survey, comes to different conclusions on many points.

Mammalian Spermatogenesis.‡—Mr. J. E. S. Moore points out the closeness of the parallel which exists between the spermatogenesis of Echinoderms, as formulated by Field, and a spermatogenetic scheme which he has elaborated for the Mammalia. He finds in the spermatozoa of Mammals—

(1) The chromatic portion of the nucleus enclosed in a transparent case probably composed of paranuclein and linin.

(2) A portion of the spermatid "Nebenkern" derived from the little wart on the nuclear membrane, kytoplasmic in origin. (1) and (2) form the head.

(3) Two centrosomes, which with the head form the cephalic portion.

(4) A further portion of kytoplasm, which forms the tail.

The relations of the parts of an Echinoderm spermatozoon are shown in the next table:—

Nucleus	Head	Cephalic portion.
Centrosome		
"Nebenkern"	"Mittelstück" ..	
Cell-membrane		
Kytoplasm		Tail.

Human Tails.§—Dr. J. J. Pjätnizky discusses "the structure of a human tail and human tails in general." He has gathered together the

* Anat. Anzeig., viii. (1893) pp. 506–9. † Tom. cit., pp. 473–87 (2 pls.).
‡ Tom. cit., pp. 683–8 (4 figs.).
§ Inaug. Diss., 2. verbess. Aufl., Moskau, 8vo, 1893, 89 pp., 2 pls. (Russian); Anat. Anzeig., viii. (1893) pp. 583–4.

literature, and describes in detail a particular case which he was able to investigate. This tail was 7 cm. in length and 2 cm. in circumference; it included no bone nor cartilage, but fibrous tissue, fat, nerves, blood-vessels, and striped muscle.

Placenta of Carnivora.*—M. M. Duval has a somewhat lengthy and detailed account of the placenta of the bitch, which is the first part of his contribution to our knowledge of the placenta of the Carnivora. It contains little matter of general interest, and we must be content to draw attention to its publication.

Development of Bladder and Allantois in Guinea-pig.†—Dr. F. Keibel finds that the cloaca in the embryo guinea-pig is divided on the eighteenth day by two lateral folds into an anterior region, the rudiment of the bladder, and a posterior region into which the rectum opens. By "cloaca" the author means, as he carefully explains, the space which His calls bursa pelvis—the space into which there open in early stages the gut, the Wolffian ducts, and the duct of the allantois, and into which at a later stage the ureters and genital ducts also open through the urinogenital sinus. The depression from the ectoderm which appears in the position of the anal membrane Keibel calls the anal groove; it corresponds to the proctodæum. The nature of the growth which separates the cloaca into two regions is then explained. From the rudiment of the bladder the urachus buds out, and a proper endodermic allantois extends to the placenta and there expands into a small vesicle. Dr. Keibel also maintains that in Mammals and Man the renal bud and the renal duct arise from the archinephric duct.

Development of Teeth in Chamæleon.‡—Dr. C. Röse has investigated by means of serial sections the development of teeth in *Chamæleon vulgaris*. He finds that the teeth are never replaced, although a well-developed supplementary ridge exists. New teeth are, however, formed throughout life behind those already existing. The teeth fuse with the bone of the jaw. The odontoblasts of the fang gradually pass into the osteoblasts of the jaw-bone, and in consequence the dentine passes over into bone by means of an intermediate tissue, which has the tubules of the one and the bone-cells of the other.

While the anterior teeth of the chamæleon are simple cones, the hinder "molars" are three-pointed. As in Mammals, these teeth arise from several papillæ which are closely apposed. Whereas, however, in Mammals the cylindrical cells of the enamel epithelium proper are continuous over all the papillæ, in the Chamæleon each papilla has a separate layer of epithelium. The fusion of the papillæ takes place later; in one case the author succeeded in finding a fully formed tooth in which the two anterior tooth-projections had fused, while the third still stood isolated. These facts support the author's theory that the complicated teeth of Mammals are formed by the fusion of simple teeth.

According to the author's previous investigations, the so-called dental germ and the enamel organ are only a part of the epithelium of the jaw which has sunk in. In most Fishes and Amphibians, and also in

* Journ. Anat. et Physiol., xxix. (1893) pp. 249–340 (3 pls.); pp. 425–65 (2 pls.).
† Anat. Anzeig., viii. (1893) pp. 545–54 (5 figs.).
‡ Tom. cit., pp. 566–77 (8 figs.).

Crocodiles, the first teeth develope from the jaw epithelium exactly like the placoid scales of Selachians. We have seen that the hinder teeth of *Chamæleo* are formed from the fusion of three small teeth. These are not all of the same size, the central one being larger and projecting. If we suppose the epithelium to proliferate further so as to form a rooted tooth instead of one fused to the jaw, we should have a tooth very similar to the molar of *Dromatherium*.

It is of great importance to note that in *Chamæleo* and also in *Hatteria* a well-developed though functionless secondary germ exists. The ancestral forms must therefore have possessed teeth which were vertically replaced. It is the author's belief that both Mammals and Theromorpha arose independently from an older polyphyodont Reptilian stock.

Development of Pancreas in Ophidians.*—M. G. Saint-Remy remarks that, though numerous researches have been made on the development of the pancreas in recent years, no observer has recently studied that of Reptiles. In *Tropidonotus natrix*, at a stage corresponding to the chick of the fifth day, there may be seen the typical two ventral and one dorsal foundations of the organ. The ventral are absolutely isolated from the intestine, and arise from the hepatic duct as a mass of acini on either side; their importance is slight as compared with the dorsal foundation. This, which is very large, communicates with the duodenum by a wide canal. In succeeding stages the three parts fuse into a single ovoid mass. Similar relations are to be seen in the Viper.

Gastrular Raphe of Triton alpestris.†—M. C. Van Bambeke finds that in urodele Batrachians, and especially in *Triton alpestris*, the median or dorsal groove (gastrular raphe), which in certain cases extends from the anterior boundary of the medullary folds as far as the hinder extremity of the primitive groove, is a vestige of this last; it, indeed, is derived from the primitive blastopore or anus of Rusconi a short time after the commencement of gastrulation. It may be admitted, with O. Hertwig, that the median groove of Batrachians represents the line of suture along which the lips of the blastopore become juxtaposed and fused; it is, therefore, comparable to what, in Ascidians, *Amphioxus* and Annelids, Hatschek has called the gastrular raphe. This groove fuses posteriorly with the still persisting part of the primitive groove. If the median really represents the line of suture of the lips of the blastopore we may say that the mesoblast on either side of the groove is a peristomial mesoblast, in Rabl's sense. Like the facts described by O. Hertwig and Davidoff, the phenomena exhibited by urodele Batrachians speak in favour of the theory of concrescence.

Regeneration of Germinal Layers in Amphibia.‡—Herr Barfurth has made some observations on the subject which have convinced him that germinal layers of Amphibia are able to undergo regeneration; there is a re-arrangement and re-differentiation of cells; the regenerative power is greatest in the ectoderm. Mechanical injuries of the gastrula give rise to typical abnormalities and growths of definite structure.

* Comptes Rendus, cxvii. (1893) pp. 405–6.
† Bull. Acad. Roy. Belg., lxiii. (1893) pp. 710–26 (1 pl.).
‡ Anat. Anzeig., viii. Ergänz. Heft (1893) pp. 43–50.

Development of Hepatic Vessels and Blood-corpuscles in Anura.* —Prof. J. Nusbaum finds that the endothelium of the first hepatic capillaries has a double origin:—from those yolk-entoblast cells which form the blood-corpuscles, and from the endothelium of the primitive vitelline veins with which the first hepatic capillaries communicate. But in reality the endothelium of the vitelline veins and of the heart is formed in Amphibia from endoblastic elements. Nusbaum believes that the endodermic origin of the blood-corpuscles is the primitive condition in Vertebrates, and the mesodermic origin a secondary modification.

Development of Scales of Lepidosteus.†—Mr. W. S. Nickerson remarks that from the Selachian type on there has been a constant tendency towards reduction of superficial parts (spines), and increase of the deeper parts which are independent of the epidermis. In Selachians the process of scale-formation begins at the surface of the dermis just beneath the basement membrane. In Ganoids there is the same process as at the base of the epidermis, but in a much less vigorous manner, while the principal activity is in the midst of the dermis. In the higher Teleosteans the whole scale-growth is dermal, and the more superficial process is entirely lost.

The author believes that the ganoin layer of the scale is found only in Ganoid fishes among Vertebrates, and he urges that the only relationship between the scales of *Lepidosteus* and teeth is such as arises from the fact that both are derived from an ancestral condition similar to that found in the scales of Selachians. To-day, each represents only a highly modified part of the early ancestor.

Segmentation in Petromyzon marinus.‡—Mr. C. F. W. McClure finds that the third plane of cleavage is not equatorial, but, as in the Ctenophora, consists of two meridional furrows; he gives a careful account of the observations made to assure himself that this marked divergence from the normal segmentation of Vertebrates occurred with great regularity. And, though he recognizes that it has no morphological significance, he thinks the facts should be recorded.

Development of Nervous Tissue.§—Prof. G. Valenti describes the development of the nerve-cells and neuroglia in cartilaginous fishes—*Mustelus vulgaris*, *Torpedo ocellata*, &c. His results tend to show: (*a*) that the ectodermic elements forming the medullary canal give origin to cells of the neuroglia as well as to nerve-cells; (*b*) that at an early stage embryonic connective elements insinuate themselves, and probably become cells of the neuroglia; (*c*) that insinuated connective cells or leucocytes from the pia mater take part in the formation of the neuroglia of the adult; (*d*) that there are thus two kinds of neuroglia, one of connective origin and of exclusively supporting function, the other of ectodermic origin and probably of more than supporting function.

β. Histology.

White Corpuscles of Mammals.‖—Herr O. Van der Stricht finds, from a careful examination of the various hæmatopoetic and lymphoid

* Biol. Centralbl., xiii. (1893) pp. 356–9.
† Bull. Mus. Comp. Zool., xxiv. (1893) pp. 115–40 (4 pls.).
‡ Zool. Anzeig., xvi. (1893) pp. 367–8; 373–6 (3 figs.).
§ Atti Soc. Toscana Sci. Nat. Pisa, xii. (1893) pp. 75–98 (1 pl.).
‖ Anat. Anzeig., viii. Ergänz. Heft (1893) pp. 81–92 (11 figs.).

organs of Mammals, that it is possible, after previous fixation with Flemming's and Hermann's fluid, and after treatment with acetic acid, to demonstrate a large number of varieties of white corpuscles. If we take the cytoplasm as our guide we may distinguish three types—Lymphocytes, Leucocytes with clear protoplasm, and Leucocytes with compact protoplasm. Of these the second and third each gives rise to four derivates. The second forms phagocytes with clear protoplasm, leucocytes with safranophilous, or with fatty granulations, and megacaryocytes with clear protoplasm. The third gives rise to phagocytes with compact protoplasm (the granulations of which may be cytoplasmic, safranophilous, fatty, or pigmented), the vacuolar leucocytes, megacaryocytes with compact protoplasm, and polycaryocytes. Of each of these varieties the author gives short descriptions.

γ. General.

Hairs and Scales in Mammals.*—Herr M. Weber discusses the question of the origin of hairs, and their relation to scales. He touches upon the wider problem of the homology of scales, feathers, and hairs, but chiefly limits himself to the relation of hairs and scales.

In examining the scales of *Manis*, *Anomalurus*, *Myrmecophaga jubata* and *tamandua*, he found that the method of arrangement differed little from that found in Reptiles, and that, although the scales themselves were always devoid of hairs, these occurred in greater or less abundance behind or between the scales. The number of hairs varied inversely with that of the scales, and the arrangement of the hairs depended on that of the scales.

From these facts Herr Weber concludes that all Mammals had originally a covering of scales like that of Reptiles, and that these primitive scales have persisted, though in a specialized form, in an animal like *Manis*. The presence of scales on the tail only, as in rats and mice, is to be explained by the fact that, while a covering of hair is important for the body as assisting the maintenance of the high temperature, it is a matter of indifference for the tail. Recently, Herr Weber has been able to confirm and extend his theory. It is found that in the vertebrates investigated the hairs are arranged in definite alternating groups. In some cases each group contains only three hairs, but usually many more. This definiteness of arrangement seems to confirm in a most striking way Herr Weber's view that hairs arose while a covering of scales still existed. In cases like that of *Myrmecophaga*, where a few hairs are found between the scales, the arrangement of the hairs is directly related to that of the scales. In Mammals which are quite devoid of scales it is again found that the hairs have a very definite arrangement. According to the author this justifies the view that the definiteness of arrangement was induced by the formerly existing scales.

If this view be correct it leads naturally to the conclusion that the scales of such existing Mammals as possess them are specialized representatives of the primitive scale-covering of the ancestral Mammals. The remainder of the paper is in consequence devoted to the maintenance of this view against Römer's theory that existing Mammals with scales are derived from hairy ancestors, that is, that the scales are secondary.

* Anat. Anzeig., viii. (1893) pp. 413–23.

Bioplastology.*—Prof. A. Hyatt, partly in answer to the criticisms of Messrs. Buckman and Bather,|| describes the four different lines of research which are usually designated by the terms, growth, heredity, acquired characteristics, and the correlations of ontogeny with phylogeny. While acknowledging the justice of Messrs. Buckman and Bather's criticisms of his nomenclature, Prof. Hyatt suggests that Bathmology is a term preferable to Auxology, and points out that the term growth covers decrease in bulk due to development and use, as well as increase. When one passes beyond this one sees that the manifestation of growth-energy arises from two facts—a living organism and the assimilation of nutritive matter.

As the term heredity has been used in two senses—that is as expressing the results of the action of an unknown force which guides the genesis of one organism from another, and also as implying the force itself—it is well to have new terms. The study of the phenomenon may be called Genesiology, the free genetic force and the principle of heredity Genism. Genism is the transmission of likeness from one ontogenic cycle to another of the same species, and appears to be due to the union of two forms of distinct ontogenic cycles of the same species.

The term Ctetology is the term proposed for the study of acquired characters, and the modifications produced through the mediation of internal forces are to be said to be due to entergogenesis, and those due to external forces to ectergogenesis. The separation of Auxology (or Bathmology), Genesiology, and Ctetology shows that the study of the correlations of ontogeny and phylogeny are distinct from these; that branch of research may be designated by the term Bioplastology.

In Ontogeny the following terms are suggested:—

Structural Conditions.	Stages.	Stages.	Substages.
Anaplasis (Haeckel)	Embryonic	Embryonic	Several (no popular names).
	Larval or young	Nepionic	Ananepionic. Metanepionic. Paranepionic.
	Immature or adolescent	Neanic	Ananeanic. Metaneanic. Paraneanic.
Metaplasis (Haeckel)	Mature or adult	Ephebic	Anephebic. Metephebic. Parephebic.
Paraplasis	Senile or old	Gerontic	Anagerontic. Metagerontic. Paragerontic.

In the comparison of ontogenetic and phylogenetic stages the following terminology may be used:—

Ontogeny.		Phylogeny.		
Structural Conditions.	Stages.	Structural Conditions.	Stages.	Dynamical.
Anaplasis	Embryonic, Nepionic, Neanic	Phylanaplasis	Phylembryonic. Phylonepionic. Phyloneanic.	Epacme.
Metaplasis	Ephebic	Phylometaplasis	Phylephebic	Acme.
Paraplasis	Gerontic	Phyloparaplasis	Phylogerontic	Paracme.

* Zool. Anzeig., xvi. (1893) pp. 317–23; 325–31.
† See this Journal, *supra*, p. 157.

The student is warned that those who try to find a complete cycle of metamorphoses in their own special lines of research will often be disappointed, and probably question whether it exists at all.

B. INVERTEBRATA.

Mollusca.

Lingual Cartilages of Mollusca.*— Dr. G. Loisel divides the lingual cartilages of Mollusca into two great groups; in many (Pulmonate Gastropods, certain Nudibranchs, Cephalopoda) they are formed of muscular fibres, among which are connective elements as in other muscles; here, because of the function which the organs have to fulfil, the connective cells almost always become vesicular. In other Mollusca (e.g. *Buccinum*) the lingual cartilages are formed of true cartilage-cells without any admixture of muscular fibres. Intermediate stages will probably be found between these two classes.

The word cartilage ought not to be employed to distinguish the organs that support the radula, and it would be better to speak of supporting pieces. The papilla or formative sheath of the radula may contain connective tissue in a mucous or gelatinous form.

The smooth muscular fibres of Gastropods are formed of two substances; one is fibrillar, and represents the contractile element, the other is granular and protoplasmic; but the topical relations of these are not constant, as is generally asserted. In following the development of a smooth fibre it may be seen that the differentiation of the protoplasm into fibrils goes on from the periphery towards the centre; when the fibre has reached its maximum development the nucleus of the primitive cell seems to have completely disappeared. The smooth muscular fibres found in the supporting pieces of the radula differ from ordinary fibres by their greater breadth, and by the difference in their reaction to staining agents. Transversely striated muscular fibres, similar to those of Insects and Vertebrates, are sometimes found in the lingual muscles. There is very little connective tissue in the muscles of Gastropods; it is most often merely represented by some fine granulations and by nuclei. At a certain stage in their development the muscles of Gastropods have large vesicular cells among their fibres. In many muscles these cells disappear in the adult stage, but when the function of the muscle requires it they may persist: this happens, for example, in the supporting pieces of the radula.

The form of the cartilaginous tissue has a relation to the connective tissue of the same animal; that found in *Buccinum* gives gelatin on boiling, and is stained yellow by iodine, and bright rose by picrocarmine. The cartilage with branched cells which is found in Cephalopods is a primitive form which is directly related to the connective tissue.

Nervous System of Lamellibranchs and Gastropods.†— M. A. d'Hardiviller brings forward evidence to show that there is no difference between the central nervous system of Lamellibranchs and that of Gastropods. The stomato-gastric system, the pleural ganglion and the

* Journ. Anat. et Physiol., xxix. (1893) pp. 466–522 (28 figs.).

† Comptes Rendus, cxvii. (1893) pp. 250–2.

pleuro-pedal connective which have been considered as characteristic of Gastropods are found also in the Lamellibranchiata.

In *Spondylus Lazardii* the author had no difficulty in finding a ganglion lying near the visceral centre; this he regards as the pleural ganglion, while the nervous band which connects it with the pedal centre is the pleuropedal ganglion. When these last are not apparent in a Lamellibranch it is because they have fused with other parts of the nervous system. In *Mactra* the author has found nerves which represent in a simplified condition the stomato-gastric nervous system of Gastropods.

α. Cephalopoda.

Peculiar Chromatophores in a Cephalopod.*—Dr. L. Joubin gives an account of certain chromatophores in the rare *Chiroteuthis Bonplandii*; it differs in several particulars from the ordinary chromatophore. In form, it is swollen in the centre, on either surface, but especially below; and the result of this is to greatly increase the thickness of the pigmented mass at the level of the nervous ending. It has the form of a biconvex lens. Its radial fibres are much shorter and more numerous than in ordinary chromatophores, and they have not the same fibrillar aspect. The nerve-ending is widened out, has a large nucleus, and is fitted with nerve-fibrils which are quite different from those found in non-modified chromatophores. The brown pigment is much denser than ordinarily. These facts lead the author to suggest that we have here to do with a thermoscopic eye.

Swedish Cephalopoda.†—Among a number of memoirs recently received we have a careful revision of Swedish Cephalopods by Herr E. Lönnberg; it is to be hoped that the paper has long since been distributed to those who are specially interested in the group.

γ. Gastropoda.

Phylogeny of Docoglossa.‡—Mr. W. H. Dall has a note on Dr. Thiele's objections to his suggestion that the Lepetidæ might represent the stem from which the Docoglossa were derived. He urges that in the Lepetidæ there are to be found the greatest number of archaic characters, which point to their being nearest to the "Protolimpet." Thiele would appear to have estimated too highly the constancy of minor details of the radula in single species. The relations of the radula in *Lepetella* to that of *Lepeta*, &c., offer additional reasons for thinking that the Lepetidæ are of limpets those most nearly allied to normal or more usual types of Gastropods.

Vallonia.§—Dr. V. Sterki's observations on this genus of minute Mollusca allied to *Helix* are almost monographic. There are notes on the anatomy, shell, physiology, habits and geographical range, as well as full descriptions of the species, to which are appended a key and a table of geographical distribution.

* Bull. Soc. Zool. France, xviii. (1893) pp. 146–51 (1 fig.).
† Bih. Svensk. Vet. Akad. Hdlgr., xvii. IV. No. 6 (1891) 42 pp. (1 pl.).
‡ Proc. Acad. Nat. Sci. Philad., 1893, pp. 285–7.
§ Tom. cit., pp. 234–79 (1 pl.).

Development of Cerata in Æoiss.*—Mr. C. B. Davenport gives a short account of his observations on this phenomenon. He finds evidence that the cerata arise from mesenchyme in two sets of facts; (1) the first indication of the formation of a new ceras is seen in the thickening of the mesenchyme at the base of the next older ceras. It is not until a solid mass of mesenchymatous tissue has been produced that the ectoderm begins to evaginate; and it then looks as if it were being pressed outwards. The alimentary diverticulum is produced still later. In the second place it is shown that the cæcum does not take the initiative by the discovery of young cerata composed only of ectoderm and a thickened mesenchymatous core, without any penetration of endoderm. Embryonic mesenchyme may be found lying at the base of the dorsal papilla.

The author's observations seem to show that the embryonic or growth tissue of *Æolis* is in its origin identical with that producing sexual cells. Like the latter it is germ-tissue, and it differs chiefly from the sexual cells in that it gives rise to growths which constitute part of the body of the present individual, growths which are as mortal as any other part of that present individual. Secondly it differs from sexual cells in giving rise to one kind of organ only—the mesenchyme to the mesenchyme of the buds, the endodermal diverticulum to the endoderm of the buds.

In one striking point there is a resemblance between mesenchymatous growth tissue and the sexual cells; the former, though it goes to produce the mesenchyme of any ceras, is not used up in doing so, part remains behind to form a new ceras, the rudiments of other new cerata. But to this power there is a limitation, which is a matter of degree in different species. In any case the limitation in the reproduction of cerata must be considered as resulting not from the limited capacity of reproduction of the embryonic tissue but from the needs of the species.

δ. Lamellibranchiata.

Morphology of Lamellibranchiata.†—Dr. J. L. Kellogg has made use of the section method, which has as yet been but little applied to the Lamellibranchiata. Of the conclusions to which his observations have led him we may note the following.

There seems to be a correlation between the aborted or absent foot and a thick mantle with no large blood-spaces, as, also, between a fully developed locomotor foot and a mantle consisting mainly of immense blood-spaces. Very large mantle-chambers seem to be characteristic of those forms which are most active, as *Yoldia*, *Venus*, or *Pecten*. Footless forms, such as the Oyster, appear to be degenerate, and to have come from active ancestors with a fully developed locomotor foot. In an active form, such as *Venus*, a great deal of oxidation goes on in the tissues, and this would require corresponding facilities for the aëration of the blood. When the power of locomotion is lost and the animal is, like *Mytilus*, fastened by a byssus, oxidation is lessened, and the respiratory apparatus is correspondingly reduced. This is well seen in the Oyster.

The gill is so subject to variation by secondary modifications that it

* Bull. Mus. Comp. Zool., xxiv. (1893) pp. 141–8 (2 pls.).
† Bull. U.S. Fish Comm., x. (1892) pp. 389–436 (16 pls.).

seems to be useless as a basis of classification for the whole group, although it is so used by Pelseneer. The author suggests the possibility of the ascending limb of the gill-filament being a new structure which has suddenly developed in the forms most closely connected with the Lamellibranchs that have plate-gills.

Elimination of Foreign Bodies in Lamellibranchs.*—M. H. Coupin gives an account of some observations with *Pholas dactylus*, which show that the palps serve chiefly to prevent large foreign bodies from reaching the mouth and so the digestive tube, the walls of which are very delicate. Driven by the palps to the orifice of the ventral siphon, the foreign bodies, such as *Pholas* meets with when making its holes, are driven outwards.

Molluscoida.

a. Tunicata.

Salpa in Relation to the Evolution of Life.†—As may be supposed from its title, Prof. W. K. Brooks' essay has a wide bearing, of the kind which it is exceedingly difficult to summarize. *Salpa* is regarded as being only remotely descended from a pelagic, *Appendicularia*-like ancestor, and is more immediately derived from a sessile form, similar in its habit of life, and, essentially, in structure also to the Ascidians.

To understand the position and significance of *Salpa* in the economy of Nature it is necessary to know at least the broad outlines of the conditions under which oceanic life has been evolved. The author commences, therefore, with contrasting terrestrial and marine life; the fauna of mid ocean is next described, and then the primary food-supply.

In discussing the origin of pelagic animals, Prof. Brooks points out the probability of there having been, long after the crust of the earth had acquired essentially its present character, a supply of oxygen so scanty that it was used by pelagic organisms in the surface water; so that life on the bottom was impossible at a time when the superficial water supported a luxuriant fauna and flora. During this period the proper conditions for the production of large and complicated organisms did not exist, and while the total volume of life was very great, it consisted of the organisms of minute size and simple structure which the author terms the primitive pelagic fauna and flora.

The origin of the Crustacea, and the phylogeny of the Metazoa, are next passed in review, after which there is a section on "the discovery of the bottom and its effect on evolution"; the primitive bottom-fauna must have had the following characteristics:—

(1) It was entirely animal, and at first depended directly upon the pelagic food-supply.

(2) It was established around elevated areas in water deep enough to be beyond the influence of the shore.

(3) The great groups of Metazoa were rapidly established from pelagic ancestors.

(4) There was a rapid increase in the size of the bottom animals and hard parts were quickly acquired.

* Comptes Rendus, cxvii. (1893) pp. 373-6.
† Studies from Biol. Laboratory, John Hopkins Univ., v. (1893) pp. 129-211.

(5) The bottom-fauna soon produced progressive development among pelagic animals.

(6) After the establishment of the bottom fauna, elaboration and differentiation among the representatives of each primitive type soon set in, and led to the extinction of the connecting forms.

The origin of the Chordata is next considered in its relation to pelagic influences, and the essay concludes with some observations on the origin of the Craspedota, which, says the author, "notwithstanding the text-books, I regard as a product of pelagic influences."

Neuro-hypophysial System of Tunicates.*—In the second of his "Studies on the Protochordata," Mr. A. Willey deals with the development of the neuro-hypophysial system in *Ciona intestinalis* and *Clavelina lepadiformis*, and gives an account of the origin of the sense-organs in *Ascidia mentula*. In *Clavelina* the permanent ganglion begins to be formed at a stage which is relatively much earlier than in *Ciona*, and, in fact, before the atrophy of the cerebral vesicle. From the first, too, it is a solid structure.

It would appear that in all Ascidians the lumen of the hypophysis is at first in direct communication with the lumen of the central nervous system; this forms a great and instructive difference between the development of the hypophysis in the Ascidians and in the higher Vertebrates. The permanent separation of the two parts of the hypophysis cerebri in the higher Vertebrates may be compared with the temporary obliteration of the lumen between the proximal and distal portions of the hypophysis which obtains in *Ciona*. The facts of development support the suggestion of Julin and Balfour that the subneural gland and dorsal tubercle of the Ascidians are homologous with the pituitary body of the higher Vertebrates.

Position of Mouth in Larvæ of Ascidians.†—In his third "study," Mr. Willey discusses the position of the mouth in the larvæ of Ascidians and *Amphioxus*, and its relation to the neuropore. Although the mouth of the larva of *Amphioxus* occupies an intermediate position between that which it holds in the Ascidian larva and in *Balanoglossus*, it certainly does not represent an intermediate stage. There is no evidence to lead us to suppose that the mouth of *Balanoglossus* has migrated from a dorsal to a ventral position; it is probable that both its mouth and that of Ascidians were originally terminal in position; the primitive vertebrate mouth, before the cranial flexure had become an established feature in the ontogeny, was probably dorsal or dorso-terminal in position. In the common ancestor of the Urochorda and Cephalochorda the mouth was, no doubt, in intimate relation with the neuropore, probably through the intermediation of a ciliated funnel or hypophysis.

β. Bryozoa.

Marine Bryozoa.‡—In another part of his "Appendix" to his contributions on these animals, the Rev. T. Hincks remarks that his genus *Pedicellinopsis* is not to be separated from *Barentsia*; his *Cyclicopora*

* Quart. Journ. Micr. Sci., xxxv. (1893) pp. 295–316 and 329–33 (2 pls.).
† Tom. cit., pp. 316–33 (1 pl.).
‡ Ann. and Mag. Nat. Hist., xii. (1893) pp. 140–7.

prælonga had already been described by MacGillivry as *Lepralia longipora*, but the generic distinction is a good one. Mr. Hincks has lately found specimens of *Schizoporella subsinuata* bearing avicularia. There are various other notes on and corrections of the author's previous descriptions.

γ. Brachiopoda.

Brachial Apparatus of Hinged Brachiopoda.*—Mr. H. S. Williams, on making some models of the arms of Brachiopods, found that doubling back the lamellæ with the spirals attached beyond the bend, caused a reversal of the direction of the coil from that presented by it when attached before the bend; he thus produced the exact difference between *Waldheimia* and *Anazyga*. The experiment showed that the fundamental difference between the brachial apparatus of the Spiriferidæ and Terebratulidæ does not merely consist in the presence of a calcified spiral in one and its absence in the other, but in the fact that in the Spiriferidæ the primary lamellæ are continued directly into the spiral coils, while in the latter the primary lamella on each side is doubled back upon itself to near the position of the mouth, whence the spiral part of the arms begins; the reversal in the direction of the coils of the spiral results from this reflexion of the primary lamella.

Arthropoda.

α. Insecta.

Insect Embryology.†—Mr. W. M. Wheeler has chiefly studied the Orthoptera, and more particularly *Xiphidium ensiferum*. The eggs of this Insect are laid in the willow-galls produced by a *Cecidomyia*. In it, as in most Orthoptera, there is an invaginate gastrula. The blastopore extends nearly the whole length of the germ-band, and is bifurcated posteriorly. Later on, a remarkable migration of the embryo complicates the study of the complex embryonic membranes; the embryo sinks down into the yolk, and by bending comes to lie on the dorsal side with its ends reversed, its head being towards the posterior or larger end of the egg; the embryo next moves back into its original position on the ventral side of the yolk, and bends back so as to lie as it did at first. This second migration, however, is not through the yolk, but on the surface, over the posterior end of the egg.

The author thinks that these movements of "blasto-kinesis" are of physiological use; the rapid growth of the embryo probably leads to contamination of the yolk, so that there is an advantage in a change of position.

The embryonic membranes of *Xiphidium* are very numerous; there is a serosa which covers the entire yolk, and an amnion which covers the ventral surface of the embryo. A most remarkable organ is the indusium to which the amnion adheres; it begins as a disk of cells anterior to the embryo, is for a time connected with the head lobes of the embryo, and again becomes free, when it forms a double body which lies in front of the embryo.

* Proc. Rochester (N.Y.) Acad. Sci., ii. (1893) pp. 113–8 (7 figs.).

† Journ. of Morphology, viii. No. 1 (1893). See Amer. Natur., xxvii. (1893) pp. 745–9.

The nervous system may be seen in its earliest stage while the blastopore is still open; large ectodermal nerve-formative cells sink beneath the surface and become arrayed in four long rows on each side of the blastopore. When this last closes another, median, row is formed. The cell now appears to bud off daughter-cells which become ganglionic. The brain is directly continuous with the ventral cords. The optic nerve fibres seem to grow out from the brain towards the ommatidium.

The mesoderm is early split up into eighteen pairs of blocks which become hollow; in the walls of some of the sacs so formed central cells become germ-cells; falling into the cavities they multiply by karyokinesis. Solid diverticula from six successive masses form the latter into a continuous gonad. The generative ducts also arise from the mesodermal sacs. In the marked metameric characters of the gonads and in the formation of the ducts as cœlomic diverticula Mr. Wheeler sees resemblances to Annelids, as, indeed, he does also in the mode of formation of the central nervous system.

Life-Histories of Ceratocampidæ, &c.*—Prof. A. S. Packard finds that the most generalized forms of the Ceratocampid Moths are *Dryocampa* and *Anisota*. An account is given of the life-history of *D. rubicunda* and of three species of *Anisota*; *Sphingicampa bicolor* is the most Sphinx-like of any Ceratocampid or other Bombycid known to the author in the shape of the head and its markings, the four thoracic horns, the caudal, the heavy anal legs, and the skin granulated with white tubercles. Full accounts are given of *Eacles imperialis* and *Citheronia regalis*; and here, as in other cases, a distinction is made between the "congenital characters" and the "later adaptational characters." After some notes on various Hemileucidæ, the author passes to the Lasiocampidæ. In them there may sometimes be noted an acceleration of the development of setæ, which, in their ancestors, were characters acquired during the later stages of the larval life. From the various larvæ of this family, of which complete or partial accounts are given, no points of general interest are drawn.

Colours of Lepidopterous Larvæ.†—Prof. E. B. Poulton has an abstract of a memoir entitled "The experimental proof that the colours of certain Lepidopterous Larvæ are largely due to modified plant-pigments, derived from food." He divided into three lots one batch of eggs laid by *Tryphæna pronuba*, and fed them (in darkness) on green leaves, yellow etiolated leaves, and white mid-ribs of cabbage. The last, whose food contained neither chlorophyll nor etiolin, were entirely unable to form the green or brown ground-colour.

Lepidopterous Pupa with Functional Mandibles.‡—Dr. T. A. Chapman remarks that it seems at first sight incredible that a lepidopterous pupa should not only have jaws, but have them of immense size proportionately to the insect, and functionally active. After describing these organs he points out that there are no muscles attached to the jaws, and no imaginal jaws within them, whose movements compel those of the pupal jaws. The characters of the pupa, especially as

* Proc. Amer. Phil. Soc., xxxi. (1893) pp. 139–92 (7 pls.).
† Proc. Roy. Soc. Lond., liv. (1893) pp. 41 and 2.
‡ Trans. Entomol. Soc. Lond., 1893, pp. 255–65.

displayed in the emergence of the moth, and of the moth itself at this time are only less remarkable than the possession of active jaws. Indeed, the author seems somewhat to doubt if the insect has been properly located in the system.

Dicranota: a Carnivorous Tipulid Larva.*—Prof. L. C. Miall gives an account of the life-histoiy of *Dicranota bimaculata*, of which as yet nothing has been recorded. The larvæ were plentiful on the muddy banks of a little stream near Leeds, and they occasionally leave the water; the pupal stage is passed in damp earth, and the pupa creeps to the surface shortly before the time for the emergence of the fly. The larvæ can be found at all seasons of the year, and it is likely that there is a continual succession of flies during the warmer months.

In its external features, which the author describes at length, the larva of *Dicranota* resembles that of the nearly allied *Pedicia rivosa;* as to its nervous system, none of the ganglia lie in the head; the annular muscles of the body-wall are very numerous; the fat-body extends almost throughout the body. The alimentary canal is a nearly straight tube of unequal diameter; from his histological observations the author concludes that this larva is well adapted for the study of the secretory changes which take place in a digestive epithelium.

The blood is colourless, with numerous minute elliptical corpuscles. Both spiracles and tracheal gills are carried on the last segment; while *Chironomus*, the larva of which also lives in mud saturated with water, has a closed and rudimentary tracheal system, with abundance of hæmoglobin in its blood, *Dicranota* has an efficient tracheal system distended with air, and no hæmoglobin.

As in many other aquatic Diptera, the pupa is notably smaller than the larva.

Anatomy and Development of Male Genital Armature of Orthoptera.†—M. A. Peytoureau throws doubt on the generally accepted homology between the genital armatures of the two sexes in Insects. He finds that the chief parts of the male armature of *Periplaneta americana* are produced, at a late period, at the expense of asymmetrical buds of the hypodermis; the female armature is derived from parts which belong to the eighth and ninth urosternites.

β. Myriopoda.

Cerebral Nuclei of Myriopoda.‡—M. J. Chatin, from his study of various Chilopod Myriopoda, finds three kinds of nervous elements in the frontal lobe of the brain. There are normal nerve-cells which are generally unipolar or bipolar, have a large body and a globular nucleus whose chromatic power varies in intensity. Other nerve-cells have one or several nuclei; these nuclei stain feebly. Thirdly, there are small cells with an average measurement of 4 μ, which have a nucleus so large that the body is often reduced to a delicate peripheral zone of protoplasm. It is clear that all these elements are cellular, and it is impossible to admit the existence of free cerebral nuclei.

* Trans. Entomol. Soc. Lond., 1893, pp. 235–53 (4 pls.).
† Comptes Rendus, cxvii. (1893) pp. 293–5.
‡ Tom. cit., pp. 291–3.

γ. Protracheata.

Peripatus from Dominica.*—Miss E. C. Pollard has a few notes on the *Peripatus* from Dominica; the number of ambulatory appendages is found to vary from twenty-five to thirty, but it is the males, which are as a rule smaller than the females, that have twenty-five pairs, while the females have more, and, generally, twenty-nine. Comparisons are instituted between this and other neotropical species.

Peripatus jamaicensis.†—Mr. T. D. A. Cockerell has a few notes on this form, supplementary to those already given; there is great variation in the number of the legs.

δ. Arachnida.

Classification of Scorpions.‡—Mr. R. I. Pocock, after giving tabular views of earlier classifications of Scorpions, proposes the following arrangement:—

Fam. I. Scorpionidæ.
Sub-families, i. Scorpionini; ii. Ischnurini; iii. Diplocentrini; iv. Hemiscorpini subf. n.; v. Urodacini subf. n.
„ II. Juridæ.
Subf. i. Jurini; ii. Chærilini; iii. Chætini.
„ III. Bothriuridæ.
„ IV. Buthidæ.

Opisthocentrus for *Opisthacanthus africanus*,' &c., *Chiromachus* for *Ischnurus ochropus*, *Iomachus* for *Hormurus læviceps*, *Anuroctonus* and *Hadruroides* are proposed new genera.

Variations in Internal Anatomy of Gamasinæ.§—Mr. A. D. Michael, who has especially studied the variations in the genital organs of these Mites, gives a very interesting account of a most remarkable mode of coition observed in *Hæmogamasus hirsutus*. As the male seizes the female what looks like a hyaline sac appears in the mouth of the genital aperture of the male, and gradually attains its full size; this, when reached, may exceed in length the length of the body of the male. The flask-shaped capsule is very elastic, and it is probably by its elasticity that the stopping is driven out of the narrow end; this small end is applied to the female, and, as the contents of the flask are spermatozoa, the emptying of it is the natural termination of the act of coition. The form of the spermatic capsule differs in different species, but is constant for each. The male is provided with great accessory glands, which produce the liquid contents of the capsule, but the author cannot yet say where the wall of the capsule arises.

With regard to the female organ of the Gamasinæ, not only are there great differences in the same part in different species, but in a large section there is a whole set of organs which are absent from those as yet described, and these new organs vary among themselves. These undescribed organs consist of a lyre-shaped organ on the upper surface of the ovary, a part of which, indeed, Mr. Michael considers it to be; he

* Quart. Journ. Micr. Sci., xxxv. (1893) pp. 287–93 (1 pl.).
† Zool. Anzeig., xvi. (1893) pp. 341–3.
‡ Ann. and Mag. Nat. Hist., xii. (1893) pp. 303–30 (2 pls.).
§ Trans. Linn. Soc. Lond., v. (1892) pp. 281–324 (4 pls.).

inclines to the view that it forms the germiniferous part of the ovary; but, as he remarks, there is no such structure in any other family of the Acarina, and we can get therefore no assistance from analogy. The author enters into the details of minute structure, into which our want of space prevents us following him. With the lyrate organ a sacculus and ringed tubes appear to be correlated. A very remarkable variation from the accepted type of the female generative organs of the Gamasinæ is recorded in *Sejus togatus*.

ε. Crustacea.

Gammarini.*—The twentieth of the splendid monographs issued under the general title of 'Fauna und Flora des Golfes von Neapel' is a treatise on the Gammarini, by Signor A. Della Valle. As is usual in these monographs the whole subject is most exhaustively dealt with, and the illustrations are of the high order to which Dr. Dohrn has now accustomed us.

Embryology of Cumacea.†—Mr. P. Butschinsky has a preliminary notice of his work on the development of the Cumacea. In *Iphinoë mæotica* the cleavage of the egg is centrolecithal. All the segmentation nuclei, which are surrounded, in the centre of the egg, by radial masses of protoplasm, make their way to the surface and finally form a homogeneous blastoderm.

On the ventral side of the egg there now appears a blastodermic thickening, the foundation of the germ-band; in this three separate thickenings may be noted—the paired anterior optic lobes and an unpaired one behind, which contains a large number of cells (meso-endoderm). These inner cell-masses become differentiated into three foundations—the yolk-cells which migrate with the yolk, the mesodermal and the endodermal cells.

The proctodæum is formed before the stomodæum and has the appearance of a very long tube. The liver is developed very early, and forms two tubes composed of large cells. The central nervous system is laid down as an ectodermal thickening at the time when the anterior extremities are being formed. In its earlier stages it is paired, but the halves gradually unite and form an unpaired cord, in which eighteen to nineteen ganglia are developed. The unpaired eye is developed from two separate thickenings of the hypodermis of the most anterior optic lobe, and undergoes a complicated metamorphosis. The first sign of the heart is a compact collection of mesodermal cells on the dorsal side. The genital organs appear as paired outgrowths of the mesoderm. The dorsal organ is developed very early as an oval ectodermal aggregation of cells; it does not disappear until after all the organs of the animal are formed.

Germinal Layers of Cladocera.‡—Dr. P. Samassa, who has already investigated the history of the summer egg of *Moina rectirostris*, now gives an account of his observations on *Daphnella brachyura* and *Daphnia hyalina*. If we compare the formation of the germinal layers in the Cladocera with that of *Branchipus*, we find that total has been replaced

* 'Fauna u. Flora des Golfes von Neapel &c. xx. Gammarini.' Berlin, 1893, xi. and 948 pp., Atlas of 61 pls.

† Zool. Anzeig., xvi. (1893) pp. 386 and 7.

‡ Arch. f. Mikr. Anat., xli. (1893) pp. 650-88 (4 pls.).

by superficial cleavage, and there has been a reduction in the amount of yolk. A close comparison is instituted between the mode of formation of the germinal layers in *Branchipus* and the Cladocera, and, again, between *Moina* on the one hand, and *Daphnia* and *Daphnella* on the other. The process of yolk-absorption is next considered, and the author expresses his opinion that the yolk-cells are to be considered part of the mesoderm; it is of importance to note that the yolk-cells become fat-body-cells in the developed organism.

Dr. Samassa thinks that instead of proposing uncertain hypotheses on the origin of the germinal layers, it is more important to determine, in every separate case, by reference to the most nearly allied holoblastic forms, what have been the cenogenetic changes which have caused the yolk; if this is done it is much easier to make out the palingenetic processes.

The Cladocera show us that the resorption of yolk may be due to the mesoderm; and as this is so we have no right, when the yolk-cells exhibit no relation to the enteron, to ascribe them to the endoderm.

Copepoda of Liverpool Bay.*—Though three reports on the Copepoda of the Liverpool district have been published in recent years, Mr. I. C. Thompson has become acquainted with so many fresh forms in the last four years, that it has been thought advisable to draw up a complete report of all the species recorded from the district. Before 1885 only six species had been noted, the present report deals with 136, eighteen of which are new to British seas, and eleven of them are new to science. Among the latter is a representative of a new genus of the Misophriidæ, which the author calls *Herdmania* (*H. stylifera* sp. n.); though minute, being only 0·6 mm. long, it is said to be remarkably elegant; it was taken at 39 fathoms, about twelve miles from Port Erin.

New Choniostomatidæ.†—MM. A. Giard and J. Bonnier describe under the names of *Spheronella microcephala* and *Salenskia tuberosa* two new parasitic Crustacea from the French coast. This is the first time that a member of the Choniostomatidæ has been met with on the coasts of France. Both the new species were found in the incubatory cavity of specimens of *Ampelisca* which had been made sterile by parasitic castration.

Reproductive Elements of Apus and Branchipus.‡—Mr. J. E. S. Moore thinks that the development of the chromosomes in the spermatozoa of *Branchipus* is partly dependent on a fusion of the globules, which gives rise to the reticulate appearance. Progress of such a fusion would produce the one-sided figure described by Hermann in the spermatocytes of the Salamander, and lead to the formation of a limited number of chromosomes, all on the nuclear periphery. The author shows that during the changes that occur there are in the resting spermatocytes three dark points (pseudosomes) whose appearance corresponds in everything but number with the centrosomes of previous authors. The fusion spreads beyond the nucleus, and the chromosomes are suspended to the pseudosomes; these last retreat towards the periphery, and in connection with this motion an axis tends to set up, round which the spindle-figure

* Trans. Liverpool Biol. Soc., vii. (1893) 56 pp. (21 pls.).
† Comptes Rendus, cxvii. (1893) pp. 446-9.
‡ Quart. Journ. Micr. Sci., xxxv. (1893) pp. 259-83 (2 pls.).

gathers, while at its apices some of the pseudosomes coalesce to build up the colossal centrosomes. Though the author speaks (for the first time) of pseudosomes and dictyosomes, he points out that there is no genetic connection between them and centrosomes; "my sole reason for using the two new terms is their successional appearance."

While bringing into prominence the existence in *Branchipus* of a veritable "Schaumplasma," the author urges that he has no predisposition to utilize Bütschli's conception of such structure as a fundamental interpretation of some of the phenomena of karyokinesis; at the same time, the observation that a foam structure is intimately bound up with the phenomena of karyokinesis (even in a single type) must materially enhance the value of Bütschli's hypothesis that it is sufficient to account for the amœboid activities of protoplasm.

The author's study of the development of the generative elements shows that in *Branchipus* the general law as to the similarity of the male and female cells is borne out, and that their specific peculiarities are physiological in origin and have no morphological significance. Secondly, the derivates of the primitive genital cells are of two kinds—one transformed directly into the reproductive elements, the other into the egg-case or into the fluid in which the spermatozoa are suspended; in one case there is karyokinesis, in the other akinesis. Thirdly, the divisional phenomena of these cells are intimately related to a protoplasmic structure, which may be called "Schaumplasma," and one of the initial physical impulses towards metamorphosis is a fusion of some of the intra-nuclear globules; a considerable portion of the complicated karyokinetic figures appears to be the logical as well as the actual consequence of the continuance of this process.

In *Apus* the divisional phenomenon exhibits a remarkable change, for the cells of the gonad are all alike, and can function both in slime and egg formation as opportunity arises. The difference is perhaps due to the fact that, in sexually produced species, the nuclei intended for fusion must, so to speak, balance one another; any infringement of the rule of karyokinesis would lead to such wide abnormalities that it would be quickly eradicated. On the other hand, a parthenogetic or hermaphrodite species may please itself as to the manner in which it evolves its reproductive elements, so long as these contain the premises necessary to the proper development of the individual.

Larval Forms of Trilobites.*—Mr. C. E. Beecher suggests the following classification of the stages of development of these difficult organisms:—

Nauplius?	Cephalon predominating, other parts not separated from it. E.g. earliest known stage of *Sao*, *Ptychoparia*, and *Acidaspis*.
Phylembryonic ..	Cephalon distinct; thorax *nil*; pygidium distinct. E.g. second stage of *Sao et al.*, and Barrande's larvæ of *Agnostus* and *Trinucleus*.
Nepionic (as many stages as normal thoracic segments)	Cephalon, thorax and pygidium distinct and complete. Growth incomplete.
Ephebic	All parts complete, and full size attained.

* Amer. Journ. Sci., xlvi. (1893) pp. 142–7 (1 pl.).

Appendages of Triarthrus Becki.*—Mr. W. D. Matthew has had the opportunity of examining some specimens of this Trilobite in which the organs of the under side are attached to the body, and are fairly well preserved. The most noticeable character, indeed, is the presence of long, many-jointed, rod-like attachments to the front of the head, which are said to resemble exactly the antennæ of Crustaceans. Of the ventral appendages, some may have been branchial in function.

On the whole, the resemblance to *Limulus* is not so striking as is the suggestion of a more comprehensive type, "approaching the general structure of other Crustacea rather than that of any special form." Though *Triarthrus* usually scuttled through soft mud, it would appear to have had considerable swimming powers, which were probably more perfect than in the later types of Trilobites.

Mr. H. M. Bernard † expresses great satisfaction at this discovery, and thinks that the Trilobites may "take a firm place at the root of the Crustacean system, with the existing *Apus* as their nearest ally."

Vermes.

α. Annelida.

Alciopidæ of Messina.‡—Dr. E. Hering gives detailed accounts of the structure of eight species of *Alciopa* found at Messina. Some are as transparent as water, and have tentacles and cirri less developed than the more opaque species; on the whole, the characters of the latter show that they are of the two groups the one more closely allied to *Phyllodoce*. There are some notes on synonymy, and *Alciopa Cari* and *A. Bartelsii* are described as new species.

Intra-epidermal Blood-vessels in Skin of Earthworm.§—M. M. v. Lenhossék finds that by Cajal's modification of Golgi's method it is possible to demonstrate very clearly the intra-epidermal blood-vessels in the skin of the earthworm. These vessels are chiefly found in the circular muscular layer, whence trunks, parallel with one another, are given off at right angles; they do not appear to form continuous circles round the body. The author suggests that their function is not, as is usually supposed, respiratory, or at any rate not respiratory only, but that it is they which keep the surface of the earthworm moist.

New Genus of Oligochæta.‖—Mr. H. J. Moore has a preliminary account of a new genus of earthworm, common near Philadelphia, which he proposes to call *Bimastos*. The setæ are arranged in four couples; the region of the male pores is much swollen, and suggested the generic name. With the exception of its distinct clitellum and its terminal anus, the worm at first sight resembles *Criodrilus*. The genital protuberances are due to the large size of the "prostate" glands which lie in somites xv. and xvi. There are no spermathecæ. Fuller details are promised.

* Amer. Journ. Sci., xlvi. (1893) pp. 121–5 (1 pl.).
† Nature, xlviii. (1893) pp. 582 and 3.
‡ SB. K. Akad. Wiss. Wien, ci. (1892) pp. 731–68 (6 pls.).
§ Ver. Nat. Ges. Basel, x. (1893) pp. 84–91 (1 fig.).
‖ Zool. Anzeig., xvi. (1893) pp. 333 and 4.

Allolobophora Savignii.*—MM. J. de Guerne and R. Horst give reasons for thinking that an earthworm of large size well known to fishermen at Cayan, in the south-east of France, is a new species, which they propose to call *Allolobophora Savignii.*

β. Nemathelminthes.

Allantonema sylvaticum.†—Dr. v. Linstow gives an account of one of the species of this remarkable genus, which he found in *Geotrupes sylvaticus.* As first found it consisted only of a very thin hyaline membrane, in which there were several hundred embryos so closely packed that they could not move. These embryos were found in the spring, and they leave the mother to make their way into the body-cavity of the beetle. As the author failed in his earlier experiments to get evidence of a free stage, owing to the presence of various species of *Rhabditis* and other worms, he adopted the procedure of bacteriologists and sterilized his soil; he was now able to cultivate his species until it reached a sexually mature stage. In this he was able to see that he had to do with a *Diplogaster*, various forms of which he compares with one another as to the length of the tail, which varies considerably.

Life-history of Echinorhynchus proteus.‡ — Herr F. Zschokke points out that the developmental cycle of this parasite may be passed through in three distinct sets of hosts.

The embryo-bearing egg may be eaten by a *Gammarus* (1st intermediate host), and pass with it into a fresh-water fish (2nd intermediate host); there it may pass its larval stage in the body, and be taken up by a carnivorous fish (chief host) in the intestine of which it becomes sexually mature. Or the piscine may be left out, the larval stages passed through in the *Gammarus*, which is eaten by a fish which becomes the chief host. Or, thirdly, the egg may be eaten by a fish, pass through all its larval stages there, and be eaten by a carnivorous fish, which becomes the chief host.

γ. Platyhelminthes.

Planarians and Nemerteans of North America.§—Dr. C. Girard, who began to study the free-living Platyhelminths of North America in 1848, gives a list, with short description, of the species known to occur; special attention has been given to the delimitation of the genera, as the author believes that the true progress of descriptive Zoology depends on their constitution.

South Georgian and other Nemertines.‖—The Nemertines from South Georgia examined by Dr. O. Bürger all belong to known types. They are all proportionately long and very compressed forms, so that they are, externally, very like the smaller species of *Amphiporus.* Some of the representatives of this genus have a head-gland enormously developed in a way hitherto unknown. Various Nemertines from other localities are also described, and in the specific diagnoses attention

* Bull. Soc. Zool. France, xviii. (1893) pp. 153–8 (1 fig.).
† Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 169–73 (6 figs.).
‡ Verh. Naturf. Gesell. Basel, x. (1892) pp. 73–83.
§ Ann. Sci. Nat., xv. (1893) pp. 145-310 (4 pls.).
‖ Zool. JB. (Systematik &c.) vii. (1893) pp. 207–40 (2 pls.).

is given to the details of internal organization. Collectors of these worms are earnestly desired to make coloured sketches of fresh specimens.

Notes on Flukes.*—Dr. P. Sonsino thinks that *Distomum trigonocephalum* is found in members of three different orders of Mammals on account of their partaking of the same kind of food. *D. ovo-caudatum* lives in the stomach and intestine of *Rana*, as well as in the mouth; previous observers would seem not to have seen perfect specimens of the egg, for its tail is at least from four to six times as long as the length of the body of the egg. The embryo is not only armed with spines at its anterior end, but possesses cilia. With regard to *D. baraldi*, which lives in *Zamenis viridiflavus*, the author suspects that, contrary to the usual course, the same animal plays the part of intermediate and final host.

Liver-Flukes of Cats.†—Dr. M. Braun makes a revision of the species of *Distomum* found in the domestic cat and allied species. He found they were common, and that of 34 cats *D. truncatum* was found in 3, *D. albidum* sp. n. in 25, and *D. conus* in 27. Of these three species he gives detailed descriptions, and he enters very fully into the literary history of his subject.

Life-cycle of Bilharzia hæmatobia.‡—Dr. P. Sonsino, from observations made in South Tunis, comes to the conclusion that the life-cycle of this Trematode differs somewhat from the typical history of digenetic forms. Its intermediate host is a small crustacean, into which the embryo penetrates, and where it lies encapsuled till its host is taken in by man with drinking water.

Helminthology of West Coast of Norway.§—We have received so long after its publication Herr E. Lönnberg's report of his helminthological observations on the west coast of Norway, that we must be content to call the attention of specialists to it.

Echinoderma.

Nutrition of Echinoderms.‖—Dr. M. Chapeaux finds that the radial glands of Asteroidea may be compared, from the physiological point of view, with the pancreas of Vertebrates; their secretion converts starch into glucose, fibrin into peptone, and emulsifies fats; the walls of the œsophagus and stomach secrete ferments which convert fibrin and starch. The most important points in his observations are the facts which go to show that the amœbocytes of the cœlomic cavity play an important part in continuing the work of digestion and of excreting the residue of the food. Thus, fats are broken up and dissolved in the cœlom, the droplets being swallowed by amœbocytes, within which, and under the influence of an acid ferment, the fat is broken up.

On peptones, on the other hand, neither the cœlomic phagocytes nor the fluid of the cœlom have any influence. The author thinks it is

* Proc. Zool. Soc. Lond., 1893, pp. 496–500.
† Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 383–92, 422–8.
‡ Proc. Verb. Soc. Tosc. Pisa, 11 August, 1893, 1 p.
§ Bih. Svensk. Vet. Akad. Hdlgr., xvi. IV. No. 5 (1890) 47 pp.
‖ Bull. Acad. Sci. Belg., lxiii. (1893) pp. 227–32.

probable that the epithelium of the radial glands converts the peptones into a soluble albumen which passes into the blood. Here the albumen would be taken up by amœbocytes and conveyed to various parts of the body.

Development of Echinocyamus pusillus.*—Dr. H. Théel has an important memoir on the development of this small Echinoid. After treating of

(1) The ovum, its maturation and impregnation, the segmentation of the ovum (2) is considered, and here attention is chiefly given to the external characters noted with the living egg; it was found that, in general, the rapidity of segmentation is proportional to the size of the segments; at the first three cleavages the blastomeres are separated almost simultaneously, but afterwards some sets of segments divide earlier than others; in the three first stages the blastomeres are equal among themselves, but afterwards they become distinctly unequal.

The blastula (3) is elongate and cylindrical, and is peculiar for the early formation of calcareous spicules, inasmuch as in other Echinoids they do not appear till some later stage.

It is at this stage too that, in *Echinocyamus*, a cell-area becomes differentiated at the animal pole; it has a tuft of long cilia and probably serves as a larval organ of sense.

(4) The gastrula of *Echinocyamus* appears to be remarkable for its length; in most Echinoids the gastrulæ are spherical or slightly oval. Especial attention was (5) paid to the formation of the mesenchyme, as such different opinions have been held as to its origin. The conclusions to which Dr. Théel arrives are as follows:—

(i.) With very few exceptions, the mesenchyme originates from the endoderm alone, and by means of immigration; it will probably be found that the formation of this layer in many Echinoderms goes on uninterruptedly during the whole gastrulation.

(ii.) The mesenchyme arises earliest, with very few exceptions, in those groups of Echinoderms in which the larvæ have the skeleton earliest developed; most of its earliest cells are calciferous.

(iii.) No bilaterally arranged archi-mesenchyme cells are to be detected.

(iv.) No true mesenchyme-bands, homologous with the mesodermic bands of Annelids or Molluscs, are met with in Echinoderms, but often, especially in Echinoids, the first wandering cells which enter arrange themselves in two bilateral heaps or bands.

(6) The process of calcification appears to be effected by the calciferous cells supplying themselves with calcareous matter in such abundance that a part becomes solidified in the shape of reserve-granules, while the rest remain fluid. When the formation of a deposit is about to begin the calciferous cells combine by means of their clear pseudopodial peripheral protoplasm protruding and combining together; this "pseudopodial clump" forms the organic ground-substance in which the calcification takes place; during the act of solidification the resulting calcareous body assumes by degrees the shape of a tetrahedron, which gradually changes into a small three-armed star. Further increase is

* Nova Acta Roy. Soc. Upsala, xv. 1 (1892) VI. 57 pp. (9 pls.).

effected by the activity of the same calciferous cells, with which new cells become connected. "The calcifying matrix, originated from the ectoplasm of many calciferous cells, predetermines the form of the increasing deposit, and gives rise to the organic substance in the deposit as well as to the thin coat or membrane which invests it.

In the development of the Pluteus (7) three successive stages are to be distinguished by a difference in the number of the centres of calcification and by a gradual increase in the number of rods and arm-like appendages. So few pluteus-larvæ are as yet well known that it is impossible to make comparisons which will give any general results of value; but it may be said that the Clypeastroids have a pluteus which is rounded posteriorly, is devoid of epaulettes and a terminal arm, and has but eight arms.

Finally, (8) the development of the young is considered; in the oldest example, which was about two months old, the bilateral symmetry is very striking; the spines are proportionately long; the buccal membrane is just pierced, but there is as yet no anus; and the dorsal region is strengthened by a large calcified perforated plate which covers the greater part of the back. This plate is derived from the central part of the odd dorsal rod which characterizes the fully mature pluteus. In order, indeed, to understand the growth of the calcareous deposits in general and all the changes which take place in connection with it, we must note that a re-deposition of calcareous matter must occur side by side with an absorption, just as in the case of bone; in other words, while a part of the wandering cells are employed in building up, other so-called phagocytes devour and destroy such parts of the plates, rods, &c., which are useless or impede the advance of a normal development.

Abnormal Specimen of Antedon rosacea.*—Mr. H. C. Chadwick has met with a specimen of this Comatulid in which there was a supernumerary disc attached to the normal one by a sort of stalk; of this he was able to make an unbroken series of sections. These showed that the body-cavities of the two discs communicated freely with each other, while the alimentary canals were quite distinct. The skeletal and axial nervous systems present in the normal disc are quite absent from the supernumerary.

Discussing the explanations that may be given as to the origin of the latter, he points out that against the hypothesis of budding there is the entire absence of arms, and of skeletal and axial nervous systems in the supernumerary disc; the suggestion (due to Prof. Milnes Marshall) that the phenomenon is the result of incomplete evisceration receives more favour.

Notes on Holothurians.†—Dr. E. von Marenzeller thinks that the Cotton-spinner (*Holothuria nigra*) is identical with *H. Forskalii* of the Mediterranean, as is also *H. cataniensis* and *Stichopus Selenkæ;* in the Atlantic Ocean *H. Forskalii* does not attain so large a size as in the Mediterranean. *Cucumaria Koellikeri* is also found in the Atlantic. The author thinks that Edward Forbes' *Psolinus brevis* is the *Cucumaria*

* Ann. and Mag. Nat. Hist., xii. (1893) pp. 195–8 (1 pl.).

† SB. Akad. Wiss. Wien, 1893, pp. 107–9; see Ann. and Mag. Nat. Hist., xii. (1893) pp. 334 and 5.

Montagui of Flemming, the *Colochirus Andersoni* of Lampert, and the *C. Lacazei* of Hérouard.

Cœlentera.

Gyractis.*—Under this name Prof. T. Boveri describes a radially symmetrical Actinian from Ceylon, for which he proposes the group-name Holactiniæ; this group may be defined as containing Actiniaria which exhibit a perfect radial symmetry, and have the septa arranged in pairs; the septa of each have longitudinal muscles on their inner and transverse muscles on their outer sides. New septa are developed in pairs in the intersepta. The mouth is round and there are no siphonoglyphes. The mode of derivation of this group from the Edwardsiæ is still obscure; it is, however, the last joint in a series which has been derived from a bilaterally symmetrical animal and has become quite radial. Two species of *Gyractis* are described.

Corals from Indian Seas.†—Dr. A. Alcock makes a welcome addition to our scanty knowledge of the coral-fauna of the seas within the limits of the Indian peninsula. Twenty-six species are enumerated, of which *Paracyathus cavatus*, *P. porphyreus*, *Heterocyathus wood-masoni*, *Discotrochus investigatoris*, *Polycyathus andamanensis*, *Balanophyllia scabra*, *Eupsammia regalis*, *Heteropsammia aphrodes*, *Cycloseris mycoides*, *Diaseris fragilis*, and *Bathyactis stephanus* are new; the last-named came from 678 fathoms in the Bay of Bengal.

Every specimen of *H. aphrodes* was found to be provided with a commensal sipunculoid worm, and with live specimens it was observed that the worm was able to propel the coral in a rapid series of short, jerky, spiral movements. These movements were performed with great ease, so that this is a true case of commensalism, in which the worm serves the polyp as a locomotor agent, while the polyp, by its stinging organs, protects the worm.

Muriceidæ.‡—Mr. T. Hedlund, we learn, at this late date, has published notes on *Acanthogorgia aspera*, *A. inermis* sp. n., *Echinomuricea Peterseni* sp. n., both from Hong Kong, and *E. philippinensis*. It is a pity that the distribution of this paper should have been so long delayed.

Revision of the Forskaliidæ.§—M. M. Bedot makes a revision of this family of the Siphonophora, in which he gives a full account of the work of preceding writers, shows there is no need for the genus *Forskaliopsis*, suggests that *Bathyphysa* belongs to a distinct family, and gives a list of the species which he recognizes in the genus *Forskalia*.

Porifera.

Structure and Classification of Calcarea Heterocœla.‖—In the fifth part of his "Studies on the Comparative Anatomy of Sponges," Dr. A. Dendy deals with the Heterocœlous form of Calcareous Sponges. As to the anatomy and histology he does not so much offer what is new as

* Zool. JB. (Systematik &c.) vii. (1893) pp. 241–53 (1 pl. and 3 figs.).
† Journ. Asiat. Soc. Bengal, lxii. (1893) pp. 138–49 (1 pl.).
‡ Bih. Svensk. Vet. Akad. Hdlgr., xvi. IV. No. 6 (1890) 19 pp. (3 pls.).
§ Rev. Suisse de Zool., i. (1893) pp. 231–54.
‖ Quart. Journ. Micr. Sci., xxxv. (1893) pp. 139–257 (5 pls.).

bring into a collected form our information on the subject. His classification, however, is quite new; five families are recognized—the Leucascidæ, Sycettidæ, Grantiidæ, Heteropidæ, and Amphoriscidæ—of these, as of their constituent genera, suitable diagnoses are given.

The canal-system is found to vary considerably in what appear to be closely related genera; if Dr. Dendy's views of relationships are correct, the Leuconoid type has been independently evolved from the Syconoid type, no less than three times. The former, however, cannot be produced until the corticate Syconoid type has been reached; then, the conversion of the originally long and radially disposed chambers into short, rounded, and irregular ones is such a simple matter that the change may well have taken place again and again. In passing from the most simple Syconoid type to the most complex Leuconoid there appear to have been five stages, which may be distinguished as the Sycetta, the Sycon, the Grantia, the Sylleibid, and the Leucandra-stages; most of the genera are found in the Grantia-stage. No one stage is very sharply marked off from the one below it, and the author thinks that the five indicate a process of evolution which has actually taken place.

The starting-point for the development of the skeleton is to be found in the radially symmetrical skeleton of *Sycetta;* this primitive radial symmetry is highly characteristic of the group, and is obviously dependent on the primitive radial symmetry of the canal-system. The first great change is due to the development of a dermal cortex, in which a special skeleton is found; the skeleton of the chamber layer of the sponge next begins to vary, in some cases because of the gradual change of the canal-system from the Syconoid to the Leuconoid type. Loss of radial symmetry now ensues, and the regular "articulate" type of *Sycon* and *Grantia* gives place to the irregularly scattered condition of *Leucandra.* Other modifications consist in the development of subdermal sagittal triradiate or quadriradiate spicules, such as are found respectively in the Heteropidæ and Amphoriscidæ. A kind of secondary centripetal radial symmetry may arise owing to the development of subdermal radiates with inwardly directed basal or apical rays. Very startling exceptions to the ordinary rules of skeleton structure are found in *Sycyssa* and *Leucyssa,* which appear to be due to the loss of all radiate spicules and the development of oxea.

The author gives a somewhat complex phylogenetic tree of the Heterocœla which, it cannot be doubted, are derived from the Homocœla. Of the latter the more advanced types appear to be found in the radiate section of the genus *Leucosolenia;* it is a most significant fact that, in the ontogeny of the simple Heterocœla, the radial tubes are formed as outgrowths from a central tube, exactly as in *L. tripodifera.* In the higher forms there has been a replacement of the collared cells of the central gastric cavity by a flattened epithelium, together with a specialization of the skeleton, such as might give rise to the primitive Heterocœle genus *Sycetta.*

Histology of Sponges.*—M. E. Topsent finds that while some sponges, such as *Desmacidon fruticosus, Reniera viscosa,* and others, give off an abundance of mucus on being taken out of the water, others, such

* Comptes Rendus, cxvii. (1893) pp. 444–6.

as *R. indistincta* are viscous, and others, especially the Chalininæ and the Ectyoninæ, are elastic. The thread-like liquid of *Desmacidon* and of *Dendoryx* is a true mucus, secreted by spherical cells, the glandular nature of which may be demonstrated with anilin dyes. Short notes are given on various Sponges of the three groups.

Notes on Sponges.*—M. E. Topsent gives a list of the nine species found by M. Alluaud at the Seychelles; among them are *Spongelia spinifera*, known from Lessina, Port Phillip, and Port Jackson, *Acervochalina finitima*, which has a connective tissue identical with that of *Reniera elegans* and *Chalina Montagui*, and *Ecionema rotundum*, which is, perhaps, only a variety of *E. acervus.*

He adds † *Spongilla fragilis* to the four species of French Spongillids already known, and has a note on some Sponges from the Gulf of Tadjoura ‡ (near Aden); among these there is a new genus which he calls *Axosuberites* (*A. Fauroti* sp. n.), in which there is a distinct axis formed of tylostyles and spongin.

Protozoa.

Structural Differentiation of Protozoa.§—Mr. J. E. S. Moore has succeeded in obtaining sections in series of *Spirostomum;* staining with gentian-violet, Victoria blue, or orange showed a splendid reticulum or vacuolation of the whole protoplasmic body. The meshes were finer round the nuclei and largest between them and the periphery, where there was a compact protoplasmic layer just within the actual outer membrane. The sections appear to indicate the existence of denser tracts of substance running down the entire length of each ridge. The presence, near the mouth, of refractive striæ probably means that the fibrillation represents the agent in transmission of something like a nervous impulse from the inner protoplasm to a specially mobile region.

When *Paramæcium* is treated in the same way as *Spirostomum* it shows no differentiation into a reticulum of chromatic fibres and achromatic spaces; the contents of the body are far more nearly uniformly made up of granular protoplasm.

Coccidia of Birds.‖—M. A. Labbé has found a very small, tetrasporous *Coccidium* in *Charadrius cantianus*, *C. philippinus*, *Strepsilas interpres*, *Calidris arenaria*, *Pelidna torquata*, *Tringa alpina*, and *Actitis hypoleucos.* One of the most interesting of its characters is the frequent presence of two light granules at the micropylar end. The author does not regard them as polar globules, and notices that they are sometimes absent, and that their presence appears to be dependent on the medium in which the Coccidia are developed. Seductive as it is to compare them with the polar globules of the eggs of Metazoa, their absence in many Coccidia, and the inconstancy of their appearance in those species in which they are developed are strong arguments against the comparison.

Coccidia.¶—M. P. Thélohan gives an account of the complex and as yet little studied differentiations which appear in the protoplasm of the

* Bull. Soc. Zool. France, xviii. (1893) pp. 172–5. † Tom. cit., p. 176.
‡ Tom. cit., pp. 177–80 (4 figs.).
§ Journ. Linn. Soc. Lond., xxiv. (1893) pp. 364–8 (1 pl.).
‖ Comptes Rendus, cxvii. (1893) pp. 407–9. ¶ Tom. cit., pp. 247–9 (3 figs.).

Coccidia during growth. Most of the author's observations were made on his new species of *Coccidium*, which he calls *C. cristalloides* (from *Motella tricirrata*) and *C. variabile* (from *Cottus bubalis* and other fish). There are no large refractive granules in the protoplasm of quite young examples, but they appear early, and do not disappear till the formation of the sporozoites. These granules appear to be of the nature of reserve-material, and to be comparable to the grains of aleurone found in vegetable cells. The author objects to Mingazzini's recent proposal to call them endoplasm, and proposes for them the term plastic granules. In addition to these constant elements there are others which are much larger and are of a different nature. These last, which are almost invisible in the fresh organism, are remarkable for the intensity with which they fix carmine and anilin colours; they would appear to have been already seen by Schneider in a species of *Eimeria*.

Psorospermosis or Gregarinosis.*—Prof. Sheridan Delépine and Mr. P. R. Cooper have made some observations on psorospermosis in rabbits. They found that *Coccidium oviforme* is invariably present in the alimentary canal of the rabbit, and that it is frequently present in the bile passages and gall bladder; it produces lesions in a certain number only. The prevalence of *Coccidia* and their lesions is greatest in young rabbits from 600 to 1200 grammes weight, less in younger rabbits, and still less in older and well-developed rabbits. This seems to show that a large number of rabbits recover from the invasion of the parasite. It appears that the presence of even a large number of *Coccidia* is not incompatible with the perfect health of the rabbit. It is easy to obtain very clear developmental changes in psorosperms allowed to remain for one or two days in tissues after the death of an affected animal.

Parasitic Amœbæ of the Human Intestine.†—Dr. A. Schuberg in a review of the parasitic Amœbæ affecting the human intestinal canal, refers to at least fifty authorities, a great number of whom deal specially with dysentery. An examination of the recorded cases renders it probable that Amœbæ and Flagellata are very common in the human intestine, and the author confirms this from his own observations. He examined the stools of about twenty persons not affected with enteritis, colitis, or intestinal irritation, and found that in about half the number of cases Amœbæ were present in considerable numbers. It is interesting to note that when the stools were obtained by aid of castor oil Amœbæ were always in small numbers. The aperient usually employed was Carlsbad salts.

The author next refers to the size, structure, and development of the parasites. In size they vary from 8 to 30 μ; their structure scarcely allows of differentiation into ectoplasm and endoplasm, though their body seems to be composed of a finely granular protoplasm bounded by a thin hyaline margin. The pseudopodia are few in number, as a rule only one or two being seen. Development seems to result from an outflow of the ectoplasm followed by the endoplasm. Many authors have

* Brit. Med. Journal, 1893, No. 1711, pp. 884–7 (1 fig.).
† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 598–609, 654–665, 701–714.

observed a nucleus (5–7 μ) and also a nucleolus. Vacuoles have been observed, but not contractile.

Cultivation experiments for the purpose of breeding the intestinal Amœbæ of man have failed.

The question of encystment in parasitic Protozoa is always important, for by this means is the parasite distributed, and according to competent observers *Amœba coli* passes through this phase.

The facts at our present disposal render it difficult to classify the Amœbæ coli, yet observers have attempted this, and a coarse subdivision into three groups has resulted: Amœbæ without any pathogenic action; Amœbæ, the specific causes of disease; and Amœbæ which, while harmless guests during health, aggravate disease when set up.

This subdivision is rather the result of the personal equation of the observers than of intrinsic differences in the parasites, and the author concludes that the facts at our disposal do not warrant a specific classification, much less to distinguish one group as *Amœba dysenteriæ*.

Cancer and Sporozoa Cell-diseases.*—This work by Dr. L. Pfeiffer is practically an édition de luxe of the author's 'Die Protozoen als Krankheitserreger.'†

It is issued in two volumes, the Text and the Atlas. The latter contains 80 photomicrographs, most of which (53) represent Sporozoa in muscle tissue, such as Sarcosporidia in the muscle of sheep, horse, and pig, Microsporidia in muscle of tortoise and frog, and Myxosporidia in muscle of some fish. The epithelial affections set up by Sporozoa receive less attention, for coccidiosis of rabbits and epithelial carcinoma in man are represented in 2 and 21 plates respectively, while the remaining 4 show an affection of the nerves in fish (*Thymallus vulgaris*)—an affection termed Polyneuritis myxosporidica.

Though much of what is dealt with is deeply interesting from a biological and pathological point of view it can hardly be said that the work bears out what is conveyed by its title, viz. researches on cancer; for cancer receives less attention than some other diseases due to Sporozoa infection. Yet the author's view seems clear, and we take it to be that there is great resemblance between many of these diseases due to animal parasites, and that the lower the organism is, the more readily it will adapt itself to its host, and therefore its pathogenic power and the destruction of its host's cells be so much the greater. The author considers that the cancer parasite belongs to that group of the Sporozoa called by Aimé Schneider, Amœbosporidia, an organism found in cancer in two developmental phases; the intracellular form which represents the resting cyst or resting-spore stage, and the zoospore form, when the parasitic germs lie free in the tissues and often infiltrate it in enormous numbers.

Coccidium in Colloid Cancer.‡—Dr. E. Burchardt states that he has found in a case of colloid cancer of the ovary, not only the intracellular forms, described by other observers, but bodies surrounded by a

* 2 vols., Jena, 1893, 62 figs. and 80 photomicrogr. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 618–22. † See this Journal, 1892, p. 808.

‡ Virchow's Archiv, cxxxi. (1893) No. 1 (1 pl.). See Centralbl., f. Bakteriol. u. Parasitenk., xiv. (1893) p. 150.

definite capsule—a discovery that the author considers is confirmatory of the coccidial nature of these bodies.

A round thick-walled cyst was observed within a cell, inside the cyst was seen a thin-walled vesicle which in its turn enclosed a thick-walled vesicle.

In the last he easily recognized a grape-like appearance, made up of five roundish bodies. The whole cyst was taken to be the resting spore cyst of a coccidium, the thin-walled vesicle was supposed to be the spore, and the five roundish bodies were germs.

Pathogenesis of Malaria.*—The views of Dr. Bacelli on malaria infection may be summed up as follows. Severe cases of fever of a malarial nature occur in which it is absolutely impossible to demonstrate in the blood the presence of pathogenic micro-organisms during the first days of the disease. Even when found, these organisms may be so few in number that it is impossible to maintain the causal connection between the quantity of parasite on the one hand, and the severity of the fever on the other. Amœbæ may exist in the blood in large numbers, provided they have not yet attained the stage of spore-formation, without exciting fever. The occurrence of the paroxysm may be predicted with certainty if within the blood-corpuscles are found micro-organisms in condition of fission or of spore-formation. But when an attack has taken place, the sporulating and those new forms which were the indicators of the paroxysm are no longer to be found in the blood-corpuscles. Among those cases in which a paroxysm has been artificially induced, some (even of the severest type) have been observed, wherein no species of pathogenic micro-organisms have been detected within the corpuscles. Fatal cases of undoubted malaria have been observed wherein the known forms of Hæmatozoa have not been found. The damage which a microbe sets up in the human organism may be referred to the " morphological blood-dyscrasia "—i. e. to the progressive destruction of the red corpuscles from the action of the parasites —or to the " chemical blood-dyscrasia," i. e. to the presence in the blood of spore and fission products. In either of these ways may the ætiogeny of malaria infection be explained. The morphological blood-dyscrasia goes hand in hand with the metamorphosis of hæmoglobin, with the circulation of the intact residue of red corpuscles, and with the prevention of the change from hæmoglobin into oxyhæmoglobin. All this may happen without the production of fever. A positive effect may be ascribed to the chemical dyscrasia, in which case the blood is infected by the spores arising out of the breaking up corpuscles. At the same time, the formation of toxic products recurs, and these exert a morbid action on the nervous system, and especially on the vaso-motor ganglia.

* Deutsche Med. Wochenschr., xviii. p. 721. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 367–8.

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

α. Anatomy.

(1) Cell-structure and Protoplasm.

Division of the Cell-nucleus.*—M. C. Decagny calls attention to the fact that at the moment when the nucleus is about to divide it is seen to swell considerably. This is due to the expulsion of albuminoid matters from the nucleole; and these are then again expelled from the nucleus by diffusion through its membrane. It is the most diffusible matters that escape first into the cell, where they are immediately coagulated by contact with the cell-sap, and large vacuoles are formed around the nucleus; these swell in the same way as the nucleus, for which they serve as appendages filled with the same albuminoid substances. These processes take place equally in *Spirogyra* (*setiformis* and *jugalis*) and in the endosperm of the lily.

Constitution of the Cell.†—In a fresh contribution on this subject Dr. L. Buscalioni deals with the ovules of *Veronica hederæfolia* and of several species of *Verbascum*. In the ovule of *Veronica* he notices a remarkable difference in the structure of the micropylar and chalazal extremities of the embryo-sac. The structure and development of the ovule of *Verbascum* are described in great detail, and the observations lead to the following conclusions:—

The structure of the protoplasm is reticulate. The filaments or meshes of the protoplasmic network are composed of microsomes and of a cementing substance, and are completely transformed into cellulose, while maintaining entirely their optical appearance. The thickening layers of the cell-wall are composed of cellulose and not of cutin. In the cellulose-filaments are two substances, the cement and the granules, of different physical and chemical constitution. The granules bear a remarkable resemblance to the so-called "bacteroids" of the root-tubercles of Leguminosæ, and are probably identical with them.

Mechanics of Growth of the Cell-wall.‡—Herr A. Zimmermann publishes a contribution to the solution of the question whether the increase of surface of cell-walls is always due to turgor. Intercellular spaces he divides into two classes, according as the walls of the limiting cells bulge inwards or outwards. In the former case the growth of the cell may clearly be attributed to turgor; the latter present greater difficulties. To this latter category belong the intercellular spaces in the parenchyme of *Juncus*. Here the branches of the stellate cells are formed by protrusion, and the phenomena are quite compatible with growth by turgor. But in the branched palisade-cells of the leaves of *Pinus* the process is different, and the folds grow centripetally towards the interior of the

* Comptes Rendus, cxvi. (1893) pp. 1397–1400.
† Malpighia, vii. (1893) pp. 105–62 (2 pls.). Cf. this Journal, *ante*, p. 57.
‡ Beitr. z. Morph. u. Phys. d. Pflanzenzelle (Zimmermann) Heft 3, pp. 189–240 (13 figs.). See Bot. Centralbl., lv. (1893) p. 105.

cell; in these cases the hypothesis of growth by turgor is excluded. The mode of growth of the epidermal cells of the leaves of *Pteris serrulata* and of some flowering plants, which have wavy lateral walls, appears to agree with that of the stellate cells of *Juncus*.

Karyokinesis in Spirogyra.*—Dr. J. W. Moll has made a series of observations on the mode of division of the nucleus in the cells of a species of *Spirogyra* (probably *S. crassa*). They relate chiefly to transitional stages between some well-known stages of karyokinesis, and appear to indicate that the process is still more complicated than has been hitherto supposed. The observations lead to the conclusion that in the resting nucleole there are one or more threads which tenaciously retain the staining reagents, and cause a skein-structure; and that the nucleole always contains a certain number of minute vacuoles. Chromatic substance does not exist to any appreciable amount outside the resting nucleole; in the stage of the nuclear plate it appears exclusively in the twelve nuclear segments. The phenomenon termed by Flemming heteropoly certainly occurs in *Spirogyra*.

Average Size of Cells.†—Herr E. Amelung has made an elaborate series of measurements of the average size of the cell in different plants and parts of plants, and has arrived at the following general conclusions:—Organs of different size, but of the same description, belonging to the same individual, consist of cells of the same, or of nearly the same size; the size is generally smaller in aquatic than in land plants. The largest tissue-cells observed were those of the stem of *Impatiens glandulifera*, 0·79 by 0·18 mm. Pollen-grains of anemophilous are generally smaller than those of entomophilous flowers.

Formation of the Cell-wall in the Hairs of Lavatera.‡—Dr. C. Acqua describes the aerial hairs of *Lavatera cretica* as being unicellular, the cell-wall at the apex being thickened so as to form a cap of considerable thickness. This thickened portion of the cell-wall is distinctly laminated, and the author has determined with certainty that the layers of greater and less refracting power are formed separately from portions of the protoplasm more or less rich in microsomes.

(2) Other Cell-contents (including Secretions).

New Vegetable Nuclein.§—M. P. Petit has extracted from the embryo of the barley-grain a new vegetable nuclein containing iron, with a percentage composition, given as C 43·18, H 6·64, N 12·86, Ph 1·11, Fe 0·195, ash 6·2, Si 3·2, O (by difference) 31·1. It differs from the animal nucleins in containing no sulphur. The chemical and physical properties of the substance are given in detail. The author thinks it probable that an analogous substance is contained in the soil.

Ferment of the Pine-apple.‖—Mr. R. H. Chittenden states that the ripe pine-apple contains a very powerful proteid-digesting principle, and the juice also possesses in a remarkable degree the power of curdling

* Verhandl. Kon. Akad. Wetensch. (Amsterdam), 1893, 36 pp. and 2 pls. (English).
† Flora, lxxvii. (1893) pp. 176–207.
‡ Atti R. Accad. Lincei, 1893, pp. 154–8.
§ Comptes Rendus, cxvi. (1893) pp. 995–7.
‖ Trans. Connecticut Acad. Arts and Sci., viii. (1893) pp. 281–308.

milk. The juice appears to contain three distinct proteids, two separable from the acid juice by heat alone, one at about 75° C., the other at 100°, while the third is not coagulable by heat, but is precipitated by acetic acid and potassium ferrocyanide. The proteid-digesting power of the juice is manifested in acid, neutral, or alkaline fluids, the ferment in this respect resembling trypsin rather than pepsin; it acts most strongly in a neutral solution. A number of experiments are described on the influence of the reaction of the fluid, on the influence of temperature, and on the rate of action. The proteolytic ferment may be separated from pine-apple juice either by saturation of the neutralized fluid with sodium chloride, or by saturation with magnesium sulphate, the former being the preferable method. It appears to be a mixture of a globulin and a proteose.

Formation of Oil or Resin in Schizogenous Receptacles.*—Herr A. Tschirch brings forward fresh evidence in favour of the view that in these receptacles the secretion is not formed inside the so-called "secreting cells," but from the gelatinized wall of these cells which faces the receptacle.

(3) Structure of Tissues.

First Formation of Vessels in the Leaves of Compositæ.†—M. A. Trécul states that in those species of Compositæ which have narrow leaves, such as *Tragopogon* and *Scorzonera*, the first veins formed at the base of the leaf are always parallel to the mid-rib; when they have extended to the whole length of the leaf they begin to anastomose with one another and with the mid-rib. A vascular network then makes its appearance a little below the extremity of the bundles at the summit of the leaf or still lower down; and this network then extends towards the base of the leaf.

Tannin-cells in the Fruit of the Carob.‡—Prof. R. F. Solla has followed out the development of the tanniferous cells which occur exclusively in the parenchyme of the fruit of *Ceratonia siliqua*. He finds them already in the very earliest stage of the young ovary. Their contents consist of a mixture of substances belonging to the group of tannins, with other substances of a proteinaceous character, the chemical reactions of which are given in detail.

Structure of Prionium serratum.§—Prof. F. Buchenau publishes a detailed account of the structure of this conspicuous plant of the Cape flora, the only shrubby member of the natural order Juncaceæ. It occupies an isolated position in the order, presenting some analogies with the fossil Restiaceæ. One of its distinguishing characters is the abundance of scattered vascular bundles in the interior of the stem.

Histology of Rheum.‖—Herr J. C. Koningsberger describes the presence of peculiar resin-receptacles in the root and rhizome of *Rheum*

* Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 201–3.
† Comptes Rendus, cxvi. (1893) pp. 850–6.
‡ Bull. Soc. Bot. Ital., 1893, pp. 121–4; and Malpighia, vii. (1893) pp. 209–42 (1 pl.).
§ Biblioth. Bot. (Luerssen and Haenlein) Heft 27, 1893, 26 pp. (2 pls. and 1 fig.).
‖ Bot. Ztg., li. 1te Abtheil. (1893) pp. 85–8 (1 pl.).

macrorhizum. They are found in the xylem of the vascular bundles, and are surrounded by a tissue which presents all the features of true cork.

(4) Structure of Organs.

Multiplicity of Homologous Parts.*—M. A. Chatin disputes the theorem of De Candolle that the most perfect plants are those in which the floral organs are most numerous and most distinct. He maintains, on the contrary, that the multiplicity of homologous organs is a sign of degradation. The doubling of the corolla occurs but rarely, and that of the calyx never, among the Gamopetalæ, while both are common phenomena among the Apopetalæ. Hence the Gamopetalæ, and not the Ranunculaceæ among the Apopetalæ, must be regarded as the highest type of flowering plants. This view is confirmed by the frequent suppression of the corolla in the Ranunculaceæ. A uniformity of law in the vegetable and in the animal kingdoms is thus also established.

Epicalyx of Tofieldia.†—From a study of its development, Dr. G. Paoletti assigns to the epicalyx or involucre of *Tofieldia palustris* a foliar origin similar to that of the spathe of *Allium*, *Galanthus*, and *Leucojum*. It results from the union of three leaves.

Development of the Caryopsis.‡—Mr. R. H. True thus sums up the results of his observations on the development of the fruit of grasses, made chiefly on the Indian corn, wheat, and oat. At the time of fertilization the ovule is furnished with two integuments, which are more or less complete. As development proceeds, the outer integument soon disappears, the inner cells of the ovary wall are absorbed in varying proportions, and the tissue of the nucellus is also absorbed, with local exceptions. At maturity there remain as seed-coverings:—the external portion of the ovary wall, in varying proportion, forming the pericarp; and the inner integument persisting in a state of compression. The epiderm of the nucellus also persists, though much compressed. Late in the development of the fruit, the remaining (inner) integument becomes soldered to the adjacent inner cells of the pericarp.

Floating-apparatus of the Fruit of Proteaceæ.§—Dr. A. Nestler describes the apparatus by means of which the fruits or seeds of many Proteaceæ are carried by the wind; while in other cases the same end is obtained by trichomic structures on either the fruit or seed. In *Leucadendron argenteum* the perianth-tube splits, when the fruit is ripe, into four divisions, which are however held together by a small piece of undivided tube. The perianth remains attached to the ripe fruit by means of the capitate stigma, and thus serves as a floating-apparatus. The perianth may also possibly serve as a protection against evaporation.

Leaves of Ranunculaceæ.‖—Dr. A. Nestler calls attention to certain anatomical peculiarities of structure in the leaves of some Ranunculaceæ.

* Comptes Rendus, cxvi. (1893) pp. 1276–80.
† Bull. Soc. Ven.-Trent. Sci. Nat., v. (1893) pp. 128–32.
‡ Bot. Gazette, xviii. (1893) pp. 212–26 (3 pls.).
§ Engler's Bot. Jahrb., xvi. (1893) p. 325 (1 pl.). See Bot. Centralbl., liii. (1893) p. 378.
‖ Oesterr. Bot. Zeitschr., xliii. pp. 166–71, 215–20 (2 pls.).

In *Clematis balearica* and *cirrhosa* the ordinary thin dividing wall of two cells is widened to a wedge-shaped structure which reaches to the inner walls and shows the reactions of cutin. Pluricellular trichomes are especially characteristic of the genus *Thalictrum.* Vascular bundles are frequently found in the medullary tissue of the leaf-stalk. Crystals of calcium oxalate very rarely occur in the leaves.

Pitchers of Dischidia.—Three species of *Dischidia* (Asclepiadeæ) produce pitchers. Mr. P. Groom * describes in detail the structure and functions of those of *D. Rafflesiana*, a twining epiphyte found chiefly on decaying trees at Singapore. The author confirms in the main Treub's view that they are not adapted for the capture of ants or other insects, and that their chief purpose is the storage of water. Living and dead insects are, however, found abundantly in the pitchers; and the detritus formed by them and by the substances which they bring is probably utilized in the nutrition of the plant, being absorbed by adventitious roots formed within the pitchers.

The pitchers are leaves modified for the purpose of providing shelter for ants and for accommodating the materials brought by them, and for the storage of rain-water and of the substances brought down with it.

Dr. D. H. Scott and Miss E. Sargant † have arrived at the same general conclusions with regard to the function of the pitchers of *Dischidia Rafflesiana.* The inside of the pitchers is coloured a deep purple due to a soluble pigment which is limited to a thin layer of the mesophyll next the inner surface. Besides unicellular glandular hairs which secrete mucilage, the plant bears secretory emergences in three positions, petiolar, laminar, and apical; they secrete mucilage, and are neither carnivorous nor myrmecophilous. The structure of the adventitious roots, which presents some anomalies, is described in detail.

Bud-protection in Dicotyledons.‡—Mr. P. Groom describes the mode in which the young buds are protected by colleters in plants belonging to the natural orders Rubiaceæ, Apocynaceæ, Asclepiadeæ, Guttiferæ, and Dilleniaceæ. These villous colleters are by no means always trichomes, but are frequently emergences, as is shown by their being penetrated by laticiferous tubes or vascular bundles. They are apparently not only protective, but also excretory. In some cases the secretion passes through the cuticle. The villi contain transitory starch, raphides or sphero-crystals, colouring matters, and tannins.

Winter-buds of Utricularia.§—Mr. J. M. Holzinger describes the winter buds or "hibernacula" of *Utricularia intermedia.* They consist of numerous broadly palmate scales crowded along a short axis and furnished along the margin with tufts of bristles; these scales appear to be metamorphosed leaves.

Rhizome of Corallorhiza.‖—Mr. M. B. Thomas describes the structure of the coral-like rhizome of *Corallorhiza* (chiefly *innata* and *multi-*

* Ann. Bot., vii. (1893) pp. 223–42 (1 pl.), and Proc. Roy. Soc., liii. (1893) pp. 51–2. † Ann. Bot., vii. (1893) pp. 243–68 (2 pls. and 3 figs.).
‡ Trans. Linn. Soc., iii. (1893) pp. 255–66 (2 pls. and 1 fig.).
§ Bull. Torrey Bot. Club, xx. (1893) pp. 288–90 (1 pl.).
‖ Bot. Gazette, xviii. (1893) pp. 166–70 (2 pls.).

flora). He finds no evidence to support the statement of the parasitic habit of the genus. On the other hand the cells of the cortical tissue contain a great quantity of septate hyphal filaments which readily pierce the cell-walls and are sometimes continued outside the stem; they are only rarely found in the epiderm. They appear to belong to a true symbiont, supplying, from the decaying vegetable matter which surrounds the rhizome, the greater part of the nutrient substances required by the plant.

β. Physiology.

(1) Reproduction and Embryology.

Embryo-sac and Embryo of Senecio aureus.*—Mr. D. M. Mottier has examined the structure and development of these organs in this species, and finds that they differ in some respects from those described by Strasburger in *S. vulgaris*. The nuclei of the synergids lie imbedded in the protoplasmic lining of the cell, about midway between the anterior and posterior ends, not in the posterior third, as in the case of *S. vulgaris*. The antipodals occupy the entire posterior end of the embryo-sac, lying in a longitudinal row. They are not absorbed during the formation of the endosperm, but persist throughout. The suspensor consists of only a few cells, usually three or four. The endosperm cells are relatively large, and not very rich in protoplasm, while the layer of cells which forms the wall of the embryo-sac, and which is the modified adjacent part of the integument, is rich in protoplasm and nuclei.

Pollen-tube of Gymnosperms.†—Pursuing his researches on this subject, Herr W. Belajeff now compares the results obtained in *Taxus* with those from other divisions of the Coniferæ, especially the Abietineæ and Cupressineæ. In the Abietineæ we find the most complex structure; at the base of the pollen-tube are two small motionless cells, which must be regarded as the vegetative cells of the prothallium; the remaining cells from which the tube is formed are the homologue of the antherid of cryptogams. This antherid consists of a large outer cell which lengthens into the tube and corresponds to the parietal cells, and of an inner cell homologous with the mother-cell of the antherozoids. In the Abietineæ the inner cell divides into three; the two anterior ones take part in the impregnation, while the posterior cell becomes disorganized. In the Cupressineæ the pollen-tube has a much simpler structure. Here there are no small motionless cells, and the male prothallium is reduced to an antherid. The small inner cell divides into three, of which two take part in the process of impregnation. In *Taxus*, on the contrary, the anterior inner cell does not divide into two, but expels its nucleus, and there is only one fertilizing cell.

In Phanerogams the author maintains, therefore, in opposition to the view of Strasburger,‡ that it is the inner cell of the pollen-grain which is the active agent in impregnation.

Andrœceum and Gynœceum of Grasses.§—Herr St. J. Golinski has studied the development of the sexual organs in a number of Gramineæ belonging to different tribes.

* Bot. Gazette, xviii. (1893) pp. 245–53 (3 pls.).
† Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 196–201 (1 pl.). Cf. this Journal, 1892, p. 231.
‡ Cf. this Journal, *ante*, p. 655.
§ Bot. Centralbl., lv. (1893) pp. 1–17, 65–72, 129–35 (3 pls.).

The wall of the anther is composed of four distinct layers—the epidermal layer or exothecium, the endothecium or fibrous layer, the temporary layer of Strasburger, and the tapetal layer. The cells of this last layer are especially rich in protoplasm, and their nuclei are very strongly coloured by pigments. There are two nuclei in each cell, but these often unite into an hour-glass-shaped single nucleus. A vascular bundle runs through the connective, surrounded by large parenchymatous cells. The primary pollen-mother-cells are much larger than those of the surrounding layers, and are at first polygonal in form; their nuclei have only eight chromatin-segments.

The embryo-sac is characterized throughout the order, with a few exceptions, by the large number of antipodals, which fill up, at a late period, the greater part of the embryo-sac. The nuclei frequently divide without the formation of walls. The number of chromatin-granules is twelve in the earlier, twenty-four in the later stages. Each nucleus has one, less often two or three, nucleoles. The author adopts the view that the antipodals exercise an important function in the conveyance of nutrient materials to the embryo.

Fertilization of the Fig.*—As the result of observations made in San Francisco by Herr G. Eisen, Graf zu Solms-Laubach believes that the true Smyrna fig is at present unknown in Europe, and that the cultivated figs are of two different classes, viz.—(1) the Smyrna fig, which requires pollination or caprification in order to produce fruit; and (2) the ordinary edible fig, which can produce the fruit (receptacle), but without seeds, even when not artificially pollinated. The ancestor of the Smyrna fig appears to be the female *Ficus Caprificus*, while the Italian fig is derived from the male plant.

Pollination of Rohdea.†—Sig. S. Baroni has studied the mode of pollination of *Rohdea japonica*, and finds it to be due chiefly to gastropodous Mollusca, though insects (especially ants) and worms take some part in it. The anatomy of the plant is described in detail, and it is stated that in the tissue of the anther are two layers only of fibrous cells, and that one of the two integuments which invest the ovule is absorbed in the ripe seed. The genus is placed in the tribe Asparageæ of Liliaceæ.

Parasitic Castration of Knautia arvensis.‡—M. Molliard has examined plants of *Knautia arvensis* attacked by *Peronospora violacea*, in which the effect has been to cause the central flowers of the inflorescence to assume the appearance of the ray-flowers; they are much larger in size, with a deeply lobed irregular corolla, and of a deeper hue; both male and female organs were also more or less completely atrophied. In other plants, attacked by *Ustilago Scabiosæ*, the anthers and many of the ovaries were also atrophied, while others of the ovaries were fertile, and two or three times the normal size.

* Bot. Ztg., li. (1893) 1te Abtheil., pp. 81–4.
† Nuov. Giorn. Bot. Ital., xxv. (1893) pp. 152–75.
‡ Comptes Rendus, cxvi. (1893) pp. 1306–8.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Germination of Umbelliferæ.*—M. L. Géneau de Lamarlière has noticed various peculiarities in the mode of germination of certain species of Umbelliferæ. In some species—*Smyrnium Olusatrum*, *perfoliatum*, and *rotundifolium*, *Myrrhis odorata*, *Thapsia villosa*, *Ferula communis* and *glauca*, and *Chærophyllum bulbosum*—the lower portions of the cotyledons are coalescent into a longer or shorter tube, partly above and partly below the surface. In *Conopodium denudatum* and *Bunium Bulbocastanum*, the coalescence of the two cotyledons is more complete, giving the appearance of there being only one. In *Smyrnium rotundifolium* and *Chærophyllum bulbosum* the cotyledonary tube is covered in its lower portion by a coating of hairs similar to that of the root; the hypocotyledonary axis passes insensibly into the root. In *Bunium* and *Conopodium* the normal plumule is suppressed, and is replaced by a bud having a lateral origin near to the root, which is swollen into a tuber.

Growth of Plants.†—Prof. E. Godlewski has made a series of experiments—chiefly with the epicotyl of *Phaseolus multiflorus*—on the influence of certain external factors on the growth of plants, and on the mode in which this influence is exercised. The apparatus used was Baranetzki's auxanometer.

The daily variations in the growth of green plants under normal light-conditions he finds not to be nearly so regular as has been stated by Sachs; they depend very largely on the individual properties of the plant, and vary also according to the period of the year. In etiolated plants the periodicity is much less marked. Rapid decrease of the moisture of the air affects turgor and tension rather than actual growth. The effect of sudden illumination is transitory. The effect of a sudden fall in temperature of the air is very marked; the influence of the temperature of the soil on growth is very slight.

In the phenomena of growth the author distinguishes two factors—the extension of the membrane from turgor, and the restoration of its extensibility. The gradual decrease in the intensity of growth after the maximum has been attained, is due to the gradual decrease of the extensibility of the membrane; the extension due to turgor appears necessarily to precede growth. The slower growth of illuminated than of etiolated internodes is the result of a diminished extensibility of the membrane due to light. The smaller thickness of the membrane of etiolated internodes is the result, not the cause, of stronger growth.

Growth of the Silver-fir.‡—In an elaborate paper on the morphology and periodicity of growth of the silver-fir, Dr. W. Busse thus sums up his general conclusions:—In relation to its form and anatomical structure, the cone of growth may be regarded as belonging to one of three types,—those of the stem, of the longer, and of the shorter shoots; and the structure of the branch is already determined in that of the resting bud. A lower type may, however, pass over into one of a higher denomination. The plerome or pith of the cone of growth is usually

* Rev. Gén. de Bot. (Bonnier) v. (1893) pp. 159–71, 224–9, 258–64 (15 figs.).
† Abhandl. Krak. Akad. Wiss., xxiii. pp. 1–157. See Bot. Centralbl., lv. (1893) p. 34.
‡ Flora, lxxvii. (1893) pp. 113–75 (1 pl.).

composed of two anatomically different tissue-elements, which appear also to have a different physiological function so long as the shoot is in the bud-condition. The growing point (in the narrower sense), the procambial bundles, and the bud-sheath, are always destitute of chlorophyll and starch while enclosed within the bud, chlorophyll being formed in their cells as soon as they pass out of the embryonal condition.

Development of the Tubercles of Leguminosæ.*—M. E. Gain finds that the humidity of the soil has a considerable influence in promoting the development of the tubercles of Leguminosæ. The experiments were made on *Pisum sativum*, *Lupinus albus*, *Faba vulgaris*, *Lotus corniculatus*, *Orobus niger*, and *Trifolium procumbens*.

Exudation from Leaves.—The late Prof. F. Pasquale † records the occurrence of the fall of a quantity of fluid in the form of small drops from the leaves of lime-trees. The phenomenon is in no way connected with the production of manna as the result of the attacks of aphides, but resembles the process which takes place normally in *Cæsalpinia pluviosa* and some other trees. It takes place only during the period immediately preceding the opening of the flowers, when the vital processes are most active, and when the transpiration from the leaves is not sufficient to eliminate the whole of the water absorbed from the soil.

M. E. Guinier ‡ describes a similar exudation from the leaves of an orange-tree.

Transpiration from Grafts. §—M. L. Daniel finds, in the case of herbaceous grafts, a strong formation of starch. This is the result of the dehydrization of sugar, transpiration taking place at the expense of substances contained in the grafts, in consequence of a diminished flow of crude sap from the stock.

(4) Chemical Changes (including Respiration and Fermentation).

Entrance of Diastase into the Endosperm. ‖—Herr J. Grüss describes the mode in which, in the maize, the diastase-ferment is excreted from the palisade-cells of the scutellum, and thence passes into the tissue of the endosperm, causing the conversion of starch into glucose in its cells. In Dicotyledons the formation of diastase takes place at the point of insertion of the cotyledons, whence it advances gradually through the tissue.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Sporophyte of Vascular Cryptogams.¶—Prof. F. O. Bower discusses several points in the morphology of the spore-producing members of the Equisetaceæ and Psilotaceæ. He does not agree with Goebel's statement that the archespore of *Equisetum* is of hypodermal origin; the

* Comptes Rendus, cxvi. (1893) pp. 1394–7.
† Bull. Soc. Bot. Ital., 1893, pp. 257–61.
‡ Comptes Rendus, cxvi. (1893) pp. 1001–2. § Tom. cit., pp. 763–5.
‖ Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 286–92 (1 pl.).
¶ Proc. Roy. Soc., liii. (1893) pp. 19–23.

essential parts of the sporange may be traced to a single superficial cell. The tapete is derived from the series of cells immediately surrounding the sporogenous tissue. The author regards the whole sporangiophore of *Psilotum* as of foliar nature, the synange being a growth from its upper surface. The synange of the Psilotaceæ is homologous with the "fertile frond" of the Ophioglossaceæ. The relationship is further pointed out between *Tmesipteris* and *Lepidodendron.*

Development of Azolla.*—Prof. D. H. Campbell has followed out in detail the life-history of *Azolla filiculoides.* The stem always grows from a single apical cell, from which two series of segments are cut off with great regularity. The sporocarps or sori always arise from the ventral lobe of the first leaf of a branch. The whole of the ventral lobe goes to form the sori, the involucre being derived from the whole of the dorsal lobe. In all cases only one megasporange is formed, and this directly from the apical cell of the sporocarp-rudiment. The divisions in the central cell correspond to those in other Leptosporangiates. The development of the megasporange bears a remarkable resemblance to that of an ovule, the indusium being apparently homologous with the first integument of the ovule. The term "swimming apparatus," which has been applied to the singular episporic appendages of the megaspore, is misleading; they apparently have no such function, the spores always sinking in the water.

The development of the microsporange corresponds in essential points to that of the megasporange; the formation of the massulæ and glochids is described in detail, as well as the germination of the microspores and megaspores. The antherid appears to consist of two cells only. *Azolla* differs from the other Hydropterideæ in the lower of the two nuclei which result from the division of the primary nucleus of the megaspore being equal in size to the nucleus of the prothallium mother-cell, and undergoing repeated division. A nucleated protoplasm or "endosperm" is thus formed, and it is evidently concerned in the elaboration of the reserve food-material in the spore; the process resembles that in *Selaginella.* If the archegone first formed is fertilized, no others are formed, but when this is not the case, a number of secondary archegones are produced. The development of the archegone closely corresponds to that in *Salvinia.*

The general conclusion arrived at by the author is that the nearest ally to *Azolla* is unquestionably *Salvinia,* though there are important differences. From the Marsileaceæ the divergence is still greater. The two families of the Hydropterideæ probably represent the ends of two different lines of development, the Salviniaceæ having been derived from the lower members of the Leptosporangiate series, near the Hymenophyllaceæ, the Marsileaceæ from forms more resembling the Polypodiaceæ.

Colonies of *Anabæna Azollæ* were invariably found in the large cavity of the dorsal lobe of the leaf. Before the megasporange becomes enclosed in the indusium, the *Anabæna* filaments creep into it, and form a mass filling up all the space between the top of the sporange and the opening of the sporocarp.

* Ann. Bot., vii. (1893) pp. 155-88 (3 pls.). Cf. this Journal, 1892, p. 825.

Apospory in Lastrea.*—A fresh example of apospory is described by Mr. C. T. Druery in the case of a species of *Lastrea*, probably *L. pseudo-mas* var. *cristata*. It occurs in a young seedling only just emerged from the prothallium.

Structure of Lepidodendron.—From a careful examination of specimens of *Lepidodendron selaginoides*, M. M. Hovelacque † confirms his previous conclusion that this plant was a vascular cryptogam with centradesmid bundles.

Herr H. Potonié ‡ describes the structure of the leaf-cushions of *Lepidodendron* and *Lepidophloios*. The latter of these genera differs from the former in the cushions projecting strongly like the scales of a fir-cone. They are imbricated, but point downwards instead of upwards.

Muscineæ.

Arrangement of Hepaticæ.§—Mr. A. W. Evans gives a synopsis of the genera as at present accepted, 117 in number, with their complicated synonymy. They are classified into 4 orders, Jungermanniaceæ, Anthocerotaceæ, Marchantiaceæ, and Ricciaceæ. The Jungermanniaceæ comprise 11 tribes, viz. Frullanieæ (7 gen.), Ptilidieæ (9 gen.), Lepidozieæ (18 gen.), Saccogyneæ (3 gen.), Jungermannieæ (19 gen.), Cœocauleæ (8 gen.), Acrobolbeæ (6 gen.), Fossombronieæ (14 gen.), Monocleæ (1 gen.), Metzgerieæ (1 gen.), and Aneureæ (1 gen.) The Anthocerotaceæ are made up of 3 genera. The Marchantiaceæ comprise 3 tribes, viz. Marchantieæ (15 gen.), Lunularieæ (2 gen.), and Targionieæ (2 gen.). The Ricciaceæ include 2 tribes, the Riccieæ (5 gen.), and the Sphærocarpeæ (3 gen.).

Rudimentary Hepaticæ.‖—Prof. K. Goebel describes several species of Hepaticæ in which a very simple structure is associated with a great reduction in size of both the sexual and the non-sexual generation.

Protocephalozia ephemeroides. The protoneme is here persistent, as in *Ephemerum* among Musci; the leafy shoot arising as an appendage to the protoneme. The protoneme consists of two parts, underground and aerial, the former being destitute of chlorophyll; the sexual shoots spring from the lower part of the aerial filaments.

Pteropsiella frondiformis. This presents an intermediate form between the thallose and the foliose Hepaticæ, the stem-leaves being replaced by a broad green wing. On the ventral side of the thallus are very rudimentary amphigasters. The thallose shoot has a three-sided pyramidal apical cell as in the foliose forms. It is properly a foliose form in which the lateral leaves have a horizontal position and are coalescent, but with two hairlike appendages on the margin of the thallus.

Lejeunia Metzgeriopsis. A minute epiphytic diœcious liverwort, formerly described as *Metzgeriopsis pusilla*. The thallus is here simply a higher development of the protoneme, bearing rows of cells which are

* Journ. Linn. Soc. (Bot.), xxix. (1893) pp. 479–82 (1 pl.).
† Bull. Soc. Bot. France, xl. (1893) pp. 48–55. Cf. this Journal, 1892, p. 237.
‡ Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 314–26 (1 pl.).
§ Trans. Connecticut Acad. Arts and Sci., viii. (1893) pp. 262–80.
‖ Flora, lxxvii. (1893) pp. 82–103 (1 pl. and 20 figs.).

the fore-runners of leaves. Other instances are given in which the differentiation of the vegetative structure varies greatly within the same genus, showing that the primary classification of the Hepaticæ into thallose and foliose forms is not a natural one.

Metzgeriopsis.*—Dr. V. Schiffner describes in detail the structure of the vegetative and reproductive organs of *Metzgeriopsis pusilla*, his observations agreeing in all essential points with those of Goebel. There are, however, not sufficient reasons for separating the genus from *Lejeunia*, in which it must be sunk as the type of a new sub-genus. The thallus consists of a single layer of cells, and is destitute of any trace of a mid-rib. Gemmæ are formed abundantly on its upper surface. There are no amphigasters on either male or female shoot. The sub-genus differs from all the others into which *Lejeunia* is divided in the formation of a true thallus.

Development of Riella.†—Prof. K. Goebel describes the development of an Algerian species of *Riella*. The wings of the thallus do not grow out of the mid-rib, and the growing point is intercalary, in which point *Riella* differs from all other Hepaticæ. The antherids are imbedded in the wing; the archegones spring from the mid-rib. The development of the thallus in a vertical rather than in a horizontal direction is a result of the aquatic mode of life.

Algæ.

Lophothalia and Seirospora.‡—Prof. F. Schmitz discusses the systematic position of these two genera of Florideæ.

Owing to prior use of the name, Agardh's genus *Lophothalia* must be entirely suppressed; and Schmitz regards the following genera as well-established:—*Brongniartella* (typ. sp. *B. byssoides*); *Lophothalia* Ktz., with sub-genera Eulophothalia (typ. sp. *L. verticillata*), and Doxodasya (typ. sp. *L. bolbochæte*); *Wrightiella* g. n. (typ. sp. *W. Blodgettii*); *Lophocladia* g. n. (typ. sp. *L. trichoclados*); *Dasya* (typ. sp. *D. elegans*); *Murrayella* g. n. (typ. sp. *M. periclados*); and *Wilsonea* g. n. (typ. sp. *W. dictyuroides*).

Harvey's generic name *Seirospora* must take the place of Agardh's *Microthamnion*, which had previously been used by Nägeli for a genus of Chlorophyceæ. *Seirospora* is distinguished from its nearest ally *Callithamnion* by the structure of the cystocarps, the gonimoblasts of which form branched tufts of sporogenous filaments, while the sporanges most often contain only two instead of four spores.

Morphology of the Fucaceæ.§—Miss A. L. Smith claims *Coccophora Langsdorfii* as one of the most highly organized of the Fucaceæ. The conceptacles are diœcious. *Seirococcus axillaris* is described in detail.

According to Miss E. S. Barton ‖ *Xiphophora Billardierii* is diœcious; each oogone contains four oospheres divided tetrahedrally.

Notheia anomala is described by Miss M. O. Mitchell ¶ as parasitic

* Oesterr. Bot. Zeitschr., xliii. (1893) pp. 118–22, 153–60, 205–10 (1 pl.).
† Flora, lxxvii. (1893) pp. 104–8 (1 pl. and 4 figs.).
‡ Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 212–32, 272–86.
§ Phycol. Mem. (Murray) ii. (1893) pp. 30–4 (2 pls.).
‖ Tom. cit., pp. 35–6 (4 figs.).
¶ Tom. cit., pp. 36–7 (4 figs.).

on *Hormosira* and *Fucodium*. No antherids were detected. Each oogone contains eight oospheres, one at each end, the remainder arranged in the centre in two groups of three each.

In *Sarcophycus potatorum* Miss F. G. Whitting * finds four oospheres in each oogone, formed as follows:—the protoplasm of the immature oogone divides into three transversely, and the middle portion then again divides into two longitudinally. *Sarcophycus* differs from *Durvillæa* in the frond being solid to the centre, while in the latter genus it is lacunar beneath the cortex, the lacunæ being separated by strands of anastomosing filaments.

Fucosan.†—According to Herr E. Crato, the bodies thus designated by Hansteen‡ and found in *Fucus serratus* and other Fucoideæ, are not of the nature asserted by him. They do not, as stated by Hansteen, constitute a hitherto unknown carbohydrate, but are of the nature of physodes.§ They are vesicular structures filled with a more or less fluid substance, having a power of motion of their own, and not merely carried passively by the currents of protoplasm.

Cryptostomates of the Phæophyceæ.‖—Mr. G. Murray describes the structure and development of the cryptostomates (Fasergrübchen or sterile conceptacles) in *Adenocystis*, *Alaria*, and *Saccorhiza*. In *Alaria* the rudimentary cryptostomates are tufts of hairs with basal growth, the cell at the apex of the hair being first cut off from the epidermal layer. In *Adenocystis* they occur in the middle of sori of unilocular sporanges; in *Hydroclathrus* among the plurilocular sporanges.

Structure of Hydroclathrus.¶—Miss M. O. Mitchell has studied the structure of *Hydroclathrus* (*sinuosus* and *clathratus*), a genus which has been separated from the Asperococcoideæ in consequence of possessing, as far as is at present known, plurilocular sporanges only. The structure and development of the cryptostomates and of the sporanges are described in detail. *H. sinuosus* has neither an apical cell nor any area of special growth; increase in size takes place by division of the epidermal cells.

Systematic Position of the Bangiaceæ.**—Prof. F. Schmitz reiterates his arguments in favour of removing the Bangiaceæ or Porphyraceæ from the Florideæ, where they are usually placed. The agreement in colour he considers to be a character of far less importance that the great difference in the vegetative structure, and especially in the mode of reproduction. These plants never form true tetraspores, although the ordinary cells of the thallus may sometimes divide into four. Any ordinary cell of the thallus can, in the Bangiaceæ, become a female cell, and there is never any formation of a trichogyne. The mode of union of the male and female elements is also different in the two groups. The author prefers to remove the Bangiaceæ altogether from the Florideæ,

* Phycol. Mem. (Murray) ii. (1893) pp. 38–9 (3 figs.).
† Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 235–41.
‡ Cf. this Journal, *ante*, p. 218. § Cf. this Journal, *ante*, p. 58.
‖ Phycol. Mem. (Murray) ii. (1893) pp. 57–64 (1 pl.).
¶ Tom. cit., pp. 53–7 (2 pls.).
** La Nuova Notarisia, iv. (1893) pp. 226–43.

and to place them in the Chlorophyceæ, near to Hieronymus's group of Glaucocystideæ.*

Halicystis and Valonia.†—Mr. G. Murray has discovered *Halicystis ovalis* as a British plant, and is disposed to remove the genus from the Siphonocladaceæ to the Siphoneæ. Its vegetative structure recalls that of *Botrydium*. He further describes the hitherto unknown reproductive organs of *Valonia ventricosa*, the single cell of which is as large as a hen's egg.

Fungi.

Fungus-gardens of Ants.‡—Herr A. Möller has confirmed the hypothesis of Belt that certain South American ants cultivate a fungus on the leaves of the plants which they frequent, and live upon this fungus. The observations were chiefly made on four species of *Atta*, the nests of which are composed of fragments of leaves which are penetrated by fungus-hyphæ and form the fungus-garden. As long as the nest is inhabited by ants, these hyphæ do not form any reproductive organs, but exhibit a strong tendency towards the formation of swellings and excrescences. When cultivated independently the fungus developes brown spores, and is found to belong to the Agaricineæ and to the genus *Rozites*, and the author names it *R. gongylophora*. Similar nests formed by three species of *Apterostigma*, were found in a decaying pileus of a *Polyporus*; and two species of *Cyphomyrmex* are also breeders of fungi.

Relationship of the Conidial Forms of Fungi.§—M. J. Costantin sums up the results of the observations of different mycologists which have established the fact that a number of fungi belonging to the Ascomycetes, Basidiomycetes, Ustilagineæ, Entomophthoreæ, and Mucorineæ go through a variety of stages of development, and asserts furthermore that a *Cladosporium*-form occurs in *Pleospora*, *Leptosphæria*, and *Fumago*.

Membrane of the Oosperm of Cystopus Tragopogonis‖—Herr P. Magnus identifies *Cystopus spinulosus* with *C. Tragopogonis*, which includes not only the parasites on *Cirsium* but also those on *Scorzonera*, *Tragopogon*, *Filago*, &c. The oosperm may be furnished either with long spines or with low warts. The membrane of the oosperm of this species presents the most complicated structure of any among the Peronosporeæ.

Saprolegniaceæ of the United States.¶—Prof. J. E. Humphrey publishes a monograph of the Saprolegniaceæ of the U.S., which includes descriptions of the following new species:—*Saprolegnia Treleaseana*, *Achlya americana*, *A. megasperma*, *A. papillosa*, *Apodachlya* (?) *completa*, also of a new genus *Thraustotheca*, formed from *Dictyuchus clavatus*. He gives a complete account of the structure and life-history of the order, which he divides into two tribes, Saprolegnieæ and Leptomiteæ. The latter is characterized by abrupt constriction of the hyphæ

* Cf. this Journal, 1892, p. 830.
† Phycol. Mem. (Murray) ii. (1893) pp. 47–52 (1 pl.).
‡ Bot. Mitthl. aus den Tropen, Heft 6 (1893) 128 pp., 7 pls. and 6 figs. See Bot. Centralbl., lv. (1893) p. 92.
§ Rev. Gén. de Bot. (Bonnier), v. (1893) pp. 84–6.
‖ Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 327–30 (1 pl.).
¶ Proc. Amer. Phil. Soc., 1893, pp. 63–148 (7 pls.).

at intervals, marking them off into segments, and comprises the genera *Leptomitus* and *Apodachlya*. The cellulin-granules of Pringsheim, which have not been recognized elsewhere, occur as discoid or lobed bodies in both the hyphæ and reproductive organs, and are probably a soluble form of cellulose available for use in forming and repairing cellulose walls. In most of the genera the zoospores display the phenomenon of "diplanetism" or double swarming, though this is not universally the case; the object of the first swarming is the escape of the zoospores from the sporange, that of the second, distribution of the spores, to enable them to reach new sources of food-supply. In *Saprolegnia* and *Achlya* the zoospores sometimes become encysted within the sporange; in *Aplanes* both swarming stages are suppressed. Many species produce also chlamydospores. With the exception of the newly discovered *Apodachlya* (?) *completa*, none of the Leptomiteæ are known to produce sexual organs of reproduction. Both the young oogones and the antherids contain a number of nuclei. Useful methods of culture are described.

New Chytridiaceæ.*—Under the name *Lagenidium* (?) *ellipticum* M. E. De Wildeman describes a new species belonging to the Chytridiaceæ, parasitic on the rhizoids of mosses; also another new species, *Rhizophidium marinum*, parasitic on diatoms of the genus *Melosira*. A monograph of the known species of *Lagenidium* is appended; and an account of all the Chytridiaceæ and Protomycetes parasitic on the tissues of roots. These include a new genus *Asterocystis*, near to *Olpidium*, characterized by the cells being elliptical or rounded, and furnished with projections which give them a star-like appearance; and the following new species—*Olpidium Borzii*, on roots of *Brassica oleracea* and *Capsella bursa-pastoris*; *Asterocystis radicis*, on a variety of roots; *Pleotrachelus radicis*, on roots of *Thlaspi arvense*.

Ulocodium and Nemacola.†—According to Sig. A. Jatta, these two genera of Lichens established by Massalongo, must be suppressed. *Ulocodium odoratum* is an undescribed species of *Biatorina* which he names *B. cohabitans*, and with which *Chroolepus odoratum* is closely associated, but not organically. *Nemacola criniformis* is nothing but a form of *Collema tenax* associated with *Microcoleus terrestris*.

Nucleus of the Yeast-cell.‡—Prof. Fr. A. Jannsens has examined the following yeasts, and found therein a nucleus:—*Saccharomyces Ludwigii* Hansen, *S. cerevisiæ* 1 Hansen, *S. pastorianus* 1 Hansen, Carlsberg bottom yeast No. 1, a top yeast, and a baker's yeast.

Especial attention was turned to *S. cerevisiæ* 1 and *S. Ludwigii*, the latter having points of especial interest. When the cells are still very young and are met with in the resting and vigorous condition, the following structure of the nucleus can be made out. The nucleus has a membrane, and contains a nucleole. The nucleole, which is usually spherical and homogeneous, is nearly always found about the middle of the nucleus, and occupies about a third of its diameter. The nucleus

* Ann. Soc. Belge Microscopie, xvii. (1893) pp. 1–32 (3 pls.).
† Malpighia, vii. (1893) pp. 192–201 (1 pl.).
‡ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 639–42. Cf. this Journal, *ante*, p. 509.

lies against the cell-wall, in consequence of which its membrane in this position is not visible. The membrane in *S. Ludwigii* does not possess a firm and regular structure like those of other Saccharomycetes. The rest of the cell is filled with a cytoplasmatic network, the meshes of which are occasionally very fine and regular. The nodes of the meshes are usually pretty thick, and when the preparations are insufficiently and badly fixed they alone are stained. These are undoubtedly Raum's granules. Secretions of various kinds which form on the interior of the cell, and especially vacuolization, may alter and distort the typical form of the nucleus. Special devices must be employed to render the nucleus evident if the yeast have been starved by being kept in water.

The sprouting of the Saccharomycetes takes place by kinetic division of the cells. This proposition is confirmed by several facts:—(1) By the cell-plate formed in *S. Ludwigii*, by the structure of the partition which eventually divides the mother-cell from the sprout, and by the peculiar structure which the cell-wall has at this spot after the two cells have separated. This place in the cell-wall which the author noticed also in the true Saccharomycetes is called by him the sterigmatic surface. (2) By the observation of the different phases of karyokinesis. The spindle-stage is peculiarly noteworthy, when the nucleus is pretty distant from the spot where the sprouting takes place, though it may be observed in other solutions.

The appearances in spore-formation were peculiarly interesting, the nucleus of the spores being formed by karyokinesis, during which process several distinct stages were observed.

The author concludes his remarks by emphasizing the fact that the yeast-cell contains a nucleus, and this nucleus multiplies by karyokinesis (1) during sprouting and (2) during spore-formation.

Two new Species of Saccharomyces closely allied to S. membranæfaciens.* — Upon fragments of the leaves of *Euonymus europæus* which had been kept in spirit in order to get rid of the chlorophyll, Sig. P. Pichi discovered a species of Saccharomyces which did not set up fermentation. The author afterwards found a second species in the deposit from a "vin des Côtes." From further examination of these two species of *Saccharomyces*, and specially from their cultures in various solid and fluid media, the author was able to confirm the observation of Hansen who discovered that *S. membranæfaciens* had no ferment power. The two new species agree in the main with Hansen's species, but differ in some details, and the author separates them for the following reasons. *S. membranæfaciens* ii. on *Euonymus* leaves: Asci usually oval or elliptical; spores usually three or four; diameter 3 μ, roundish, occasionally oblate. *S. membranæfaciens* iii.: Asci spheroidal, oval, or elliptical; two, three, or four spores in each, with a diameter of 2·5 to 3·5 μ. The cultivation results may be shortly expressed as follows: with *S. membranæfaciens* iii. there is a copious development of asci during beer fermentation at 22°–25°; with *S. membranæfaciens* ii. very little. In artificial and wine-fermentation and beer-wort *S. membranæfaciens* ii. forms within 24 hours at 22°–25° a wrinkled milk-white scum.

* Ann. Scuola di Viticolt. ed Enologia in Conegliano, Ser. iii. An. i. (1892). See Bot. Centralbl., liv. (1893) p. 9.

S. membranæfaciens iii., a uniform thin smooth scum. In acid grape-must *S. membranæfaciens* ii. forms within two days a thick wrinkled scum. *S. membranæfaciens* iii. behaves as in other media, but there are well-marked differences in the asci and the sprouting vegetative elements.

Saccharomyces ellipsoideus.*—Herr J. Wortmann has decided from experiments with twenty-seven different kinds of yeasts obtained from Germany and the Crimea that the wine-ferment known as *Saccharomyces ellipsoideus* does not represent one definite species, but consists of a number of races which differ from one another, not only morphologically, but also physiologically; and further, that these differences are, so to speak, constant, inasmuch as the different species produce from one and the same must different wines. It is obvious, therefore, that if good wine is to be produced great care must be taken in the selection of the yeast, a proposition which will hardly be disputed; but the author's position seems rather to be that the ferment is of more importance than the must.

White-rot of the Vine.†—Herr E. Ráthay describes the appearance and life-history of *Coniothyrium Diplodiella*, the fungus causing this disease of the vine, which must be carefully distinguished from the black-rot, from which it differs in the following particulars. It attacks the berries only; the pycnids are brown or light-coloured, not black, and have a different structure; the spores are brown, not colourless; the spermogones are unknown.

Æcidium leucospermum.‡—From observations made on this fungus, parasitic on the leaves of *Anemone nemorosa*, Mr. H. T. Soppitt concludes that it is not connected genetically with *Puccinia fusca*. It appears to propagate itself entirely by means of its spores and its perennial mycele, its development resembling in every respect that of *Endophyllum*, except that it does not produce promycelial spores.

Fungus-parasite of Cochylis.§—MM. C. Sauvageau and J. Perraud state that the larva of *Cochylis ambiguella*, the "grape-worm," is frequently infested by a parasite identical with that which is used for the destruction of the larva of the cockchafer, *Isaria farinosa*.

Choiromyces.‖—Dr. O. Mattirolo describes in detail the structure of this genus of Tuberaceæ, and concludes that the species known as *C. gangliformis* must be sunk as a form in the cycle of development of *C. meandriformis*.

Rabenhorst's Cryptogamic Flora of Germany (Fungi). — In parts 39–41 of the first vol. of this work Dr. H. Rehm continues his account of the section Helotieæ of the Pezizaceæ. The description of the species of *Phialea* is completed, followed by that of *Cyathicula* (4 sp.), *Belonioxypha* gen. nov. (6 sp.), separated from *Belonium*, and distinguished

* Landwirthschaftl. Jahrb., i. (1892) p. 901. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 756–7.
† Die Weinlaube, 1892, 9 pp and 12 figs. See Bot. Centralbl., lv. (1893) p. 118.
‡ Journ. of Bot., xxxi. (1893) pp. 273–4.
§ Comptes Rendus, cxvii. (1893) pp. 189–91.
‖ Malpighia, vi. (1893) pp. 380–9?, 467–81.

from *Phialea* and from *Cyathicula* by the multiseptated spores, *Pocillum* (1 sp.), *Chlorosplenium* (2 sp.), *Ciboria* (15 sp.), *Rutstrœmia* (7 sp.), *Helotium* (35 sp.), *Sclerotinia* (30 sp.), *Dasyscypha* (42 sp.), *Lachnella* (17 sp.), *Lachnellula* (3 sp.), *Lachnum* (66 sp.), and *Erinella* (4 sp.). Many new species are described.

Part 52 completes Dr. A. Fischer's monograph of the Phycomycetes, comprising 375 species, not including doubtful ones. At the conclusion is given a synopsis of the species classified into saprophytic and parasitic, and further arranged under the families to which their hosts belong, whether animal or vegetable.

Myxomycetes.

Division of Nuclei in the Mycetozoa.*—From observations made on a large number of species of Mycetozoa, Mr. A. Lister states that at the time when the swarm-cells divide, the division of the nucleus takes place by karyokinesis, the nuclei remaining distinct when the swarm-cells unite to form a plasmode. In the streaming plasmode, on the contrary, the nuclei appear to increase by direct division. When division of the protoplasm into true cells takes place, karyokinesis again occurs. In other words—setting aside the question of the sclerote—wherever cell-formation occurs in the life-history of the Mycetozoa, the nuclei divide by karyokinesis.

New Myxomycetes.†—Mr. A. P. Morgan describes a number of new Myxomycetes from Ohio, including a new genus *Calonema*, belonging to the Trichiaceæ, with the following diagnosis:—Sporanges subglobose, irregular, sessile, without a hypothallus; the wall thin, marked with branching veins, irregularly dehiscent. Capillitium of slender tubules, arising from the base of the sporange, repeatedly branched, and with numerous free extremities; the surface traversed by a system of branching veins, ending in minute veinlets, which appear as irregular rings and spirals. Spores subglobose, yellow.

Protophyta.

a. Schizophyceæ.

New Genera of Protococcaceæ.‡—In an account of a collection of Freshwater Algæ received from East India, Mr. W. B. Turner describes a large number of new species, chiefly desmids, and the following new genera of Protococcaceæ:—

Staurophanum. Frons plus minus cruciformis, normaliter 4-partita v. 4-lobulata, ad fines aut singula aut furcata, angulis v. non productis; anguli interiores rotundati; apicibus 2–3-dentatis v. cuspidatis, a latere visa lanceolata, finibus plus minus attenuatis.

Thallodesmium. Plantula minuta (plana?) sub-orbicularis, in stratum gelatinosum tenue nidulans v. libere natans; ex cellula unica margine sinuata v. incisa pilis rectis brevibus instructa, medio profunde constricta, constituta; massæ chlorophyllaceæ irregulares, sub-radiatim dispositæ.

* Journ. Linn. Soc. (Bot.), xxix. (1893) pp. 529–43 (2 pls.).
† Journ. Cincinnati Soc. Nat. Hist., xvi. (1893) pp. 13–36 (1 pl.).
‡ K. Svensk. Vetensk. Akad. Handl., xxv. (1892) 187 pp. and 23 pls.

Movement of Diatoms.*—Prof. O. Bütschli has observed the following phenomenon in *Pinnularia nobilis*, with the aid of an infusion of Indian ink in the water. At the point of the raphe which adjoins the central node of each valve, the fine granules of Indian ink collect in larger or smaller masses, apparently connected with the raphe by a viscous binding substance. After some time a very delicate filament was often seen to shoot out from the lump and to elongate itself along the raphe, though it was not in direct contact with it, but formed an acute angle with the surface of the diatom. The end of this filament is sometimes swollen in a club-shaped manner. The filament is absolutely colourless and transparent, and has very nearly the same index of refraction as the water. It is not stained by anilin-dyes, and is only rendered visible by the particles of Indian ink adhering to it. The elongation of the filament takes place by jerks, and this is apparently the cause of the jerking motion of diatoms, the frond being pushed back by the lengthening filament, the distal end of which rests on the substratum. When the diatom lies on its girdle-side, two of these filaments may be seen, one on each side, directed usually towards the same end of the diatom, occasionally towards opposite ends. Experiments with other species of diatoms gave negative results. According to this explanation the movement of diatoms presents considerable analogy to that of desmids.

Microcrocis, a new Genus of Cyanophyceæ.†—Under the name *Microcrocis Dieteli*, Herr P. Richter describes the type of a new genus of Cyanophyceæ, with the following diagnosis:—Thallus parvulus, oculis nudis visibilis, ærugineo-viridis, siccitate violascens, membranaceo-subfoliaceus, libere natans, e cellularum strato unico formatus; cellulæ geminæ, pseudoparenchymatice conjunctæ, utroque polo rotundatæ, planitiem versus perpendiculariter positæ, e vertice sphæricæ, tegumento universali circumdatæ; divisio cellularum in planitiei utramque directionem, ut in *Merismopedio*. *Microcrocis* is nearly allied to *Merismopedium*.

Prof. G. v. Lagerheim ‡ identifies *M. Dietelii* with his own *Merismopedium (Holopedium) geminatum*. He now proposes *Holopedium* as an independent genus, with the following diagnosis:—Familiis forma irregulari e cellulis irregulariter dispositis compositis; divisio cellularum irregularis. It is distinguished from *Merismopedium* by its irregular, as contrasted with a rectilinear mode of cell-division.

To this Herr Richter § replies, maintaining the essential distinction of *Microcrocis* and *Merismopedium*.

β. Schizomycetes.

Bactericidal Action of a Continuous Electric Current.‖—Drs. E. Burci and V. Frascani have made the following series of experiments. First, they tested the effect of nascent iodine obtained by electrolytic action from a solution of potassium iodide. The result was the destruction of the spores (*Staphylococcus pyogenes aureus*, *Streptococcus*, *Bacillus ureæ*, &c.). Secondly, they applied the electric current directly to tissues affected by erysipelas. The effect was a slight retardation and

* Abhandl. naturh.-med. Ver. Heidelberg, iv. (1892) pp. 580–6 (1 fig.).
† Richter's Phycotheca universalis, Fasc. xi. (1 fig.). See Hedwigia, xxxii. (1893) p. 74.
‡ La Nuova Notarisia, iv. (1893) pp. 207–10.
§ Tom. cit., pp. 292–8.
‖ Atti Soc. Tosc. Sci. Nat. Pisa, xii. (1893) pp. 99–119.

alleviation, when the application was made immediately after inoculation; at a later stage there was little result. Thirdly, they applied the current to affected tissues surrounded by distilled water, salt solution, or potassium iodide solution. In many cases the effect was very distinctly ameliorative.

Pleochroism of Stained Bacteria.*—The optical properties of the cell-membrane of bacteria have been examined by Herr J. Amann, who observes that the problem to be solved consists in determining whether the cell-membrane behaves like single or double refracting crystals, and in the second alternative whether these optical properties are in accord with those of uni- or bi-axial crystals. The technical difficulties in studying such a question are great, since on account of their composition and tenuity the doubly refracting properties of the bacterial membrane are so slight that they would be with difficulty perceived by the usual method of examination with the polarizing apparatus. The bacteria must therefore be stained, and anthrax stained with malachite-green was found to possess pleochroistic properties. The conclusions drawn by the author from his observations are that the cell-membrane of certain Schizomycetes, when stained with some suitable pigment, shows a clear though faint pleochroism, and it is therefore doubly refracting. In anthrax the maximum absorption occurs when the longitudinal axis of the bacillus is placed vertical to the plane of the polarized ray. The optical behaviour of the stained anthrax bacilli makes it very probable that the pigment exists in the crystalline condition in the cell-membrane, and that the pigment crystals must be so disposed that their longitudinal axis is vertical to the long side of the bacterial cell. This view is supported by the fact that artificially stained bacteria, observed in a suitable manner, constantly show the colour of the pigment crystals.

Formation of Sulphuretted Hydrogen by Bacteria.†—Dr. Stagnitta-Balistrera has found that the formation of H_2S gas by bacteria is much more extended than is usually supposed, and depends partly on a definite organization of the protoplasm, and partly on the composition of the pabulum. Only aerobic germs were used in the experiment, and on analysis the following quantity of sulphur was found in the media:—Bouillon 0·0705, pepton-bouillon 0·2131, pepton-agar 0·3016, 10 per cent. gelatin 0·7051 grm.

H_2S is best demonstrated when the medium is solid by the iron-gelatin employed by Fromme, made by adding the saccharate, tartrate, or acetate of iron to ordinary gelatin. When the nutrient medium is liquid, the simplest and most sensitive reagent is moistened lead paper suspended within the flasks; 0·03 mg. H_2S from 50 ccm. of fluid give a clear reaction (slight brown colour): the lead papers must be examined at least daily, as the evidence of a reaction may disappear.

The first experiments were made on solid media, while in the latter ones liquid media were used, and that which seemed to give the best results was simple bouillon.

Out of thirty-five organisms examined, eighteen were found to have

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 775–80.
† Arch. f. Hygiene, xvi. pp. 10–34. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 755–7.

the power of forming H_2S, and of these, some, e.g. bacillus of rabbit septicæmia, *B. fulvus*, and *B. subtilis* are essentially aerobic, a fact worthy of notice, inasmuch as the formation of H_2S is usually regarded as a reduction process taking place in the absence of oxygen.

By the author's experiments, which showed that different germs cultivated in the same medium, behaved differently with regard to the formation of H_2S, the question whether the protoplasm of bacteria was endowed with different powers of forming H_2S, was answered in the affirmative.

Experiments made with H_2S formers, e.g. *Proteus vulgaris* and bacillus of rabbit septicæmia, and with two non-formers, e.g. *Tetragenus* and Wurzel-bacillus, showed that the former, when cultivated on quite different media, always formed H_2S, while the latter did not. And even when the sulphur existing as sulphate in the medium was precipitated by means of barium chloride, so that only the sulphur in organic composition remained, the same power was evinced.

On raw eggs *Proteus* does not form H_2S, though when the albumen is coagulated the production takes place as usual, whilst the albumen of bacteria cells coagulated during the process of sterilization is not decomposed with formation of H_2S.

The author also examined the formation of H_2S by different bacteria from aqueous extract of asparagus which contains in organic and inorganic combination 0·00327 per cent. of sulphur. Results were similar to those obtained from animal media.

Influence of Fatty Cultivation Media on Bacteria.*—According to Escherich the stools of healthy sucklings contain only a few and quite definite species of bacteria, which are decolorized with iodo-potassic iodide and anilin-xylol. It might have been expected that this behaviour would serve for recognizing bacteria present in the stools under pathological conditions, for the latter resist decoloration, appearing blue, while the normal fæcal bacteria, when after-stained with aqueous solution of fuchsin, are red. This supposition was, however, not confirmed in practice; on the contrary, it was found that in those stools which might have been expected to have exhibited the most normal reactions, and in which even after most careful cultivation researches no species differing from *B. coli commune* could be found, the evacuations from healthy sucklings were almost exclusively blue, that is, no decolorizable rodlets were present, while in the diarrhœic stools the red forms predominated.

At the suggestion of Emmerich, Herr A. Schmidt examined a large number of stools from healthy and sick suckling infants, and found that the blue greatly predominated in normal stools, whether the child was suckled by the mother or fed with cow's milk. When the stools were clayey, the same reaction was observed, but when they were mucoid or watery, the red forms predominated. The bacteria from the small intestine were red, and those from the large were blue. But if some normal fæces were cultivated in bouillon, the blue were gradually replaced by red, slim organisms, and if plate cultivations were made from the bouillon at the time when blue forms predominated, colonies of *B. coli commune*, which are decolorized by Weigert's method, were developed.

* Wiener Klin. Wochenschr., 1892, No. 45. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 761–2.

By these researches it became very probable that both the blue and the red forms belonged to a single species of bacterium, and that that was *B. coli commune.*

The very considerable differences in shape are not, according to the author, contradictory of this view, since by breeding pure cultivations of the bacterium in bouillon containing different qualities of alkali and acid, he has convinced himself that these variations produce extraordinary polymorphism. The principal cause of the variable behaviour to stains must rather be sought in the influence of the nutrient medium, conditions certainly present in the intestinal canal. After that the reaction, the absence of oxygen, the saline constituents, and so forth, had been excluded, it followed that the fat normally present in the stools of suckling infants was the cause of this alteration in the bacteria. By breeding pure cultivations on buttery media (agar or gelatin) similar properties were imparted to bacteria as were possessed by those in stools: they resisted decoloration with iodine and assumed the slim rodlet form, like those present in the stools of suckling infants. Thus the variable behaviour of the bacilli in normal and clayey stools on the one hand, and those in slimy stools almost free of fat and watery evacuations on the other was explained.

If the bacteria from butter-gelatin were sub-cultivated in the usual way, they again lost the resistance to the iodine solution. Yet none of the fat-dissolving media was able to impart this peculiarity, and the expectation of finding a diagnostic method for recognizing bacterial diseases of the alimentary tract failed, though it must be admitted that these researches have brought to light new and interesting peculiarities in *B. coli commune.*

Fertilization-processes in Vibrios.*—Dr. Max Dahmen has observed that certain of the superficial colonies of some vibrios (V. Koch, Finkler-Prior, Metschnikoff, Denecke) are distinguishable into two varieties called α and β colonies. The α colony sends a prolongation into the β colony, the latter inverting itself over the extension like a bell-jar, so that the compound colony somewhat resembles a mushroom or a bell and its clapper. The α colonies seem to possess very little, and the β colonies no inclination to run together when cultivated apart, but when in association they unite eagerly and produce the most diverse appearances. The effect of the metabolic products of the α colonies is shown by the fact that the β colonies grow with extraordinary rapidity, and liquefy the gelatin in a corresponding manner when the latter are subjected to its influence.

Both the α and β colonies breed fairly true, though in both single vibrios arise from which are developed colonies with opposite characteristics. From the fact that the gelatin is more quickly liquefied and that proliferation is more rapid, the author considers that the organisms have acquired new properties and that the acquisition is the result of the influence of other individuals of the same species. Also he thinks that the difference in the characters of an epidemic are to be explained by the differences noted in the α and β colonies and their mixtures, and would further explain the absence of severe symptoms in Pettenkofer and others by supposing that they took β cultivations.

* Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 43–53 (7 figs.).

Behaviour of Mobile Micro-organisms in Running Fluids.*—Dr. Roth has noticed that mobile micro-organisms which generally move about in an apparently aimless way have a decided tendency to swim upwards in running fluids. He considers that this is a perfectly mechanical phenomenon, and that bacteria move forward in a given direction until they happen to knock up against something. The current then acts on the free posterior end, the front end becomes free and is turned against the current, so that the movements of the organism are directed upwards. In the observations dental mucus was used, for with this a current can be easily induced if at one side of the cover-glass be placed a little water and a piece of blotting paper at the other. Obstacles, consisting of minute bodies, were placed in the fluid for the bacteria to impinge against, and these were found to impart an upward direction to them.

The author concludes from his observations that micro-organisms of elongated shape when moving in the direction of their length in a running fluid tend to move upwards, provided the current is suitably rapid and the stream sufficiently narrow. The author applies the same explanation to the upward course of the spermatozoa to the ovaries.

Defence of the Organism against Microbes after Vaccination.†—Dr. Sanarelli has been studying the question of the bactericidal state of the vaccinated organism by the aid of the disease produced by the Vibrio Metschnikovi, a disease easily inoculable on birds and on guinea-pigs, in which it produces the symptoms and phenomena of a very acute septicæmia. From the fact that the experiments were conducted under the supervision of M. E. Metschnikoff, it scarcely needs to be said that the author's position is defensive of phagocytosis and attacks humoralism under its three different aspects. These three hypotheses are known as the bactericidal, the attenuating, and the anti-toxic. By the first, acquired immunity is ascribed to the power the body-juices possess of killing the invading organisms; by the second, to their ability to remove the pathogenic properties of the microbes; by the third, to their neutralizing action on the toxins secreted by the bacteria.

The general conclusions of the author concerning the result of infection in the case of vaccinated animals are that microbes can develope without difficulty even in the serum of vaccinated animals, where, instead of becoming attenuated, they acquire a still greater virulence. The serum of vaccinated animals is not endowed with an anti-toxic property and does not prevent the formation of microbic toxins. The vaccinated animals escape infection owing to the efficient action of the phagocytes.

With regard to the case of animals treated with serum obtained from vaccinated animals, the author finds that this serum is endowed with eminently preventive properties, and animals do not take the disease if inoculated with this serum. The serum seems to work by stimulating the leucocytes both in the general circulation and at the site of inoculation, but the destruction of the microbes is always effected by the phagocytes.

It is interesting to note that the action of the phagocytes is paralysed

* Deutsche Med. Wochenschr., 1893, No. 15. See Centralbl f. Bakteriol. u. Parasitenk., xiii. (1893) p. 755.
† Ann. Inst. Pasteur, vii. (1893) pp. 225–59.

if the organism be cooled; then they no longer react to the stimulus of the preventive serum, and the vaccinated animal inevitably succumbs to the infection.

Resistant Germs in Gelatin.*—Dr. L. Heim has found that gelatin such as is used for the preparation of nutrient media contains germs, highly tenacious of life, and that these develope after the medium has been carefully sterilized. Isolation experiments proved that those germs which resisted the action of steam were two species of endogenous spore-forming bacilli distinguishable by their cultural characters. The resistance of the smaller of the pair was overcome by 3 hours exposure to steam, while the larger bacterium took from 5–7 hours to die under similar conditions. After several cultivations, the resistance to heat seemed to diminish, and when exposed to the action of steam with tension of the atmosphere, they did not grow, for the spores were destroyed in the sterilizer in 15 minutes.

It is probable that during the manufacture the gelatin became contaminated with earth.

Thermotaxis of Micro-organisms and its Relation to Chill.†—Prof. S. L. Schenk considers thermotaxis to be a vital property of bacteria, exhibited when there is a difference of temperature amounting to 8–10° C. Under these conditions heat acts as an irritant upon bacteria, causing them to move towards the warm point. Bacteria which are free and independent present the phenomena of thermotaxis more clearly than those united together in chains. When, however, micro-organisms have been kept for some time in a room, at a low temperature, and are afterwards placed in a room with a higher temperature, they do not at first develope with their full energy, and do not manifest their full effect. As they become acclimatized to the higher temperature the decrease in developmental energy and virulence disappears. Chills are separable into two groups, those unassociated with bacterial influence, and those chills which are to be regarded as the expression of an infection. In infection chills the disease does not manifest itself immediately after the occurrence of the lesion, but in the other group the morbid phenomena appear soon after the action of the irritant. When a man enters a cold room a bacterial stream sets in towards him by reason of his higher temperature, and thus induces a chill. For the occurrence of an infection-chill two conditions are necessary, first a difference of temperature which causes a microbic current to set towards the warmer point, and secondly, the penetrability of the skin or mucosa to microbes or some other mode of entrance of the bacteria into the body.

Action of Gravity on Bacterium Zopfii.‡—Mr. R. Boyce and Mr. A. E. Evans describe a pecular "pinnate" growth of this bacterium which could only be obtained in gelatin cultures which were kept vertical or nearly so. The mode of growth appeared, from experiment, to be due to the action of gravity.

Organism of the Root-tubercles of Leguminosæ.§—Prof. G. F. Atkinson gives a careful review of the literature of this subject, and an

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 649–50.
† Tom. cit., pp. 33–43.
‡ Proc. Roy. Soc., liii. (1893) pp. 48–50.
§ Bot. Gazette, xviii. (1893) pp. 157–66, 226–37, 257–66 (3 pls.).

account of his own observations, chiefly on *Vicia sativa*. His conclusions agree on the whole with those of Laurent and Ward. He favours the view of racial peculiarities dependent on the influence of the special host on the parasite, rather than on the specific distinctness of the parasites of different species of leguminous plants.

Ætiology of Cholera.*—Dr. W. Hesse maintains that cholera is probably more often transmitted by dust blown about by the air than is usually supposed. In support of this view he carried out the following experiment. A piece of calico was steeped in a bouillon culture of cholera, and dried in an incubator for one hour. It was then rubbed and shaken over an agar plate. Up to $22\frac{1}{2}$ hours viable bacilli fell on the plate, and typical colonies were there developed. After two or three days the experiments were negative and no cholera bacilli could be demonstrated microscopically.

Microbe resembling the Cholera Bacillus.†—Dr. Fokker has lighted on another comma-shaped water bacterium which liquefies gelatin. It was found in a Dutch harbour suspected of containing cholera bacilli. In shape it resembles Koch's comma bacillus, yet in gelatin puncture cultivations and on plates it grows like the Finkler-Prior bacillus. On agar it thrives well at 37°, in fluid media it developes best at the room temperature. Injection of liquefied gelatin cultures into the peritoneal sac of guinea-pigs had no effect. By precipitating liquefied gelatin cultures with alcohol the author isolated an enzyme which coagulates milk. The author regards his bacillus as a degenerated cholera vibrio.

Relation of the Cholera Vibrio to Asiatic Cholera.‡—M. E. Metschnikoff concludes from researches on the preventive property of the blood, made on 68 persons, that this, as far as regards the cholera vibrio of Indian origin, is extremely variable. It exists in about half the number of persons who have not had cholera, and in 58 per cent. of those who have passed through an attack. Almost half the number of persons sick of cholera, and half of those dead of this disease, are also possessed of this preventive property of the blood. The patient may recover without this property being established.

The author seems to have derived his initiative from the experiments of G. Klemperer, who found that by injecting blood-serum of persons who had never had cholera into the peritoneal sac of guinea-pigs, that these animals were no longer susceptible to inoculation with the comma bacillus. Very similar results were obtained when guinea-pigs were treated with blood taken from patients actually suffering from cholera, some of whom died. A third series of experiments was made with the blood of persons dead of cholera, and a fourth with blood taken from persons who had recovered.

Detrimental Effect of Cholera-products on other Organisms.§—Herren G. Gabritschewsky and E. Maljutin are of opinion that the comma bacillus produces chemical substances which markedly inhibit the

* Zeitschr. f. Hygiene, xiv. No. 1. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 822.

† Deutsche Med. Wochenschr., 1893, No. 7. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 440.

‡ Ann. Inst. Pasteur, vii. (1893) pp. 403–22.

§ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 780–5.

growth of *B. coli commune*, *B. anthracis*, *B. pyocyaneus*, *B. typhi abdominalis;* that these metabolic products of the comma bacillus are the cause in many cases of *B. coli commune* not growing when cultivations are made on gelatin plates from the dejecta of cholera patients; that the power of these metabolic products of *B. choleræ asiaticæ* of inhibiting, and perhaps of quite preventing the growth of other bacteria is manifested in the animal organism, and occasionally renders mice immune to anthrax.

Modification of Leucocytes, as the Result of Infection and Immunization.*—Mdlle. C. Everard, M. J. Demoor, and M. J. Massart have examined the quantitative and qualitative variations affecting leucocytes as the result of infection and of immunization. The microbes used were *Vibrio metchnikovi*, bacillus of hog cholera, *St. pyogenes aureus*, anthrax, *B. tetani*, and *B. mycoides*.

The authors find that the infection of living or dead microbic cultures at first diminishes the number of leucocytes, and especially those with polymorphic nucleus and compact and granular protoplasm. This period of hypoleucocytosis is followed when the animal resists the infection by one of hyperleucocytosis. There is no phase of hyperleucocytosis in animals which succumb. In animals which have been vaccinated the blood is richer in leucocytes than in fresh unvaccinated animals.

The authors depict twenty-six different forms of leucocytes, all of which are evolution stages of the same cell; the adult leucocytes and that which is most powerfully phagocytic possess a polymorphic nucleus and a plasma charged with granules. These stages are passed through very rapidly, the life of a leucocyte being very ephemeral; hence it is suggested that those leucocytes which impart immunity to a refractory animal are not those which have been affected by vaccination, but their descendants.

Influenza Bacillus.†—In February 1890 Prof. O. Bujwid made cultivations on oblique agar from blood drawn off from the spleen of a man suffering from influenza.

After incubation for two days at 37° small colonies appeared, and these were found to consist of short rods or of ovoid cocci, often in twos or threes. The bacteria stained badly with dilute alcoholic solution of fuchsin. Subcultures failed, and this was thought at the time to be due to the rapid death of the bacteria, but Pfeiffer's discovery renders it more probable that the cause was absence of hæmoglobin. The first generation grew because some hæmoglobin from the fresh blood was present.

Association of Streptococcus and Bacillus typhosus.‡—The fatality of typhoid fever is possibly often due, says Dr. H. Vincent, to a mixed infection, a combination of enteric fever and pyosis, the *Streptococcus* acting in conjunction with the *Bacillus typhosus*. This association may be primary, or secondary. The latter form of mixed infection is easy to understand, as the more or less extensive ulceration of the intestinal

* Ann. Inst. Pasteur, vii. (1893) pp. 165–212 (1 pl.).
† Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 554–5.
‡ Ann. Inst. Pasteur, vii. (1893) pp. 141–64.

tract will explain it. The former condition is much less common, and the symptoms and anatomical appearances seem from the two cases quoted to have little in common with the usual post mortem phenomena of enteric fever. In both, however, the bacilli of typhoid and the streptococci were isolated from the cadaver. The cases quoted in which mixed infection was found were six out of a series of thirty-one. The virulence of mixed infection from these two organisms is supported by experiments made on rabbits; of five rabbits inoculated with *B. typhosus* all recovered; of five inoculated with *Streptococcus* four recovered and one died on the eighteenth day of a large subcutaneous abscess; of five other rabbits four died and one recovered. In the dead animals Peyer's patches were swollen and hæmorrhagic; the spleen and abdominal lymphatic glands much swollen. Cultivation from the spleen showed the presence of the bacillus of Eberth and of the streptococcus. The chief symptoms were high fever, stupor, diarrhœa. Several other experiments are detailed, which indicate the increased virulence of these organisms when acting together.

The author next goes on to glance at the phagocytic reaction in the case of the mixed infection. Experiments were made with Ziegler's plates and with capillary tubes filled with cultures and inserted beneath the skin of the arms or the ear of rabbits. In the case of the typhoid bacilli the phagocytic action was very marked, even within 24 hours, although the bacteria had not altogether disappeared in 51 hours.

In cases of mixed cultivations, so far from a diminution as in the previous instance, there was a manifest increase even in seven hours, although the immigration of leucocytes was considerable, and the phagocytosis marked. In 24 hours, however, the bacterial increase was colossal and the phagocytes had disappeared. Hence the addition of *Streptococcus* enabled the combination to prevail against the leucocytes. The author then alludes to the numerous germs before which *Bacillus typhosus* dies out, and concludes with some practical suggestions.

The author invariably uses the term *Streptococcus*, and from the context we gather that this means the *Streptococcus* of Fehleisen.

Suspected Identity of Bacillus butyri fluorescens and Bacillus melochloros.*—Dr. F. Lafar points out that *B. butyri fluorescens* and *B. melochloros* are distinguished from one another by the following characteristics. *B. melochloros* is actively mobile. Colonies on gelatin plates are recognizable with the naked eye, even in four hours, and the inoculation track shows a watch-glass depression. Agar stroke cultures soon develope a yellowish overlay, while the rest of the medium assumes a green colour. On the other hand, *B. butyri fluorescens* is immobile. Gelatin puncture cultures show the conical "filter," and on plates the colonies become visible to the naked eye in about 30 hours. The agar stroke cultivations are of white colour, and the substratum is quite unaltered.

Bacillus pyocyaneus in Plants.†—The difficulty of finding a plant susceptible by inoculation with a virus pathogenic to animals has been overcome by M. A. Charrin, who has discovered in one of the Crassu-

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 807–8.
† Comptes Rendus, cxvi. (1893) pp. 1082–5.

laceæ, *Pachyphyton bracteosum*, a plant the anatomical structure and juices of which facilitate bacteriological experiment. Injection of pure cultivations of *Bac. pyocyaneus* into leaves of this plant gave results similar to those observed in animals, that is to say, the virus must be of a certain quality and quantity in order to produce deteriorating or lethal effects. Microscopical examination of leaves which had died showed that most of the germs were in the intercellular spaces, very few being observed within the cells. And, as might have been anticipated, none of the phenomena of phagocytosis were observed, though undoubted evidence of degeneration was present. Chemical changes accompanied the anatomical; the reaction of the leaf-juice of *P. bracteosum* is acid and equivalent to 0·225 grm. H_2SO_4. In from 10 to 15 days this acidity fell to about half the quantity, and in general was proportional to the quantity of the cultivation introduced.

It was also found that the leaves did not react to the influence of toxines as do animal tissues. No protection was afforded.

Varieties of Diplococcus lanceolatus.*—Sig. P. Foà distinguishes two varieties of this bacterium (*Pneumococcus* of Fränkel), which differ in their pathogenic action. The one (*Pneumococcus*) is œdematogenous or toxic; the other (*Meningococcus*) is fibrinogenous or septic; but they are convertible into one another.

Toxic Action of Cultivation Products of Avian Tuberculosis.†—M. E. de Freudenreich notes that animals injected with the products of avian tuberculosis die of emaciation and without the development of tubercle. The author had mixed 10 litres of milk, 300 grm. of a tubercle culture in glycerinized bouillon, and an emulsion of three cultures in glycerin-agar, and a cheese was made. After a period of maturation, rabbits were injected from this cheese, the animals dying in condition of extreme emaciation, but without tuberculosis. Control experiments were made with healthy cheeses for the purpose of ascertaining if products of maturation gave rise to similar phenomena, but the animals were unaffected, and the author infers that the toxins were introduced into the cheese when it was made.

Microbic Synthesis of Tartar and Salivary Calculi.‡—M. V. Galippe finds from microbiological analyses of concretions that the parasites contained therein are not accidental, but are the agents of the chemical phenomena. The parasites preserve their vitality for years, and may be isolated and cultivated. By the aid of chemical reagents the author determined that the organic skeleton of these salivary calculi was composed of a close network of micro-organisms, which had brought about the precipitation of the earthy salts. These micro-organisms vary according to the kind of calculus. From a chemical point of view salivary calculi are composed of phosphates and carbonates of lime and magnesia, like those which are formed spontaneously in the animal body.

* Atti R. Accad. Lincei, 1893, pp. 403–5.
† Ann. de Micrographie, v. (1893) pp. 31–3.
‡ Comptes Rendus, cxvi. (1893) pp. 1085–6.

ACOSTA, E., & F. GRANDE ROSSI—**Descripción de un nuevo cladothrix** (*Cladothrix invulnerabilis*). (Description of a new *Cladothrix* (*Cladothrix invulnerabilis*.) *Crón. Méd.-Quir. de la Habana*, 1893, pp. 97–100.

Beiträge zur Physiologie und Morphologie niederer Organismen. (Contributions to the Physiology and Morphology of Lower Organisms.) Aus dem kryptogam. Laboratorium der Universität Halle a. S. Edited by W. Zopf. Part 3, Leipzig, 1893, 8vo, 74 pp., 10 figs. and 3 pls.

BOBROW, N.—**Ueber das Verhalten einiger pathogenen Mikroorganismen im Wasser.** (On the Characters of some Pathogenic Microbes in Water.) Jurjew [Dorpat], 1893, 8vo, 63 pp.

BOURQUELOT, E.—**Remarques sur les ferments solubles sécrétés par l'Aspergillus niger v. Tgh. et de Penicillium glaucum Link.** (Remarks on the Soluble Ferments secreted by *Aspergillus niger* v. Tgh. and *Penicillium glaucum* Link.) *Compt. Rend. Soc. Biol.*, 1893, pp. 653–4.

COREIL, F.—**Recherches bactériologiques sur les eaux d'alimentation de la ville de Toulon.** (Bacteriological Researches on the Drinking Waters of Toulon.) *Annal. d'Hyg. Publ.*, 1893, pp. 524–46.

CRAMER, E.—**Die Zusammensetzung der Bakterien in ihrer Abhängigkeit von dem Nährmaterial.** (The Composition of Bacteria as dependent on their Nutrient Material.) *Arch. f. Hygiene*, XVI. p. 151.

FERRATI, ENRIGO—**Zur Unterscheidung des Typhus-bacillus vom** *Bacterium coli commune*. (On the Discrimination of Typhus-bacillus from *B. coli commune*.) *Arch. f. Hygiene*, XVI. p. 1.

GRUBER—*Mycromyces Hofmanni*, **eine neue pathogene Hyphomycetenart.** *Arch. f. Hygiene*, XVI. p. 35.

HOUSTON, A. E.—**Note on the Number of Bacteria in the Soil at different Depths from the Surface.** *Edinburgh Med. Journ.*, 1893, pp. 1122–5.

JANCZEWSKI, E. DE—**Polymorphisme du** *Cladosporium herbarum* **Lk. Communication préliminaire.** *Bull. Acad. Sci. Cracovie*, Dec. 1892.

KNORR—**Experimentelle Untersuchungen über den** *Streptococcus longus*. (Experimental Investigations on *Streptococcus longus*.) *Zeitschr. f. Hygiene u. Infectionskrankh.*, XIII. p. 427.

KOTLJAR, E. J.—**Zur Morphologie von** *Microsporon furfur*. *Wratsch*, 1892, pp. 1055–7 [Russian].

LANDMANN—**Ueber das Vorkommen virulenter Streptokokken** (*Streptococcus longus*) **in Trinkwasser.** (On the Presence of virulent Streptococci in Drinking Water.) *Deutsche Med. Wochenschr.*, 1893, p. 700.

OHLMACHER, A. P.—**Myxosporidia in the Common Toad, with preliminary observations on two chromophile substances in their spores.** *Journ. Amer. Med. Assoc.*, 1893, pp. 561–7.

PAVONE, C.—**I microbi dell' uomo.** (The Microbes of Man.) Milan, 1893, 16mo, 84 pp.

POPE, F. M.—**Micro-organisms in their Relations to the Higher Animals.** *Trans. Leicester Lit. and Phil. Soc.*, II. (1891) pp. 256–62.

TATE, G.—**The Chemical History of some recently observed Bacteria.** *Liverpool Med.-Chir. Journ.*, 1893, pp. 100–4.

WURTZ, R., & R. LEUDET—**Note sur l'identité du bacille lactique de Pasteur avec le** *Bacillus lactis aerogenes*. (Note on the Identity of Pasteur's Lactic Bacillus with *Bacillus lactis aerogenes*.) *Compt. Rend. Soc. Biol.*, 1893, pp. 531–2.

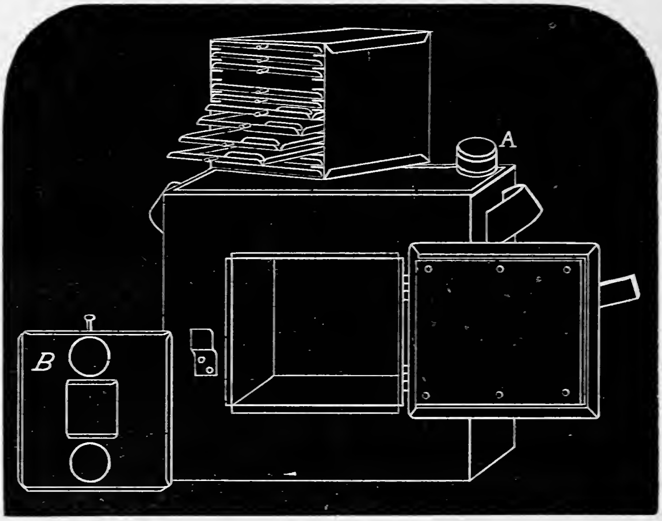
MICROSCOPY.

a. Instruments, Accessories, &c.*

(3) Illuminating and other Apparatus.

Practical Drying Oven.†—Feeling the need of a compact drying or hardening oven for slides in which a uniform temperature could be maintained—one in which the slides would be held in place without disturbing the specimen and at the same time be easy of access, Mr. W. N. Preston made the oven illustrated in fig. 107. As will be seen by the figure, the rack is placed in a $6\frac{1}{2}$ inch water-bath, which, having a hole bored in the screw cap A, keeps the heat at or below boiling point. This oven may be set on a stove or on a tripod over a Bunsen burner or other flame. The rack is made with slides or ways for the drawers to run on. The drawers, twelve in number, and holding

Fig. 107.



three slides each, are made from one piece of metal, the sides and ends being 1/8 in. high, and two similar elevations being turned up from the centre hole make three divisions in the drawer, each holding a slide which may be taken out, examined, and replaced at pleasure.

The three holes in the drawers, as shown at B, are for the purpose of allowing the ready removal of the slides by placing the finger under and raising them, and also admit of the hardening of inverted mounts. Should spring clips be necessary for holding the cover-glasses in place,

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

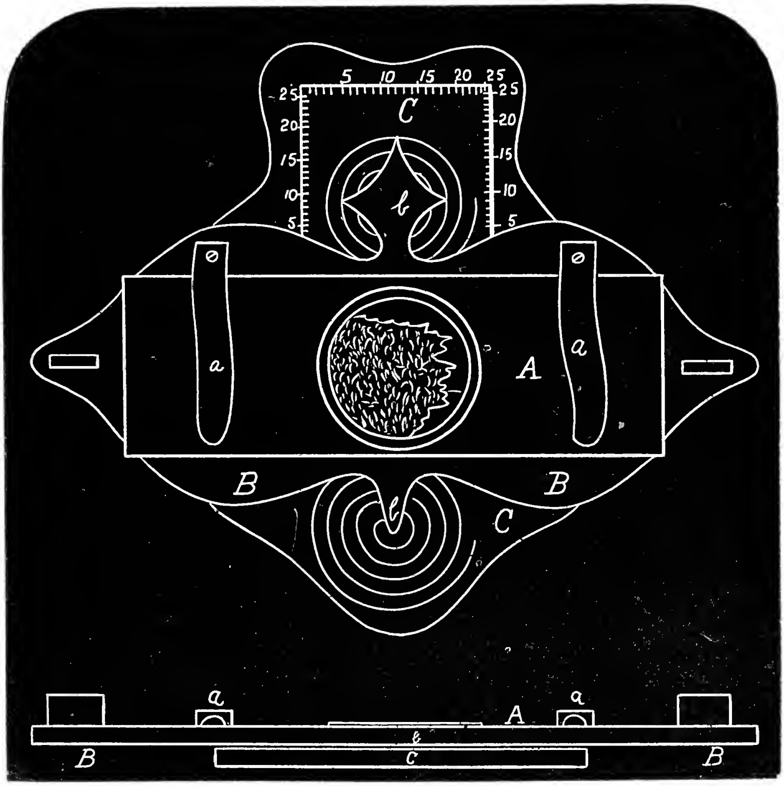
† Proc. Amer. Micr. Soc., xiv. (1893) pp. 152–3 (1 fig.).

they may be accommodated by removing the drawer next above and placing but two slides in each drawer at right angles to the position occupied by three, the springs thus coming to the centre. Being made entirely of copper, the durability of the apparatus is assured as well as its safety from rust.

Mr. Preston adds that the object of the rack is to allow the ready removal of the entire lot of slides from the oven without the necessity of taking the oven as well.

Slide Carriage and Object-finder.*—Mr. F. L. J. Boettcher, finding it very difficult to get on without an object-finder, has constructed a contrivance whose object is twofold; first, to bring every part of the

FIG. 108.

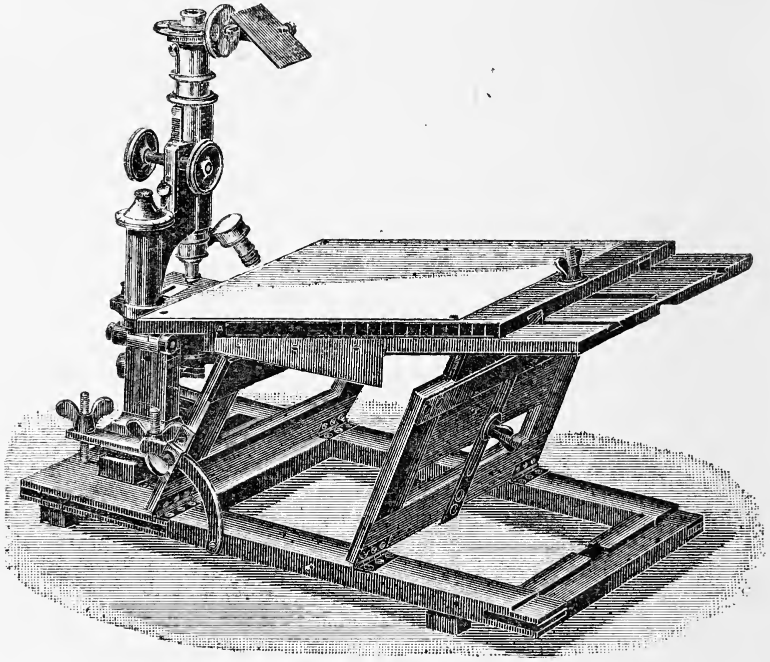


section by the shortest route once and once only under the Microscope; and secondly, to enable any point in the section to be recorded. In fig. 108 A represents a slide 3 in. by 1 in., lying in a recess or hollow of the carriage B, into which it fits closely and is held by the clamps *a a*.

* Amer. Mon. Micr. Journ., xiv. (1893) pp. 200-2 (1 fig.).

B lies firmly upon the table C, and contains at *b b* two short pins which rest firmly in the two spiral grooves. "These two pins will direct the motion applied; the section describing exactly similar revolutions, as the pins *b b*, will bring exactly the width between the lines of the spiral groove under the focus as a definite part of the same, decreasing in diameter as the power of magnification increases. The diameter of the field and the space between the lines of the spiral groove can correspond exactly only with the power for which the instrument has been made, and the possibilities lie between 50 and 250 diameter magnification. To find the actual field, measure the diameter of the field in millimetres and divide this by the previously ascertained magnification. The diameter of the actual field will be the exact distance between the lines of the spiral groove. In most instruments, 100 to 150 diameters give fields of 1 mm. diameter, just wide enough for the grooves, while the powers beyond these furnish too small a space. The apparatus should therefore be exactly fitted for one of the lower powers of the Microscope. C, the table, is firmly but not permanently attached to the stage of the Microscope by means of pins and sockets, clamps or screws, according to the stage of the instrument."

Fig. 109



Desk for Microscopical Drawing.*—Dr. W. Bernhard has designed a new desk for microscopical drawing which in many respects is an

* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 439-45.

improvement on that of Dr. Giesenhagen, described in this Journal, 1891, p. 291. The latter instrument, as seen in figs. 30 and 31 (loc. cit.), was lacking in stability. In the design of the present apparatus the author was guided by the following principles:—

(1) Microscope and drawing-table must be rigidly connected together upon the same base-plate. (2) The plane of the drawing must be at the normal distance of distinct vision, i. e. 250 mm. from the eye of the observer, since (3) in general the drawing should correspond in its dimensions with the microscopic magnification, and therefore also (4) the drawing-desk must be adjustable in height and in inclination to the Microscope.

The mode of construction of the desk is seen in fig. 109.

On a base-plate, 25 × 44 cm., supported on three short feet, at distances from its left edge of 11·5 and 28·5 cm. respectively, are hinged two frames, each 15 cm. high, which are connected above with an upper plate, 25 by 38 cm. The frame on the left is directly hinged to this upper plate, while the other is only connected with it by means of a sliding-piece which is adjustable by a screw. By means of the arc-guide and clamping screw on the first frame the upper plate can be raised and fixed in any position, while its inclination can be regulated by drawing out the slide in the second. A sector of 10° on the upper plate gives its inclination. The height above the base-plate to which it can be raised is from 3 cm. to 17 cm.

The drawing-board proper moves in a swallow-tail groove on the upper plate and is clamped by a binding-screw. The Microscope is screwed on the free portion of the base-plate to the left of the first frame.

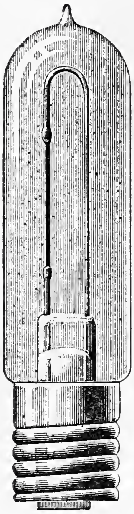
Improved Means of Obtaining Critical Illumination for the Microscope: Piffard's Electric Lamp.*—Dr. H. G. Piffard being unable to use with comfort either gas or an oil lamp in microscopic work, and finding that he could work by electric light for several hours continuously without inconvenience, applied to the Edison Lamp Works for a lamp to be constructed according to his own specifications. These were carried out, and the result was a lamp of fifteen candle-power requiring a current of about 3 ampères under a pressure of 15 volts. The lamp (fig. 110) has a cylindrical glass bulb about 3 in. long by 1 in. wide. The carbon filament is much broader and thicker than in the ordinary electric lamp, and is only 3/4 in. long, while the rest of the apparent filament is composed of copper wire arranged so as to support the carbon in a vertical position. When the carbon is rendered incandescent it shows a streak of light of intense brilliancy about 3/4 in. long and apparently 1/8 in. wide. The minified image of this is focused by mirror or condenser on the object and constitutes "critical" illumination. On examining the object with a 1/4 in. objective it was found that the field was not evenly illuminated, as there was a central brilliant streak on each side of which the light was comparatively feeble; but the portion of the object within the area of the streak was illuminated in the manner most favourable for the revelation of its intimate structure. In systematic work critical illumination is rarely called for except as a

* New York Med. Journ., lvi. (1892) pp. 71–2.

means of control, and subcritical or diffuse illumination, as obtained by racking the condenser a little out of focus, is preferable and more commonly employed.

While the lamp can be readily maintained at full incandescence by the current from an eight-cell storage battery, the care of this latter is by no means an insignificant matter, and Dr. Piffard is not prepared to recommend its use unless one has access to a street circuit. In New York they have both the Edison circuit with a pressure of from 110 to 120 volts, and the alternating current distributed to houses under the pressure of 55 to 60 volts. If the lamp was connected directly with either of these circuits it would be instantly destroyed unless the pressure was neutralized by the introduction of suitable resistance. This was accomplished on the Edison circuit by the interposition of a 100-candle power, 100 volt, 3-ampère lamp of the "*municipal*" type, the two lamps being in *series*. Both lamps will, when thus arranged, burn at full incandescence; and the large lamp can be covered up if not desired.

Fig. 110.



In photomicrography Dr. Piffard has used nearly all the methods of artificial illumination, including the arc, calcium, Welsbach gaslight, and oil, but the lamp described was found infinitely more convenient and amply efficient.

For ordinary work and for the study of absorption spectra by means of artificial light, this lamp is said to be an ideal illuminant.

New Mounting Table.*—Mr. W. N. Preston in describing his mounting table, says that it is intended to aid the microscopist in putting up uniform mounts. "A circular brass plate, 6 in. in diameter, turned perfectly flat on top, is set on three legs having levelling screws at the bottom. This table may be set over a Bunsen burner or alcohol lamp and kept warm while working.

The figure (fig. 111) shows a plan of the top, laid out in four sections, by placing the three pins, 1, 2, 3 (which are set in sockets and may be changed at pleasure or removed altogether), in the holes opposite the single set of circles and laying a slide against them, an object and its cover-glass may be exactly centered on the slide.

By using the set of double circles two objects may be set at equal distances from the centre and covers accurately placed; likewise the triple set, when three are wanted on a slide.

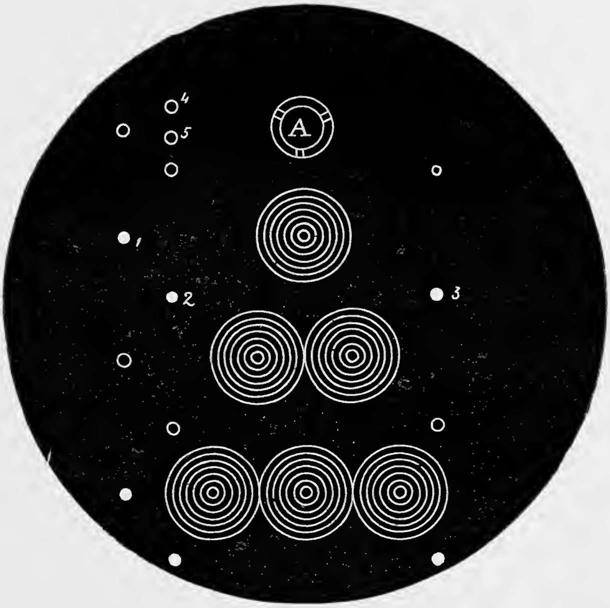
The first section is for cover-glass mounts, the cover being laid in the elevated socket A, object up; the slide, guided by the outer pins, is gently lowered till it touches the drop of balsam, the two shorter pins 4 and 5 holding it level with the top of the socket.

At the suggestion of my friend Mr. Summers, to whom I am indebted for many ideas in this table, I intend having a semicircular piece of

* Proc. Amer. Micr. Soc., xiv. (1893) pp. 150-1 (1 fig.).

plate-glass cut and ground on the surfaces, to rest on one half of the table for the purpose of evaporation in mounting diatoms, a more uniform

Fig. 111.



distribution of the heat being thus obtained as well as absorption for any particle of water which may overflow the cover-glass."

(4) Photomicrography.

Photography as an Instrument for recording the Macroscopic Characters of Micro-organisms in Artificial Cultures.*—Prof. G. F. Atkinson recommends the following mode of proceeding for this purpose. By cutting off the perpendicular rays of light, and throwing oblique rays from several directions through the plate-culture upon the sensitive plate, the colonies are differentiated strongly in all their exquisite forms and tracings. The culture plates (Petrie dishes) or tubes are inserted in an opening in the end of a box, which is painted perfectly black on the inside. Sliding boards in a grooved frame, each cut to clamp over half the Petrie dish, and lined with black velvety stuff, hold the plate-culture in position. The lens of the camera is pointed towards a window with the plate-culture between them. A perfectly black screen 30–40 cm. in diameter is then hung upon the window directly in front of the object, in order to cut off the perpendicular rays of light.

* Bull. Torrey Bot. Club, xx. (1893) pp. 357–8.

A suggested Improvement in the Correction of Lenses for Photomicrography.*—Dr. H. G. Piffard writes:—"Prior to the time of the late Colonel J. J. Woodward, M.D., Surgeon of the United States Army, say twenty-five years ago, photomicrography was in its first infancy. It is true that photographs of microscopic objects had been made, but they were crude and unsatisfactory, and were all made with what we would call low-power objectives. Although the objectives then made were of excellent construction and well adapted to the revelation of the structure of minute objects to the eye, yet the photographs made with them were greatly inferior in clearness and sharpness to the virtual image appreciated by the retina. The cause of this was not far to seek, and was due to the lack of coincidence of the visual with the so-called actinic focus. At the period mentioned the art of photography was almost exclusively practised with the aid of collodio-iodide plates, which were very sensitive to the blue, violet, and ultra-violet (more refrangible), and but feebly sensitive to the green, yellow, and red (less refrangible) rays. *Per contra*, these latter rays impress the eye so forcibly that the effect of the more refrangible rays is almost obscured—that is, when mingled with the others, as in ordinary white light. The practical outcome of this condition was, that when the ground glass of the camera was in a position that gave the sharpest image to the eye, this image could not be duplicated as to sharpness in the developed photographic plate occupying the plane previously occupied by the ground glass.

In order to obtain a sharp photographic image it was necessary either to shorten the anterior conjugate focus, which involved the veriest guess-work, and was practically unavailable, or else to move the plate to a point nearer the lens where the actinic rays came to their posterior conjugate focus. This was perfectly practical, and by repeated experiment the relation of the actinic to the visual focus in a given lens could be ascertained. Although practical, this method was hardly satisfactory.

In ordinary photography, the difficulty attending this difference in the natural positions of the actinic and visual foci had already been overcome by making the visual focus correspond with the actinic by constructing the lens so that it should be left in a state of moderate 'under-correction,' as it is termed by opticians.

Among the first to appreciate the value of this, as applied to photomicrography, was Colonel Woodward, and the first opticians to give it practical form were, I believe, Mr. William Wales, of New York, and Mr. Ernst Gundlach, then of Berlin, but now for many years a practical optician in this country. This example was followed by Tolles, of Boston; Powell and Lealand, of London, and others.

Woodward was one of the most accomplished microscopists, so far as the manipulation of the instrument was concerned, that ever lived. His skill in securing the virtual image and in projecting the real image was at that time equalled by few and probably surpassed by none.

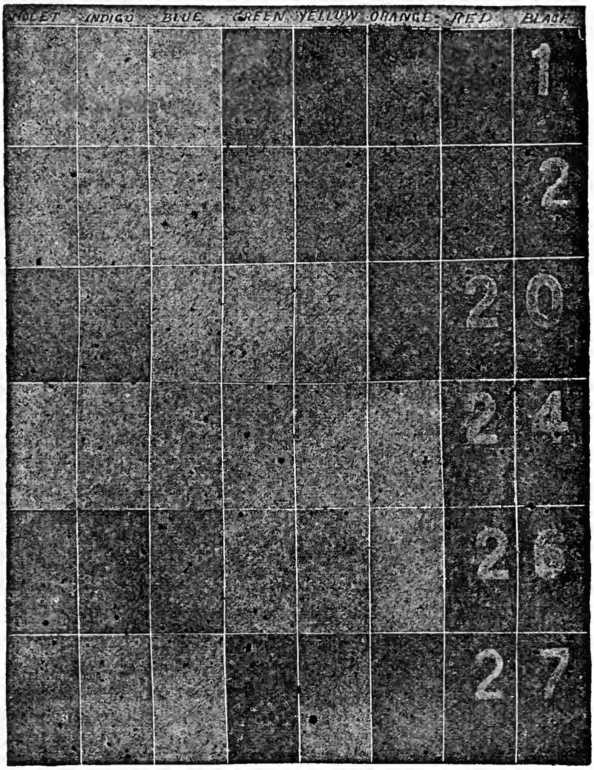
With Woodward's skill and the possession of lenses specially adapted to his purpose, the results obtained by him were the wonder of the scientific world.

Since his time photomicrography has, in the main, followed the paths

* Amer. Journ. Med. Sci., cvi. (1893) pp. 23–9.

he marked out, and the improvements in the art since then have simply kept pace with the gradual improvement of the objective, and especially in the direction of increased apertures. One notable advance in the technique, however, is Abbe's happy conception of the projection ocular.*

Fig. 112.



Photograph of Artificial Spectrum.

The collodio-iodide gave place some years ago to the gelatino-bromide plate, which, like its predecessor, is especially sensitive to the blue and more refrangible rays, and almost wholly insensitive to those which give the strongest visual impression. The relative sensitiveness of such a plate to pigment colours is clearly shown in the annexed photograph of an artificial spectrum. (See fig. 112.)

In order to obtain the sharpest image on such a plate the lens must

* Peculiar advantages have been claimed in behalf of objectives constructed according to the so-called "apochromatic" system. These lenses, however, possess certain disadvantages which restrain me from giving them unqualified commendation.

of necessity be under-corrected, as already stated. In accomplishing this, however, there is a certain loss of visual excellence which, however, is of little moment in ordinary photography. That this under-correction of lenses for photomicrography results in an impairment of their visual excellence is well known to opticians, bnt has thus far received but little notice from the actual users of the lenses in question. A few recent writers, however, have directed attention to the matter.

Londe * says: 'The first and most important question is the choice of objectives. These may be excellent for observation and more than mediocre for photography.'

Mercer, † in speaking of some of the objectives used by him in photomicrography, says. 'The Wales objectives are corrected spherically for the violet ray. The violet image is, therefore, somewhat superior to the visual, with which, however, it is coincident.'

Czapski, in a letter published in Van Heurck's treatise on 'The Microscope,' London, 1893, says, 'In every case the objectives specially constructed by opticians for photography can never be advantageously employed for observations, and inversely.'

From the foregoing it will be clear that lenses which were best for visual purposes were not the best for photographic use, and it was necessary, therefore, when the most perfect results were sought in both departments, to have a double set of objectives, and many investigators did provide themselves with such an outfit.‡

The inconvenience and lack of economy involved in this arrangement is manifest, but how to obviate it does not appear to have occurred to opticians or others interested in the subject.

Having been practically familiar with photography and photomicrography for upward of twenty years, I have had the opportunity in that period to become reasonably familiar with the inherent defects of their technique, but it was not until the latter part of 1891 that I perceived that a way out of the difficulty might be readily found.

During the past five or six years the manufacturers of gelatino-bromide plates have placed on the market plates which are extremely sensitive to yellow light, and but feebly so to the blue, violet, ultra-violet rays of the spectrum, as will be perceived on examination of the band marked 26 (see fig. 112), and comparing it with band marked 1, of the same figure. (The other bands do not concern the purposes of this paper).

If now the objective be corrected for yellow instead of for blue or violet light, the negative being made on one of these yellow sensitive or so-called 'orthochromatic' plates, there should be an exact correspondence of the visual and chemical foci, and the resulting picture should be superior to one that could be obtained by the ordinary procedures—that is, an under-corrected lens and blue-sensitive plate; and at the same time the objective would not have its visual excellence impaired, supposing, of course, that the optician performs his part of the work with care and skill.

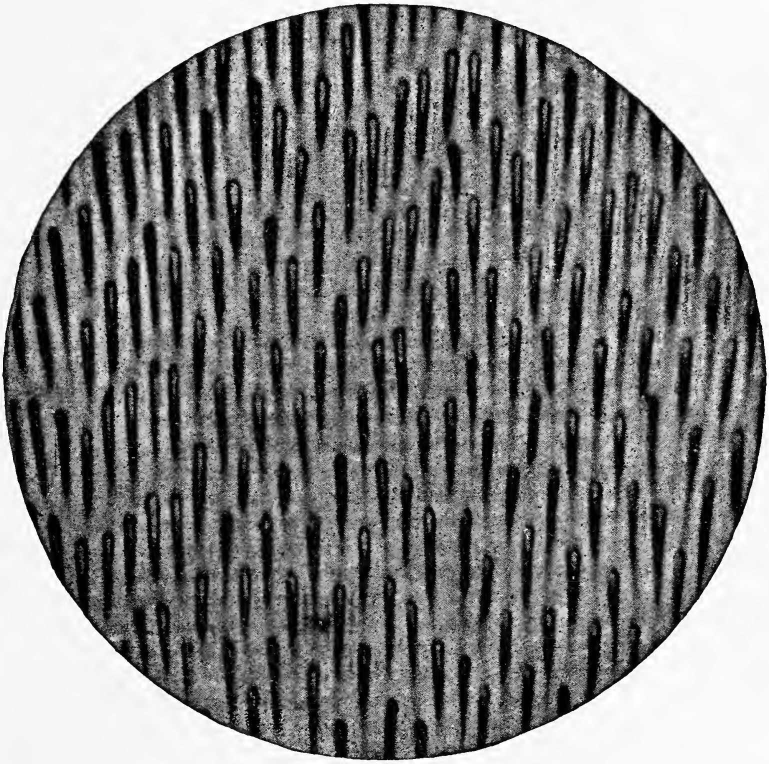
* 'La Photographie Médicale,' Paris, 1893.

† Journ. Roy. Micr. Soc., June 1892.

‡ It must be admitted that some of the apochromatics of short focus (2 mm.) obviate, in a measure, this difficulty, but those of longer focus have not, at least in my hands, proved satisfactory.

In order to test the practical value of this theoretical reasoning, I requested Mr. H. R. Spencer, now of the Spencer & Smith Optical Co., of Buffalo, N.Y., to calculate the formula and construct a lens which would fulfil the stated requirements. The result was a lens of 1/6 in. equivalent focus, and possessing a numerical aperture of 1·35. With this objective I have resolved and photographed the *Amphipleura pellucida* in lines, and have photographed both the *Navicula rhomboides* and the *Van Heurckia crassinervis* in lines and beads.*

FIG. 113.



Photograph of the Test *Podura* (*Lepidocyrtis curvicollis*). × 3000.
Spencer & Smith Obj. 1/15, N.A. 1·35.

In ordinary histological work, with amplification ranging from 200 to 400 diameters, the results with this lens have been very much more satisfactory than I have been able to obtain by any other combination of lenses or plates.

With a 1/4 in. objective of the same construction, made by Spencer &

* As regards the last-named object, it has been previously photographed in beads, so far as I am aware, only by Van Heurck with the aid of a lens of higher power, 1/8 in., and much larger aperture (N.A. 1·60).

Smith on the order of Dr. J. A. Fordyce, of this city, I have resolved the *A. pellucida* with white light, and have demonstrated the resolution to him and to others. With a 1/15 in. of the same construction, the property of Dr. J. H. Kellogg, of Battle Creek, Michigan, I made the photograph of the podura which accompanies this paper (fig. 113).

In order to further test the correctness of the principles involved, I requested Mr. Turner, of the Gundlach Optical Co., Rochester, N.Y., to make a 3/4 in. lens of moderate aperture (N.A. 0·33). Considering the power, aperture, and price (12 dollars), the lens gave very satisfactory results, and wholly confirmatory of the theoretical demand.

In using these lenses with yellow sensitive plates there is a distinct gain in definition and purity of image, both visual and photographic, if the object be illuminated with light of corresponding refrangibility (λ 5892). This may be obtained absolutely by employing a sodium flame, or approximately by intercepting the white light with a medium capable of absorbing the rays of short wave-length.

For the greater part of photomicrographic work, and especially that which deals with histology, I unhesitatingly recommend the technique here described, which, briefly stated, consists in the use of objectives whose corrections shall be adjusted to the D instead of the G or H lines, and in connection with plates specially sensitive to D light, and having the object illuminated as near as may be with rays of the same refrangibility.

If, however, we have to deal with objects in which we must resolve or optically separate particles whose approximation to each other is less than, say, 1/100,000 in., the foregoing statements do not apply.

The studies of Helmholtz and of Abbe have placed us in possession of a formula which appears to be theoretically and practically true, and may be expressed as follows :

$$\text{R. P.} = \frac{n \; x \sin u}{\lambda}.$$

R. P. here indicates the resolving power of the objective; *n*, the refractive index of the medium lying between the cover-glass of the object and the front lens of the objective (be the same air, water, glycerin, or oil); *u*, the semi-angle of the aperture of the objective; sin, the natural sine of said semi-angle; and λ, the wave-length of the light employed. Now the 'numerical aperture' of the lens is equal to $n \; x \sin u$, and the equation becomes simplified into

$$\text{R. P.} = \frac{\text{N.A.}}{\lambda}.$$

From this it will be seen that if we desire to obtain extreme resolution, it is necessary to employ objectives of the greatest numerical aperture, and employ in connection therewith such visible rays as possess the shortest wave-lengths. For the photographic reproductions of such images blue-violet sensitive plates, with under-corrected lenses and approximately blue or violet illumination (Woodward's technique) will give the best results. At the present time Mr. E. M. Nelson, of London, is devoting special attention to the development of this branch of photomicrography.

It will be noted that the formula above given does not take into account the equivalent focus or magnifying power of the lens; in other words, that this factor has no influence on the resolving power of the objective. This is correct. A well-connected 1 in. objective will resolve exactly as well as an equally good 1/4 in., provided the factors N.A. and λ remain the same. I here allude to this matter, as every few years some one imagines that he is on the verge of great discoveries to be brought about by the simple feat of increasing the amplification of the image. Let us assume that a photograph be made with an amplification of 3000 diameters, with N.A. the greatest and λ the least possible. This photograph may then be further enlarged to 30,000 or 300,000, but the enlarged pictures will not show any finer or more intimate structure than was delineated on the original smaller picture." *

(5) Microscopical Optics and Manipulation.

Unusual Microscopic Images.†—Herr L. Sohncke describes and explains a curious observation which he accidentally made with an Abbe diffraction plate. He found that, with the Microscope left quite unaltered, there were five different distances of the plate at which microscopic images of the grating upon it were obtained. The images were partly inverted, partly erect, and of different magnifications. The unusual images differed from the normal one by considerably diminished brightness. The phenomenon was not dependent on the particular Microscope employed nor on the mode of illumination. It was not connected with the known focal properties of diffraction plates, for it was found to be quite independent of the grating nature of the object. Its production was finally determined to be due to the plate carrying the object having the properties of a mirror. A plate, however, can only act as a mirror if it is illuminated from the side of the Microscope. Thus certain faces of the Microscope lenses must also act as mirrors. Only bounding surfaces between glass and air need be taken into account, not those between glass and glass, because in the latter case the reflected intensity is too slight. By this double reflection an image of the object may be produced at the right object distance from the front lens of the Microscope. The author shows that in this way the phenomenon in question is completely explained.

The following table contains the data of observation on the position and magnitude of the five images which were obtained by a Zeiss Micro-

* Some months ago a friend, who is a sub-chief in one of the principal bacteriological laboratories of this city, remarked to the writer that the height of his ambition was to possess and work with a Zeiss 1/18 in. apochromatic. I replied that if he fancied Zeiss lenses he had better select a 1/12 in., as with it he would be able to do more and better work in the line of research and discovery than with the 1/18 in. My reply was evidently received with extreme incredulity. If we refer to Zeiss' catalogue, we shall find that the numerical aperture of the 1/18 in. is given as 1·18, but the 1/12 in. of the same maker has a N.A. of 1·30. He makes still another 1/12 in. N.A. 1·40. Applying these figures to the equation above given, and assuming for white light λ 5269, we shall find that the 1/18 in. will resolve or differentiate particles that approach each other as closely as about 114,000 to the inch, while the 1/12 in. of N.A. 1·30 will resolve particles as close as about 125,000 to the inch, and the 1/12 in., N.A. 1·40, will take optical cognizance of lines or particles that approximate each other to within about 1/135,000 in.

† SB. K. B. Akad. Wiss. München, 1893, pp. 223-35.

scope. The first column contains the number of the image; the second the distances *e* of the front face of the objective from the upper face of the diffraction plate; the third column gives the position of the image in which the normal image (No. IV.) is reckoned as "normal," the inverted ones as "abnormal"; while the fourth column shows the relation of the magnifications:—

Image.	*e*.	Position.	Relation of Magnifications.
	mm.		
I.	0·50	Normal	3·21
II.	4·15	,,	1·00
III.	8·55	Abnormal	0·61
IV.	12·70	Normal	1·00
V.	25·05	Abnormal	1·09

The objective aa of the Zeiss Microscope consists of two lens systems. The front one of these is a plano-convex lens, the plane face of which forms the front surface of the whole objective. The front face of the second system is convex. The author shows that the surfaces concerned in the phenomenon under examination are—*a*, the plane front face of the objective; *b*, the back surface of the plano-convex lens; and *c*, the convex front face of the second system of the objective. By means of the ordinary rules for reflection at plane, concave, and convex surfaces he demonstrates that the effect of *a* is to produce the image II. with magnification equal to that of the normal image IV.; that from *b* result the images I. and III. with magnifications, as compared with image IV., of 3·29 and 0·62 respectively, which agree very closely with the actual numbers given in the above table; and that *c* is responsible for image V., which should theoretically have a magnification of 1·10 as compared with that of image IV.

(6) Miscellaneous.

The late Mr. Charles Baker, F.R.M.S.—Mr. J. E. Ingpen, at the meeting of the Society on October 18th, made the following remarks:— "By the death of Mr. Charles Baker, the optician, of High Holborn, a Fellow of thirty years' standing, a link between the earlier and later stages of microscopic work has been severed; a few words of reference to his share in that work may, therefore, perhaps, be not out of place. When, some five-and-forty years ago, Mr. Baker turned his attention to Microscope manufacture, good Microscopes were very scarce and expensive, and students' Microscopes, in the present acceptation of the term, almost unknown. By the introduction of French objectives, which were of very good quality, and their adaptation to simple and serviceable stands, the Microscope was placed within the reach of many who could not afford to purchase the higher class work. In more recent times Mr. Baker was chiefly instrumental in introducing into this country the optical improvements developed by Prof. Abbe and Dr. Carl Zeiss, which have given so great a stimulus to microscopical research, and of which our English opticians have so wisely availed themselves.

Mr. Baker very rarely attended our meetings; but his establishment has always been well known to many of us, who have from time to time availed themselves of its facilities for the discussion of current scientific topics, and of the assistance always obtainable there towards the practical construction and improvement of microscopical accessories."

The late Mr. Joseph Zentmayer.*—The American Microscopical Society publish in their Proceedings the following abstract of an obituary notice of this celebrated optician, which originally appeared in the 'Journal of the Franklin Institute,' December 1888. "Joseph Zentmayer, optician, whose name was known all over the world, was born in Mannheim, Baden, in South Germany, in 1826. He received a good education, and learned his trade as an instrument maker. At the termination of his apprenticeship, and after having made his 'masterpiece,' as is the custom among German mechanics, he travelled throughout Germany, working in the best establishments, and improving himself in the knowledge and use of scientific instruments. He was an ardent republican, and his natural love of liberty led him to take an active part in the agitation that had as its objects the establishment of republican institutions in Germany.

He came to America in 1848, in the twenty-fourth year of his age, hoping to find a free scope for his notions of freedom in the Western Republic. Between 1848 and 1853 he worked for the best instrument-makers in Baltimore, Washington, and Philadelphia.

In 1853 he began to make mathematical instruments in Philadelphia at Eighth and Chestnut Streets with but one single lathe. The high character of his work and the boldness of his conceptions attracted the attention of leading scientific men. Among these the late Dr. Paul B. Goddard was practically drawn to him, and it was Dr. Goddard who persuaded him to make the first of his large compound Microscopes. This early effort was so successful that the Academy of Natural Sciences and many of leading physicians who required such instruments, purchased those of his make and discarded the heavy and yet unstable instruments of European manufacture. Once fully embarked in this enterprise, it seemed to absorb his attention, and many were the improvements that followed each other in rapid succession, not only in the stand of the Microscope, but in its objectives. At the present time there is not a maker of Microscopes in the world who does not use some of the important inventions of this Philadelphia mechanician. During the war for the Union he furnished most of the Microscopes used in the Government hospitals, and he received the highest commendations from all the officers and other authorities for his work.

In 1865 he invented his photographic lens. The story of his invention of this photographic objective is very interesting. At the time when the Harrison globe lens was attracting attention, Prof. Coleman Sellers was requested to write a paper for the 'American Journal of Science and Arts' on the nature and advantages of the globe lens for the photographic camera. After this was published its writer consulted Mr. Zentmayer about the combination, and he said that it was quite possible to make a lens of two simple uncorrected concavo-convex or meniscus glasses, made thin and of proper curves, and that such a lens would be chemically

* Proc. Amer. Micr. Soc., xiv. (1893) pp. 161–6.

correct as to focus, and would also copy a drawing with the marginal lines straight, that is, without any bending of the lines either out or in. He was urged to make a lens of this kind, and finally he did so, sending it to Prof. Sellers to test. That first lens, made as he had proposed, was perfect in its definition, and had all the good qualities he had promised. Most lenses for this kind of work have been the result of a long series of experiments ending in the form adopted. In this case a lens constructed upon a theory proved the correctness of that theory in a most remarkable manner. The Zentmayer lens, which in working is as rapid, if not more so, than other globe lenses in the market, was more simple, and filled a want, inasmuch as his system enabled him to make a series of lenses, the front of one lens being used as the back one of another through a series of sizes from the longest focus wanted to the shortest; a set of these lenses, combined as required, meeting all cases that could occur both as to size of plate and proportion of reduction. Mr. Zentmayer's patent for these lenses was not granted at once, but he was obliged to contest his claim before a master, in which on examination his claim in regard to priority was fully sustained.

So radically original was the invention embodied in this lens, that the descriptions of it were at first regarded by the practical opticians of Europe as incredible, and as American exaggerations, and these ideas led to quite an animated controversy, which may be found in the 'Journal of the Franklin Institute,' 1867, vol. lxxxiii. p. 349; also 1868, vol. lxxxv. p. 153, and more fully in the 'Philadelphia Photographer,' 1867, vol. iv. pp. 177, 251, 253, 344; also 1868, vol. v. pp. 79, 109.

After the system of screw-threads as the "United States" or the "Franklin Institute standard of screw-threads" was introduced, and makers called for instruments to measure the amount of reduction or the width of the flat top and bottom of the threads, a set of thin steel plates ground to an angle of 60° was sent to Mr. Zentmayer to have him grind the apex of each to the proper amount, the width of each being given to him in decimals of an inch to the fourth point. In topping these off he measured the flat by means of a stage and eye-piece micrometer. The correctness of his work was then verified by a member of this committee, who, taking the finished pieces, measured them on his own Microscope in the same manner, setting down the dimensions as found, and afterwards comparing them with what was required, with the result of finding them correct to the fourth place of decimals in each case. This was, in the first place, one of the earliest instances in which the Microscope was used in such a mechanical process, and a remarkable example of the facility with which good instruments can be used in such work of precision. The standard gauges, made since by the Brown and Sharpe Manufacturing Company, have all been adjusted to the standard pieces prepared by Mr. Zentmayer.

The wonderful comparator designed by Prof. Rogers, of Boston, and made and used by the Pratt and Whitney Company, of Hartford, Conn., is furnished with Microscopes made by Mr. Zentmayer, who took great pains to perfect the instruments to be applied to this system of comparing measurements. In all cases where work of great nicety has been required, those who knew Mr. Zentmayer's skill were in the habit of seeking his aid, even in matters not pertaining to optics. The freedom from petty jealousy that marked his character was pleasing to his many friends. No one ever heard him say a harsh word about rivals in trade, even when in the contests, called by some sharpness in trade, he might justly blame some for having acted unfairly. Those who have been for years in the habit of visiting him in his shop know how kind he always was and how patiently he listened to what they had got to say, giving freely from his great store of knowledge, showing his methods and even supplying to those who wished to make any piece of apparatus themselves such parts as he could find suited to their purpose.

Mr. Zentmayer's office in Walnut Street, where he had his lathe close to his counter, and near to the cases containing his instruments, was the meeting place of all the scientists of the day. There at all times, while he was working, professors and physicians, and mechanical engineers, would meet and discuss problems in optics or in mechanism, all of these men learning to love the good man who was so simple-minded and so honest in his dealings. Many times young men coming to purchase their first Microscope, found the great optician advising the purchase of a good working instrument cheaper than the one they had come to buy, but well fitted to do what would be required of it. No instrument would leave his hands without being personally inspected by him, after he had advanced to the condition of employing workmen to do what at first he did with his own hands. All those who knew Mr. Zentmayer felt the influence of his honest, straightforward seeking after truth. It was always a source of pride to him that among the many thousand instruments which he constructed, none ever came back for repair after years of hard usage, except in the case of severe accident, such as would come from a fall or the like. No amount of work ever did them harm.

The great triumph of his Microscope-making was the perfection of the stand, known as that of 1876, which elicited so much favourable comment during our Centennial Exhibition. The invention and practical application of his swinging substage, that enabled him to rotate the illuminating apparatus completely round the object without disturbing its focus, were marked examples of his talent. Others may claim to have made something similar, but none had ever made it so perfect as to be substantially new to all who used it. Now no good Microscope is made without this important arrangement of stand. The binocular Microscope, under his hands, became more useful than ever before. It was not until he had perfected this form that he was willing to sell a binocular instrument. He knew the good that was to be obtained by means of the binocular principle, but he was unwilling to make one for sale until at last he had surmounted all the objections he saw in the system, and had made so perfect an instrument that he did not fear to attach his name and reputation to it.

In the construction of his simple form of sliding stage, others may claim the prior invention of the principle in a crude form, but it is very certain that to Mr. Zentmayer, and to him alone, is due the credit of making this simple device as perfect as the most costly compound stage, so far as comfort of working and certainty of motion are concerned. To suggest is one thing, but to perfect into an efficient instrument is perhaps the most important after all.

Mr. Zentmayer was not willing to push himself forward, but when he was at last pursuaded to lecture on optics at the Franklin Institute, his lecture proved to be as well worthy of the man as all his mechanical work. It stands to-day as an important addition to the literature of optics.

Mr. Zentmayer's musical education, as well as his artistic, made him an appreciative critic, and among his countrymen his poetry is valued. He was so loving and so kind, so winning in his ways, that all who came in contact with him were attracted towards him, and when his last illness came, warning them that the mind they had valued so highly was losing its great strength, they mourned his death long before the actual dissolution of his body.

The illness that at last resulted in the death of Mr. Zentmayer came on very slowly, and fortunately only after he had instructed his sons in the processes that had made his work so celebrated. Those sons have had charge for a number of years of the construction of the instruments which have given such great satisfaction to all who have used them. To members of the committee of the Franklin Institute the father confided his system of education of his children, and to them he explained how thoroughly he had informed them of the minutiæ of his operations that they might worthily carry on a business of which he was so proud. Mr. Zentmayer would never do any work slightingly. What was to be done must be done well, his constant effort being to improve his methods as well as improve the construction of his instruments.

As a writer Mr. Zentmayer was not prolific, preferring to express his ideas verbally to his friends rather than to put them on paper for publication. We find, however, the following articles which were his work in the 'Journal of the Franklin Institute':—

"On a Mechanical Finger for Use in Mounting Diatoms under the Microscope," 1870, vol. lxxxix. p. 334.

"On an Erecting Prism for Use in the Microscope," 1872, vol. xciii. p. 375; "A Lecture on Lenses," 1877, vol. civ. p. 49.

Also in the 'Philadelphia Photographer,' 1867, vol. iv. p. 251, we find an article entitled "Refraction without Dispersion, and some Reflections," in which he takes a hand in the controversy about his photographic lens with marked ability."

β. Technique.*

NABIAS, B. DE, & J. SABRAZÈS—**Bemerkungen über einige Punkte der histologischen und Bakteriologischen Technik.** (Remarks on some points in Histological and Bacteriological Technique.)
Prag. Med. Wochenschr., 1893, pp. 286–8.

(1) Collecting Objects, including Culture Processes.

Non-albuminous Nutritive Solution for Pathogenic Bacteria.†—Dr. Uschinsky has devised a non-albuminous medium for cultivating pathogenic microbes in which they grow as luxuriantly as in ordinary bouillon. The solution is composed of the following ingredients:—

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

† Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 316–9.

Water 1000; glycerin 30–40; sodium chloride 5–7; calcium chloride 0·1; magnesium sulphate 0·2–0·4; calcium biphosphate 2·0–2·5; ammonium lactate 6–7; sodium asparaginate 3·4.

Cholera, diphtheria, swine-erysipelas, peripneumonia bovina, tetanus, typhoid, &c., grow in this solution as freely as in bouillon. Tuberculosis has not yet been successfully cultivated in this medium, while diphtheria and tetanus seem to have claimed most of the author's attention.

Growing Yeasts on Solid Media.*—Herr P. Lindner cultivated various species of yeasts in "giant colonies" on gelatin, and found that this medium is specially suitable for recognizing and studying the different kinds of yeasts. When used for the purpose of comparing yeasts it is of great importance that each young colony should be laid down in exactly the same way. A colony is sown by just touching the surface of the gelatin with a small drop. The surface should not be damaged in the process, and hence the gelatin should not be too dry from age or too soft. The best cultivation vessels are small flasks plugged with cotton-wool, because they are more easily photographed and because contamination during inoculation is more easily avoided.

During the development of the culture care should be taken that neither sunshine nor radiant heat shall act unequally. The giant colonies of particular species of yeast exhibit a quite definite form of growth which is typical of the species, and developes with precision in newly formed colonies. Experiments as to the influence of the medium on the form and shape of giant colonies showed that even considerable alterations in the composition of the medium were not altogether able to efface the type of growth.

Cultivation of Gonococcus.†—Dr. Steinschneider has cultivated gonococcus on an artificial medium composed chiefly of human blood-serum and agar. The incubation temperature was from 35°–40°. The results were very satisfactory. The growth was still more luxuriant if the blood-serum-agar were mixed with sterile human urine, or if the serum were previously heated up to 55° in order to remove its bactericidal property. Additions of grape-sugar and mucin are harmful; an increase of pepton ($1\frac{1}{2}$–2 per cent.) is beneficial.

Two experiments on the human urethra with pure cultivations are recorded. (1) A twelfth-generation culture caused a moderate urethritis, in which pus-corpuscles and diplococci were found. (2) With a fourth-generation culture, a typical gonorrhœa was excited in a college student who had never had the disease. The gonococci were in considerable quantity, and their disposition was typical.

Inoculation on the peritoneum of animals excited an exudative peritonitis, and experiments on the cornea resulted in suppurative inflammation, but in neither instance could the gonococcus be demonstrated in the secretion by cultivation.

New Apparatus for Counting Bacterial Colonies in Roll-Cultures.‡—Dr. G. Buchanan Young being dissatisfied with Von Esmarch's

* Wochenschr. f. Brauerei, 1893, No. 27. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) p. 372.

† Berlin Med. Wochenschr., 1893, No. 29. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 331–2.

‡ Proc. Roy. Soc. Edinb., xx. (1893) pp. 28 and 29 (1 pl.).

apparatus, which does not permit of the whole contents of the culture-tube being actually counted, since colonies are never so uniformly distributed that the counting of them in a given area or areas can give more than a rough approximation of the number actually present, has invented a new apparatus. It consists of a glass tube, 15 cm. long, the surface of which is divided by finely etched lines into square cms. The bore of this tube is such that the roll-culture-tubes just slide without play in it. Indiarubber rings keep the culture-tubes in position during the process of counting. A sheet of optical black glass forms a suitable blackground.

The contents of each longitudinal row of squares are counted seriatim, the counting-tube being rotated by means of a milled collar. The number of colonies in each square is noted on a paper scheme having squares corresponding to those on the counter. It is only necessary to add together the contents of all the squares to obtain the total.

In practice it has been found better to count the number of colonies in the space between the adjacent lines for the whole circumference of the tube—rotating the tube as the counting is done.

Diagnosis of Cholera Bacilli by Means of Agar Plates.*—The recommendation of Koch induced Dr. Schiller to try agar plates for cultivating and examining cholera bacilli. The liquefied agar was cooled down as far as possible, inoculated, and plates made. After six hours in the incubator the condensation-water was found to have evaporated. The superficial and deep-lying colonies were found to be well separated. The former consisted of badly formed and badly staining bacilli, while the latter made good preparations. By allowing the surface to dry the superficial growth was stopped, and only the deep-lying colonies were made use of. With a little practice these could be easily recognized, though Finkler-Prior, Metschnikoff, and typhoid have some resemblance. These deep colonies are easily removed with a thin platinum needle. This needle was made by heating a platinum wire 0·2 mm. thick in a Bunsen's burner, and carefully drawing it out until it broke. When examined, comma-forms, spirilla, and S-forms are seen dancing about like a swarm of gnats; this is sufficient to exclude typhoid, while on the other hand Finkler-Prior, that bugbear of the tyro bacteriologist, and Metschnikoff would hardly be found in a cultivation made directly from fæces.

With a fine platinum needle the whole colony can be easily removed and used for further examination. The cultivations were also characterized by staining well and showing well comma- and S-forms and spirilla. Even old colonies showing atypical growth returned to typical growth.

Use of Formalin for Preserving Cultivations of Bacteria.†—According to Dr. G. Hauser the vapour of formalin possesses disinfecting power sufficient to quickly inhibit the development of, and kill deep-lying colonies in plate cultivations. Plate cultivations can,

* Deutsche Mediz. Wochenschr., 1893, No. 27. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 292–3.

† Münchener Med. Wochenschr., 1893, No. 30. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) pp. 290–1.

therefore, be fixed at any particular stage, and the previously liquefied gelatin sets again, but without losing the appearance due to liquefaction. The bacteria look and stain just as well as they ever did, even when they have been exposed to the action of formalin vapour for some weeks. Test-tube puncture cultivations of liquefied species are also fixed by means of formalin. Thus puncture cultivations of cholera and Finkler-Prior spirilla can be preserved to show their characteristic funnel-shaped liquefaction.

When Petri's plates are used the method is carried out by inserting under the lid a layer of filter paper, upon which 10–15 drops of formalin are deposited; the capsules are placed in a moist chamber also containing a dishlet with some damp cotton-wool. Test-tube puncture cultivations are treated by moistening the lower end of the cotton-wool plug with about 10 drops of formalin, and then placing the glass in a vertical position in a tall glass vessel, on the floor of which is placed some cotton-wool moistened with formalin (50–60 drops to 1000 ccm.). The glass is then closed. To obtain a good result it is necessary to use fresh undecomposed formalin.

SANDER—**Ueber das Wachsthum von Tuberkelbacillen auf pflanzlichen Nährböden.** (On the Growth of Tubercle Bacilli on Vegetable Media.)
Arch. f. Hygiene, XVI. p. 238.

SCHMIDT, A.—**Ueber die Benutzung verschiedener Sputa als Nährböden und das Wachstum der Pneumokokken auf denselben.** (On the use of various Sputa as Culture-media and the Growth of Pneumococci on them.)
Centralbl. f. Klin. Med., 1893, pp. 625–8.

(2) Preparing Objects.

Fixing Fluid for Animal Tissues.*—Dr. G. Mann recommends the following fluid for fixing animal tissues:—Absolute alcohol 100 ccm., picric acid 4 grm., corrosive sublimate 15 grm., tannic acid 6–8 grm. It is essential to use only living tissue, and the pieces should not exceed 0·5–1 cm. in thickness and the amount of fluid used should be 20 times the bulk of the specimen. The tissue must be immersed for 12–24 hours, after which it is washed (*a*) twice in absolute alcohol for five hours each time, or (*b*) for two hours in running water, and then placed for 12 hours in 30 per cent. spirit containing enough tincture of iodine to give it a brown colour. Then for 12 hours more in 50 per cent. spirit containing potassium iodide. Transfer to 50 per cent. spirit for three hours, and next place for five hours in each of the following, 70, 80, 85, 90 per cent. spirit. (If process *a* be employed it is necessary to immerse the sections before staining for five minutes in iodine-iodide solution.) Then transfer to absolute alcohol for six hours (twice). After this they may be saturated with chloroform and finally imbedded in paraffin.

The advantages claimed for this method are that it causes less shrinkage than other methods; the cell outlines are well marked and the cell plasma and nuclei are very distinct.

Preservation of Colours in Dragon-Flies.†—Prof. P. Stefanelli recommends a simple method of making dry preparations of Odonata.

* Anat. Anzeig., viii. (1893) pp. 441–3.
† Bull. Soc. Entomol. Ital., xxv. (1893) pp. 1-11.

The insects are immersed for two days in an alcoholic solution of naphthaline, and are rapidly desiccated by heat. Sometimes a little touching up with brilliant anilin-azure and alcoholic tincture of curcuma is advisable. For the refinements of the author's method the original paper must be consulted.

Embryology of Echinocyamus.*—Dr. Théel did not succeed in raising larvæ of *Echinocyamus pusillus* to the stage of the young sea-urchin till he adopted the following precautions. The aquaria ought to be of a capacity of 30 litres or more, rather high, made altogether of glass, and be covered in. Clean marine plants in sufficient number must grow in the water. The water itself must be cautiously stirred with a glass rod several times a day, and no film must be allowed to form on the surface. All the water used must be fetched from the open sea and filtered through cloth or the finest canvas. The foul matter from the bottom must be taken away every other day. The temperature ought not to be too high, or, in other words, the aquaria should not be placed in sunny rooms.

The form of moist chamber preferred by Dr. Théel is that in which the drop of water is slightly pressed between the slide and the cover-glass; compression of the eggs may be prevented by small particles of wax, and evaporation hindered by fixing the cover-glass with melted paraffin or wax. In such chambers the author succeeded in following the gradual changes in the development of the same egg for several days.

There is no difficulty at all in artificially fertilizing the eggs of this animal if care be taken to choose males and females accustomed to live under similar conditions.

Preparation of Sections of Protozoa.†—Mr. J. E. S. Moore killed specimens of *Spirostomum* by osmic acid or by heating, fixed them in Flemming's or Hermann's solution, and, after 12 to 18 hours, transferred them to a tall tube, from which the supernatant liquid was repeatedly decanted and replaced by distilled water for some hours. After the last filling up the water was poured off and alcohol added very gradually until a 50 per cent. solution was obtained; in this the infusoria remained, like a coarse precipitate, for 12 or 18 hours more. The strength of the spirit was then increased until the whole was gradually replaced by absolute alcohol. After treatment with cedar oil or chloroform the objects were transferred to paraffin.

(3) Cutting, including Imbedding and Microtomes.

Method of Fixing and Imbedding Tissues for the Rocking Microtome.‡—Mr. J. H. Mummery, in giving a demonstration at the Annual Meeting of the British Dental Association, gave the following lucid directions for preparing tissues for the microtome:—

"By 'fixing' two things are implied:—

(1) The rapid killing of the element, so that it may not have time to change the form it had during life.

* Nova Acta Reg. Soc. Upsala, xv. 1 (1892) vi. pp. 3–6.
† Journ. Linn. Soc. Lond., xxiv. (1893) p. 365.
‡ Journ. British Dental Assoc., xxiv. (1893) pp. 489–90.

(2) The hardening of it so that it may resist, without changing form, the action of reagents with which it may subsequently be treated.

The fixing agents in use are chiefly osmic acid, chromic acid, perchloride of mercury, or picric acid.

After hardening, the tissue must be washed, so as to remove all traces of the fixing reagent. The washing may be done with water if any of the first three agents have been used, but if picric acid has been used, then alcohol must be used for washing.

After this, the water of the tissues must be removed, i. e. the tissue must be dehydrated, so that *post-mortem* decomposition may be prevented. Dehydration is performed as follows:—Put the object into 50 per cent. alcohol for 2 hours; then into 70 per cent. for 24 hours; then into 80 per cent. for 12 hours; then into 95 per cent. for 2 hours; then into absolute alcohol for a short time.

The object, dehydrated, must now be cleared, i. e. the alcohol must be removed and its place taken by some anhydrous substance, miscible with the material used for imbedding. Put some of the clearing medium, e. g. cedar wood oil or turpentine, into a test-tube, on to the top of it pour a little absolute alcohol; then the object is put into the alcohol, and sinks slowly into the clearing medium. When it has sunk to the bottom the alcohol may be drawn off with a pipette. The object may now be imbedded. It is removed from the clearing medium and soaked until thoroughly penetrated by the imbedding medium. The imbedding medium is hard paraffin. The paraffin is kept at its melting point, 45° C., and the object is kept in this for 24 to 48 hours; then the paraffin containing the object is allowed to cool. Cut out the block of paraffin containing the object and fix it on a cone of paraffin mounted on the object-carrier of the microtome. Pare it square and close down to the object on all sides. Set the knife of the rocking microtome square. Set the block square to the knife-edge. Cut the sections."

Imbedding Fresh Tissues in Metal.*—According to Dr. Liebreich useful sections may be made from fresh tissues, organs, &c., with a razor, if the specimens be firmly imbedded in some soft metal, such as tinfoil, old colour-tubes, &c. Owing to its softness the metal is easily cut, and not only does not harm the knife, but acts as a support to it. The results are said to be very good.

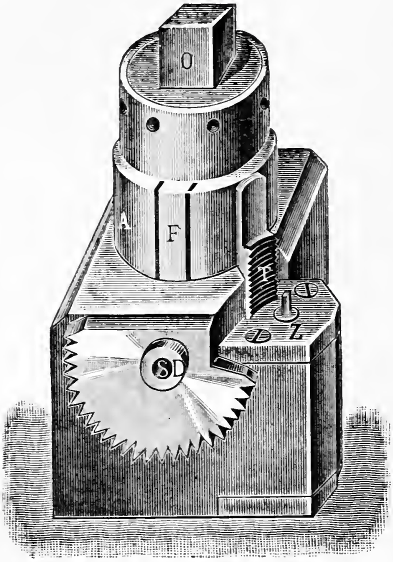
New Arrangement for Raising the Object in Jung Microtome.†—Drs. A. and H. Borgert describe the latest arrangement for raising the object in the Jung microtome. The object-holder consists of two cylinders (fig. 114), the interior one of which supports the object O, and fits exactly in the outer one A. The latter carries on the side turned towards the knife a rack T, in which an endless screw engages. By means of a key fitting over the pin Z, as in a watch, the screw is turned and both cylinders are raised together until the exact adjustment in height of the object is effected. The outer cylinder possesses a spring-piece F, and by the pressure against this of the screw which passes through the axis of rotation D of the metal block the two cylinders are simultaneously fixed in their position.

* Therapeut. Monatshefte, August 1892. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) p. 193.

† Zeitschr. f. wiss. Mikr., x. (1893) pp. 1-4.

In cutting, when the object slideway has been used as far as possible, the object-holder is brought back again to the lower end, the screw which fixes the two cylinders is loosened, and the object is then brought to the desired height by turning the screw. The cylinders are then again fastened, the key withdrawn and the cutting renewed.

Fig. 114.



(4) Staining and Injecting.

Examination of Brain of Ornithorhynchus.*— Dr. A. Hill stained the left hemisphere in carmine *en bloc*, and cut it into an irregular series of sections. The right hemisphere was treated with much greater care; it was placed for a fortnight in a 2 per cent. solution of bichromate of ammonia, "for even a brain which, like this one, has been for years in spirit, will yield sections which can be stained by Weigert's method, if it is placed in a chrome-salt for a time." It was next placed in a solution of carmine-alum for a week, washed in water, and after dehydration by alcohols of increasing strength, imbedded in celloidin. After being cut into blocks, a certain number of sections from each block were stained by Weigert's method, in order that the arrangement of the fibre-tracts might be determined with certainty.

Staining Nerve-Tissue.†—Dr. Kaiser lays pieces of brain or spinal cord in Müller's fluid for two or three days, cuts them into sections 1 to 2 mm. thick, and leaves them for five or six days longer in the fluid. They are next treated for eight days with Marchi's fluid (Müller's fluid 2 parts, 1 per cent. osmic acid 1 part). After washing in distilled water the hardening of the tissue is completed in alcohol. Sections cut in celloidin are laid in iron solution for five minutes, washed in Weigert's hæmatoxylin solution, and warmed in a fresh quantity of that solution for a few minutes. After washing in water, differentiation is effected by Pal's method; the sections are then immediately washed in ammonia water to neutralize the oxalic acid. The use of a contrast stain is not advisable.

Staining Connective Tissue.‡—Dr. Beneke describes a modification of Weigert's fibrin method, by which the connective tissues of the most

* Phil. Trans., 184 B (1893) p. 373.
† Neurol. Centralbl., June 1st, 1893. See Brit. Med. Journ., No. 1706 (1893) p. 44.
‡ Centralbl. f. Allgem. Path., July 28, 1893. See Brit. Med. Journ., No. 1705 (1893) p. 40.

diverse organs can be consistently stained. Portions of tissue fixed in alcohol are cut in paraffin; sections, fixed upon the slide, are stained with anilin-gentian-violet for 10–20 minutes. After treatment for one minute with lugol solution of a port wine tint, the preparation is dried with filter-paper and decolorized with anilin-xylol. Mount in xylol-balsam.

Fat as affected by Osmic Acid.*—Dr. B. Solger directs attention to a communication which he made ten years ago on the effect of osmic acid on fresh fatty tissue. It separates the fatty substance into a firmer (peripheral) and a more fluid (central) portion. The former probably consists of palmitin and stearin, the latter of olein. This effect of osmic acid does not seem to have been sufficiently appreciated.

Double Staining of Vegetable Membranes.†—M. Ch. Roulet treats sections of vegetable tissue by placing them for a quarter of an hour in a saturated alcoholic solution of cyanin. The sections have been previously decolorized in eau de Javelle. From the cyanin solution they are transferred to spirit, and then for 15 minutes to a 5 per cent. ammoniacal solution of Congo-red. Having been again washed in spirit, the preparations are mounted in xylol balsam. The cellulose membranes are stained red; the ligneous blue.

As a mounting medium for sections stained with Genfer's solution (2–5 per cent. ammoniacal solution of Congo-red with a 0·5 per cent. chrysoidin) the author prefers glycerin or Venetian turpentine to Canada balsam. Glycerin-jelly is less advantageous than pure glycerin.

Method of Staining the Cilia of Living Bacteria.‡—M. Strauss places a loopful of a bouillon culture 1–3 days old of *Spirillum choleræ asiaticæ*, *Metschnikovi*, or Finkler-Prior upon a slide, and then adds a loopful of Ziehl's solution diluted with three or four times as much water. The two are thoroughly mixed, a cover-glass is imposed, and the preparation is examined as quickly as possible. By this simple method the micro-organisms are stained a deep red, and many retain their mobility for a short time. At one of the poles the delicate corkscrewy or wavy flagellum can be perceived; it is of a pale red hue and contains deeply stained granules in the long axis of the flagellum. Even in the motionless organisms the flagellum can be seen, although it is less distinct. In the preparation can also be observed a number of free or detached flagella in active motion. The author only succeeded in staining by this procedure the flagella of the bacteria mentioned.

Staining Tubercle Bacilli in Tissues.§—For demonstrating tubercle bacilli in tissues Sig. G. Pacinotti hardens the material in Müller's fluid and not in alcohol. The piece to be frozen should not be thicker than 4 mm., but its other dimensions may be of any size. The sections should

* Anat. Anzeig., viii. (1893) pp. 647–8 (1 fig.).

† Arch. Sci. Phys. et Nat. Genève, xxix. (1893) pp. 100–1. See Zeitschr. f. wiss. Mikr., x. (1893) p. 267.

‡ Bull. Méd., 1892, p. 1003. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) p. 257.

§ Gazzetta degli Ospitali, 1892, p. 726. See Centralbl. f. Bakteriol. u. Parasitenk., xiv. (1893) p. 292.

be placed in a large quantity of water in order to dissolve out excess of chromic acid. They are next placed in weak, and afterwards in strong spirit for 24 hours, and then for 24 hours in Ehrlich's solution, and decolorized in alcohol to which a small quantity of hydrochloric acid has been added. By this procedure the bacilli are not shrunken owing to deprivation of water, as in hardening in alcohol, they stain deeply, and can be well seen without the aid of an immersion lens or a condenser: a Hartnack obj. 7 and oc. 3 will suffice. This method is not applicable to freshly frozen tissue unless it has been previously treated with Müller's fluid, and for ascertaining the relations of the bacilli to the elements of the tissues, the Ziehl-Neelsen or the Fraenkel-Gabbett methods are better suited.

Demonstrating Polar Bodies in Cholera Bacilli.*—Dr. A. Rahmer finds that when cholera bacilli are stained with an aqueous anilin-water solution of methylen-blue, polar bodies are visible at both ends. The solution must be freshly prepared, and when placed on the cover-glass heated until it just begins to vaporize. The author afterwards discovered that polar bodies might be seen when cover-glass preparations were stained with phenol-fuchsin.

New Infection Needle.†—Mr. J. C. Bay proposes a new infection needle for the study of lower plants. A pointed wire, about 6 in. long, bent round at one end to form a handle, and sharpened at the other, is thrust through a metal disc, an inch in diameter. The disc acts as a screen to prevent contamination from falling dust and germs when transferring infection to or from liquid cultures of micro-organisms.

(5) Mounting, including Slides, Preservative Fluids, &c.

Lysol in Histological Technique.‡—Dr. F. Reinke has made some experiments with lysol, which is a solution of cresol in neutral soap, for the purpose of testing its value in histological technique. In strong solution it first shrivels up living tissues, but afterwards causes them to swell. Weak solutions have a swelling and macerating action, while in 10 per cent. solutions the effect of the antiseptic is conservative for a few hours, but afterwards its specific action is manifested. In general this specific action may be described as clarifying, isolating, and macerating, but this is always attended with swelling, and hence on the whole the action is somewhat analogous to that of alkalies. No brilliant results were obtained from its use, though the condition of things were presented in a different light.

The author used the lysol most frequently as 10 per cent. solution in distilled water, but for some things found the following formula useful:—Lysol 10, aq. dest. 60, alcohol abs. 30. If a stronger clearing-up were desired he used Lysol 10, aq. dest. 50, glycerin 10, alcohol 30. For many objects the solution required to be warmed to blood heat.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1893) pp. 786–90.
† Bot. Gazette, xviii. (1893) p. 335. ‡ Anat. Anzeig., viii. (1893) pp. 532–8.

(6) Miscellaneous.

Chemical Nature and Chromatophily of Protoplasm.*—Herr E. Zacharias has endeavoured to determine the question whether the cyanophilous and erythrophilous properties of different constituents of animal and vegetable cells are connected, or not, with other differences in the nature of these constituents. His observations were made on spermatozoa of the salmon and of *Triton*, on the epiderm of young leaves of *Galanthus nivalis*, the endosperm of *Ricinus*, pollen-grains, &c. His conclusion is opposed to that of Strasburger that the different reaction towards pigments is the result of a different degree of nutrition of the cell or of the nucleus.

He regards protoplasm and nucleus as consisting largely of substances which are insoluble in artificial digestive fluid. To these substances belong the greater part of the chromatin-substance of the nucleus (nuclein). The remaining insoluble albuminous portions of the cell-contents (plastin) differ in their reactions. In addition to these substances, cell-protoplasm and nucleus contain albumen soluble in the digestive fluid; this is especially abundant in the nucleoli.

* Ber. Deutsch. Bot. Gesell., xi. (1893) pp. 1880-96, 293-37.

PROCEEDINGS OF THE SOCIETY.

MEETING OF 18TH OCTOBER, 1893, AT 20 HANOVER SQUARE, W., THE PRESIDENT (A. D. MICHAEL, ESQ., F.L.S.) IN THE CHAIR.

The Minutes of the Meeting of 21st June last 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, and the thanks of the Society were voted to the donors.

	From
Transactions of the Seventh International Congress of Hygiene. Vols. ii. and iii. (8vo, London, 1892)	*Prof. F. J. Bell.*
A. B. Lee, The Microtomist's Vade Mecum. 3rd edition. (8vo, London, 1893)	*The Author.*
J. W. Lovibond, Measurement of Light and Colour Sensations. (8vo, London, 1893)	*The Author.*
W. B. Turner, Freshwater Algæ of Eastern India. (4to, Stockholm, 1893)	*The Author.*
11th Annual Report of the U.S. Geological Survey. (1893)	*The Survey.*
Two Slides (Hair of *Notoryctes typhlops; Ixodes flavomaculatus?*)	*Mr. R. T. Lewis.*
Two Microscopes by Oberhaeuser	*Dr. J. B. Nias.*

Prof. F. J. Bell called attention to the book presented to the Society by Mr. Lovibond 'On the Measurement of Light and Colour Sensations,' which embodied the results of his researches on the subject.

Mr. E. M. Nelson thought this was a most valuable and interesting work. The author had stated the case in the most beautiful way, and the illustrations were extremely good.

Prof. Bell said they had also another donation for which their special thanks were due. It would be remembered that at their last meeting a paper was read by Dr. Nias upon the Continental form of stand, and that a considerable interest was excited by the discussion which followed. Dr. Nias appeared to have been pleased with his reception, and had presented the Society with two examples of Oberhaeuser's Microscopes, which would be valuable additions to their collection.

On the motion of the President the special thanks of the Society were voted to Dr. Nias for his donation.

Mr. J. G. Grenfell described by means of drawings on the board some specimens of diatoms which he had recently found at Plymouth, belonging to the genera *Melosira* and *Surirella*, which appeared to be of exceptional interest from the presence of pseudopodia. In specimens identified as *Melosira costata* these formed a fringe round the extremities of each frustule.

Mr. A. W. Bennett said he should like to say a word on one point which occurred to him in connection with these appendages. He did not like to insist too much upon his own view of the matter, but he might say that he still objected to the term pseudopodia being applied to these processes unless it could be shown that they were actual prolongations of the internal protoplasm of the object. If, as would appear from the description and drawings, they were connected with the external layers only, then they certainly were not pseudopodia. Prof. Bütschli had described some prolongations from a species of *Pinnularia*, but these were undoubtedly connected with the external and not with the internal structure, which to his mind at once showed that they were not pseudopodia.

Mr. T. Comber said he believed this kind of thing had been seen by Prof. Greville, and also by Prof. Grunow, who was of opinion that they were in reality spines. He believed that they would prove to be of great interest very shortly, in consequence of observations which were being brought to completion and would soon be published. As regarded *Cyclotella*, the idea that these processes were probably due to some sort of *Vampyrella* seemed to be unlikely, because if they were found in every form in a gathering it would certainly seem as if they were not simply parasitic, but rather something belonging to the diatom. As to the third species, it was probably a *Lasiosira*, the characters of which were that the frustules were connected by a long thread of mucus. With regard to the structure shown upon the board, it seemed to him that, having been treated with carbolic acid, it was conclusively shown that it could not be organic.

Mr. G. C. Karop said he quite agreed with Mr. Bennett that these processes were not pseudopodia. He had seen Mr. Grenfell's preparations on several occasions, and was still of opinion that the processes were something adventitious. As to the frequency of *Vampyrella* or similar organisms negativing the idea that such things were parasitic, he remembered some observations in which it was recorded that scarcely any diatoms in one gathering were free from these parasites. It was impossible offhand to say what the threads were in Mr. Grenfell's last example, but the description tallied to some extent with *Rhizidium*, which fungus entangled diatoms freely in its delicate ramifying mycele. The spores were covered with a mucous envelope, which would resist the action of carbolic acid unless very strong; indeed, this substance was much overrated as a germicide.

The President inquired whether Mr. Grenfell had found these things to occur both in species which had and in those which had not been treated with carbolic acid; also, what was the strength of the acid?

Mr. Grenfell said he had found them in both cases; though he had not found them in the material whilst in the acid, he had found them developed in the test-tubes in which he had put some which had been in a bottle with acid for fifteen months; after taking it out he had thoroughly washed it in distilled water before placing it in the tubes.

The thanks of the meeting were voted to Mr. Grenfell for his communication.

The President having inspected the ballot-box, stated that as some adverse votes had been cast it would be necessary for the candidates for election to be balloted for separately.

Mr J. E. Ingpen said that no doubt most of the Fellows of the Society were aware of the death of Mr. Charles Baker. Having known him for a long time, he had been asked to put together a few words about him, which he then read (see *ante*, p. 792).

Mr. Nelson said he had brought for exhibition a new model of a Microscope made by Messrs. Watson, which contained all the new things which he had mentioned at their last meeting.

Mr. F. Chapman read a further communication "On the Foraminifera of the Gault of Folkestone," being part v. of the series, illustrated by drawings of the species described.

Prof. Bell said he heartily congratulated Mr. Chapman on the production of the fifth part of his paper on this subject, and upon the very excellent drawings with which it was illustrated. As editor of the Journal, he could only regret that the conditions by which they were bound—seeing the number of plates required—prevented them from bringing out this paper in this year's Journal; they were, however, fully aware of the necessity of publishing Mr. Chapman's paper as soon as it was possible to do so.

The President said that the Society was greatly indebted to Mr. Chapman for this contribution; they were aware from what had already appeared of the value of Mr. Chapman's work, and the drawings which he had executed in illustration of the paper before them were very beautifully executed and did him the highest credit.

Prof. Bell said they had received a paper from Dr. R. L. Maddox "On Progressive Phases of *Spirillum volutans*." In this paper he had traced the history of the development of this organism and, so far as he had been able to make out, had discovered some points which appeared to be entirely new in the history of Bacteria. Considering the lateness of the hour and the temperature to which the room had been heated, it would perhaps be best to take the paper as read.

The President said, whatever might be the ultimate result of the inquiry, their thanks were certainly due to Dr. Maddox for giving them this paper on what might turn out ultimately to be a very important addition to their knowledge of the subject.

Cordial votes of thanks were then passed to Mr. Chapman and to Dr. Maddox for their communications.

The following Instruments, Objects, &c., were exhibited:—

Mr. Chapman:—Foraminifera illustrating his paper.
Mr. Grenfell:—Marine Diatoms, Threads and Films.
Mr. Lewis:—*Ixodes flavomaculatus* (?); Hair of *Notoryctes typhlops*.
Dr. Maddox:—Photomicrographs of *Spirillum volutans*.
Mr. Nelson:—New form of Microscope.
Dr. Nias:—Two forms of Microscope by Oberhaeuser.
Mr. F. P. J. Parker:—*Cristatella mucedo* from Epping Forest.
Mr. C. F. Rousselet:—*Melicerta ringens*, mounted fully extended.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. William Benjamin Boyes, Thomas Rowney, Dr. Marc Armand Ruffer, Messrs. Ernest Algernon Sparkes, M.A., and Joseph Cheseman Thompson. *Honorary* Fellow:—Dr. Oscar Hertwig.

Meeting of 16th November, 1893, at 20 Hanover Square, W., The President (A. D. Michael, Esq., F.L.S.) in the Chair.

The Minutes of the meeting of 18th October last 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 submitted, and the thanks of the Society were given to the donors.

	From
G. Brook, Catalogue of the Madreporarian Corals. (4to, London, 1893)	*The Trustees of the British Museum.*
Abstract of the Proceedings of the Western Microscopical Club. (8vo, London, 1883-92)	*The Club.*
8th Annual Report of the Bureau of Ethnology. (8vo, Washington, 1891)	*The Smithsonian Institution.*
T. C. White, The Microscope and how to use it. 2nd edition. (8vo, London, 1893)	*The Author.*

Prof. F. J. Bell called special attention to a book included in the list of donations which he thought would be found well worth inspection by those who had not yet seen it. This book—mentioned in the last Journal, p. 642—was the first volume of the new Catalogue of the Madreporarian Corals in the collection of the British Museum, and he was quite sure that no one who saw it would do so without regret that science had suffered so great a loss in the death of Mr. George Brook, the author. This volume had been presented to the Society by the Trustees of the British Museum, and it was specially remarkable for the extreme beauty of the photographic illustrations, which he thought were the finest of the kind hitherto produced for this purpose. Another donation was a copy of a new edition of a small work entitled 'The Microscope and how to use it,' by Mr. T. Charters White.

Mr. T. C. White said this little manual was brought out as a first edition some five or six years ago; it was taken up so well and was spoken of as being so useful to young beginners that he had been encouraged to bring out this new edition. He considered that it was only likely to be of use to those who took up the Microscope for the first time, its purpose being chiefly to show such persons how much there was of interest within easy reach. With this idea he had endeavoured to make the book as practical as possible, its contents being derived almost entirely from the experience of himself and his friends, rather than being a matter of paste and scissors.

The President said that the illustrations in Mr. Brook's book were in his opinion some of the most beautiful ever seen. Being of corals they were of course subjects specially suited for representation by photography, but a chief feature about them was that they were printed in ordinary printing ink and were therefore absolutely permanent. He hardly saw how in perfection of illustration anything could go beyond these.

The Secretary said they would not have the advantage of the communication from Mr. E. M. Nelson which was down upon the Agenda, as that gentleman was unfortunately ill.

Mr. C. L. Curties exhibited a new Microscope by Leitz, of Wetzlar, made on the English model, with the tripod foot and inclining body now found in most of our best instruments, as well as the substage fittings, Nelson's horse-shoe stage, sliding bar, &c.; there was also a new arrangement for keeping the rack up to its work by means of a steel spring acted upon by screws.

Prof. Bell said that their Assistant-Secretary had been lately preparing an inventory of the Society's instruments and apparatus. This was a matter of much importance and one which ought to have been carried out long ago. One result of his efforts had been so far to discover that they had a considerable number of objects concerning which they were unable to obtain any information, although such records of the meetings as were available were being carefully searched with the idea of tracing them. Many of these things were no doubt of great historical interest, and the Council would be very glad if any of the Fellows who were in the habit of attending the earlier meetings of the Society would look through the list and give any information as to those objects about which they were anxious for particulars. The lamented death of Mr. Mayall frustrated an intention to catalogue the apparatus in the Society's collection, and it was doubtful if the whole of the Fellows of the Society combined more knowledge than he possessed on such matters. The list which had been prepared would remain in the Library for their inspection, and if Fellows would afford the help of any recollections or suggestions upon the subject the Council would be greatly obliged. It was hoped that at some future time the list would be put into shape, and that it would then be of value. Of course at present it must necessarily remain in the rough.

The President said if there was any Fellow present who could suggest any means by which this matter might be better dealt with they would be very glad to receive such suggestions.

Mr. T. C. White thought that a search through the minute books, going back to the early meetings of the Society, would be likely to throw much light on the subject; or, failing this, the published reports of some of their earlier transactions might afford information as to the donations which were presented at those periods.

The President believed that Mr. Brown had been engaged in a search through the two sources of information mentioned, and the results of this would of course be incorporated in the rough catalogue.

Prof. Bell feared that the references made in the minutes, though sufficient at the time to recall the particulars when the objects were fresh in memory, were quite inadequate after a lapse of time to give the detailed information required for such a catalogue as they had in contemplation.

Mr. W. West's paper "On New British Freshwater Algæ" was read in abstract by Mr. A. W. Bennett, who said that this description of new British freshwater algæ was an important addition to their knowledge of these organisms. The author was one of the best of the few students of this subject, and he had already added much to their information in this direction. The illustrations with which the paper was accompanied were very admirably executed by Mr. West and by his son Mr. George West, both of whom were remarkably skilled in drawing.

The thanks of the Society were, on the motion of the President, unanimously voted to Mr. West for his paper, and to Mr. Bennett for reading it to the meeting.

Mr. T. F. Smith, who had been announced to read a paper "On the Ultimate Structure of *Pleurosigma angulatum*," was unable to do so owing to some misunderstanding as to the provision of a lantern for the exhibition of the photographs with which he had intended to illustrate the subject.

Prof. Bell read a paper by Mr. G. Sandeman on "A Parasitic Disease in Flounders," as follows:—

There are often found on our coasts flounders having small round swellings under the skin, occurring singly or grouped in larger masses which have been described under the name of multiple tumours. In the Scottish Fishery Board's Reports,* Prof. M'Intosh has written on this disease, and in the eleventh report I have given a short account of the microscopical features of the "tumours," with drawings of various appearances of them.

The tumours have in every respect the appearance of eggs deposited immediately beneath the skin of the fish. When occurring on a transparent fin beneath the rays, they are seen to be perfectly regular and opaque spheres; and when under the skin on another part of the body, they give rise to a low smooth projection of the skin which is apparently unbroken and of its normal colour. If there is little pigment on the skin over the egg, the latter shows through a clear white colour. The eggs are from 1 to 1·5 mm. in diameter. On one fish there may be many such single eggs distributed quite irregularly, but more often they are grouped in masses consisting of from two to a hundred or more elements. In the smaller groups the eggs usually lie side by side, assuming a polygonal form, owing to mutual pressure. They cause a low projection of the skin which sinks slightly between the individual ova. But when very many are present in one mass, the large tumour which is formed projects considerably from the body, and is sometimes even a pedunculated or finger-shaped formation, the skin over it being still normal and showing through it the closely packed elements. While the single eggs are more frequently found on the dorsal, ventral, and caudal fins, and under the skin of the body on the upper side, the large masses

* iii. p. 66; iv. p. 214.

occur mostly on the blind side, especially in the axil of the pectoral fin, on the side of the head, and even sometimes within the mouth, reaching a size of over 1 in. in length and 1/2 in. in diameter. The lower operculum is also a common site for these tumours, which sometimes extend within it and prevent its closing. If the skin is stripped from the body the eggs are found closely adherent to it and imbedded in it, while if only a few are present they are quite free from the subcutaneous connective tissue. But in the case of the larger "tumours," there is a very close connection both with the skin and with the connective tissue; and if the mass is cut across it bleeds freely from various points, showing that there is a considerable vascular supply to a tissue which is distributed between the eggs. On a few fish affected, as well as on one without any of the eggs under its skin, I have found small depressions, opening outwards, with rough edges, and in course of healing, whence probably such bodies have escaped. But this is evidently a rare occurrence, as a flounder with many of these bodies on it was kept alive for four weeks, and none of them were set free.

On microscopic examination the bodies present all the characteristics of eggs. A perfectly smooth pearly white membrane, with a radial striation in its inner layer, or zona radiata, encloses a granular material which gives all the staining reactions of yolk. There are usually fine fibrillæ plainly visible, due to the coagulation of the substance, which when pressed from a fresh specimen, is fluid and milky in appearance. In two cases only have I found any development of these eggs, and in each of these the blastoderm had nearly completed the investment of the yolk; each of these eggs was lying singly in the skin, the pigment layer being as usual over them, and reflected so as nearly to meet beneath them. In one case there were spaces in the skin around the developing egg, whence others had escaped, leaving portions of the egg-membrane clearly recognizable in section. In the large masses there are found, besides the eggs, whose mutual pressure gives them a polygonal appearance in section, though in other respects they wholly resemble those which occur singly, a connective tissue of various kinds; and in most cases, always when the tumour is large, a plentiful vascular supply. This connective tissue is especially abundant near the base of the tumour, where the eggs seem to be not so closely packed. It consists of numerous small round nucleated cells, which are usually present in great numbers, and besides these there is frequently a more advanced tissue, spindle-shaped and stellate cells, and sometimes mucoid tissue. Thin-walled vessels pass between the eggs, and frequent hæmorrhages from them leave either masses of red nucleated blood-corpuscles, or pigment. These hæmorrhages are probably due to mechanical irritation of these tumours, which are very much exposed to violence, especially when on the under side of the fish. In the large tumours the elements are of a fairly constant size. They appear healthy and never appear to be breaking down or undergoing disorganization. But in no case has an egg in process of development been found in such a mass, nor does the covering skin show marks of eggs having been set free from it.

In one case Prof. M'Intosh found an adult specimen of *Diplozoon paradoxicum* in one of these tumours, but neither this nor any other parasite is commonly present.

The cause of this condition is very obscure. The fish affected often seem emaciated, but this is by no means always the case, and occurs more often where there are very many single eggs and small masses than where one large tumour is present. They often seem to be more liable to the attacks of *Caligus* than normal fishes; but probably both of these conditions are due to the same cause, that is, some circumstance which renders the flounder more liable than usual to be seized on by a parasite, perhaps weakness and want of activity. Certainly there is no diseased condition common to all the fish affected in this way. Perhaps the fact that such fish are most commonly found near the mouths of rivers might suggest the action of a fresh-water parasite, especially as flounders ascend rivers for some distance. Day mentions the fact that many such are found in the Thames estuary, and while many with this disease are caught near the mouths of the Tay and the Forth, I have not seen any flounders caught by trawl more than twenty miles from a considerable river, affected by this disease. They are commonly found on the Danish coast of the Baltic by fishermen, but are apparently not known on the south and west coasts of Norway. The plaice is very rarely affected in this way; I have only found two specimens, in each case there was a large tumour on the head.

It is difficult to understand how any animal could force so large a mass of eggs beneath the skin of a fish, and yet more difficult to see why it should do so. The eggs rarely develope, they are usually kept for a long time beneath the skin, perhaps for all the life of the host, the interspaces being organized. Indeed the process seems so useless to the unknown species to which the eggs belong, that we are driven to suppose that eggs laid in masses free in the water adhere in some way to the skin of the flounder, that the skin beneath is absorbed, and that new skin over the mass and connective tissue between its elements grows at the same time, until the whole tumour is formed. And although no stage of such a process has been seen, this view appears the more likely because of the elongated and even pedunculated form of some specimens, because of the parts of the fish to which they are attached, and because marks are not found in the skin which would show that the eggs had been forced in.

Yet so improbable does such a view as this seem that until these eggs have been hatched out and the species to which they belong established, it will be impossible to pronounce a definite opinion on the subject.

On the motion of the President the thanks of the meeting were voted to the author.

The President said it would be remembered that last year about that time the Society held a Conversazione; the Council had decided to hold another, but thought it would be better to defer it until their exhibitors were better able to obtain a supply of specimens of pond life, which always proved so attractive to visitors. Instead, therefore, of holding it during the winter they proposed to postpone it until March or April, which would enable them to exhibit collections made during the Easter holidays.

Mr. C. Beck, calling attention to a recent discussion as to the method of obtaining a standard tube-length for the Microscope, pointed out that the difficulty experienced by some in fully understanding the matter arose from the way in which English optics had been taught—namely, that the distance of the focus should be measured from the centre of a lens. This was laid down by all English text-books, and it was upon this point that the whole thing turned, for although in the case of a single very thin lens the difference would not be much, if they took their measurement from the centre of a combination they would get a result materially in error. Having drawn explanatory diagrams upon the board he showed that the plane varied according to the kind of combination used, and that whereas in an ordinary English 1/4-in. objective the principal plane was somewhere about the back lens, in a 4-in. objective it would be about 2 in. up the tube, so that the tube-length was in this way practically decreased, and in order to give the tube a more uniform length, a 4-in. objective would have to be made with a very long mounting, and high powers in similarly short ones. It would hardly meet the case, however, to mount high-power objectives in very short tubes and low powers in long tubes, especially as in using low powers with the binocular it was necessary to have the back lens as near as possible to the binocular prism in order to get a good light in both tubes.

Dr. W. H. Dallinger said that Mr. Beck had called attention to a subject which certainly deserved great attention, and there were points about it which called for the most careful consideration. He had himself quite come to the conclusion that it would be a wise thing for the Society to go into the whole question, for there was very much more in it than could be done upon the board, though he could but congratulate Mr. Beck upon the able way in which he had brought it before them. They would find that the subject was one which could not be measured and weighed by persons who had not given themselves to the study of the questions involved, neither did he think that opticians themselves could compass all that it comprised. In short, he thought they wanted a committee appointed to follow out the whole question.

The President expressed the thanks of the Society to Mr. Beck for raising this very important and interesting question. The subject was one well worthy of the attention and consideration of the Fellows of the Society. Any suggestions which they might have to make on the subject would be gladly received by the Council.

The following Instruments, Objects, &c., were exhibited :—

Mr. C. Lees Curties :—New model of a Microscope by Leitz of Wetzlar.

Mr. C. Rousselet: *Notops brachionus* and *Stephanoceros Eichhornii*, mounted.

New Fellows :—The following were elected *Ordinary* Fellows :—Messrs. H. Neville Beeman, Arthur Blake, Edward Russell Budden, Dr. George Alexander Cohen, Messrs. Oliver Collett, Charles Lees Curties, Robert W. Dunham, Dr. Elmer Ellsworth Hägler, Messrs. Edwin Ernest Hill, Samuel Lowe, and Dr. Ernest Wende.

INDEX OF NEW BIOLOGICAL TERMS, OR OLD TERMS WITH NEW MEANINGS, RECORDED IN THIS VOLUME.

a. ZOOLOGY.

β. BOTANY.

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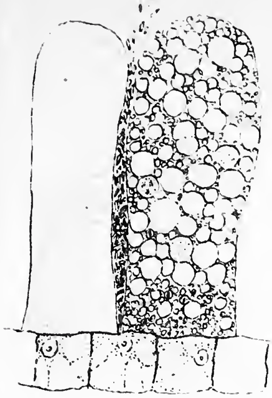
LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.



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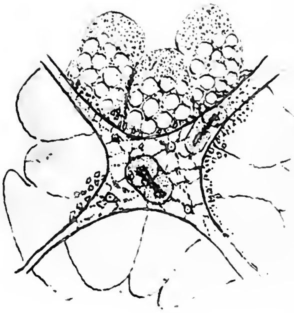

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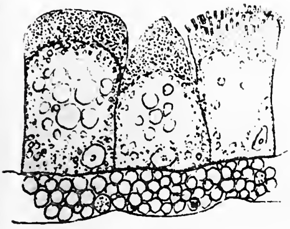

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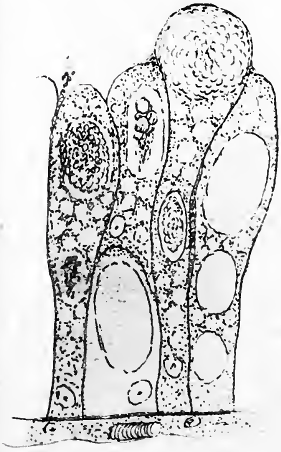

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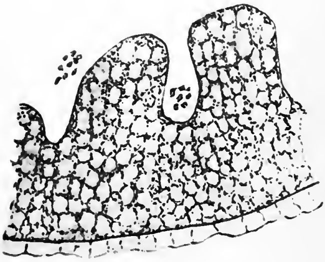
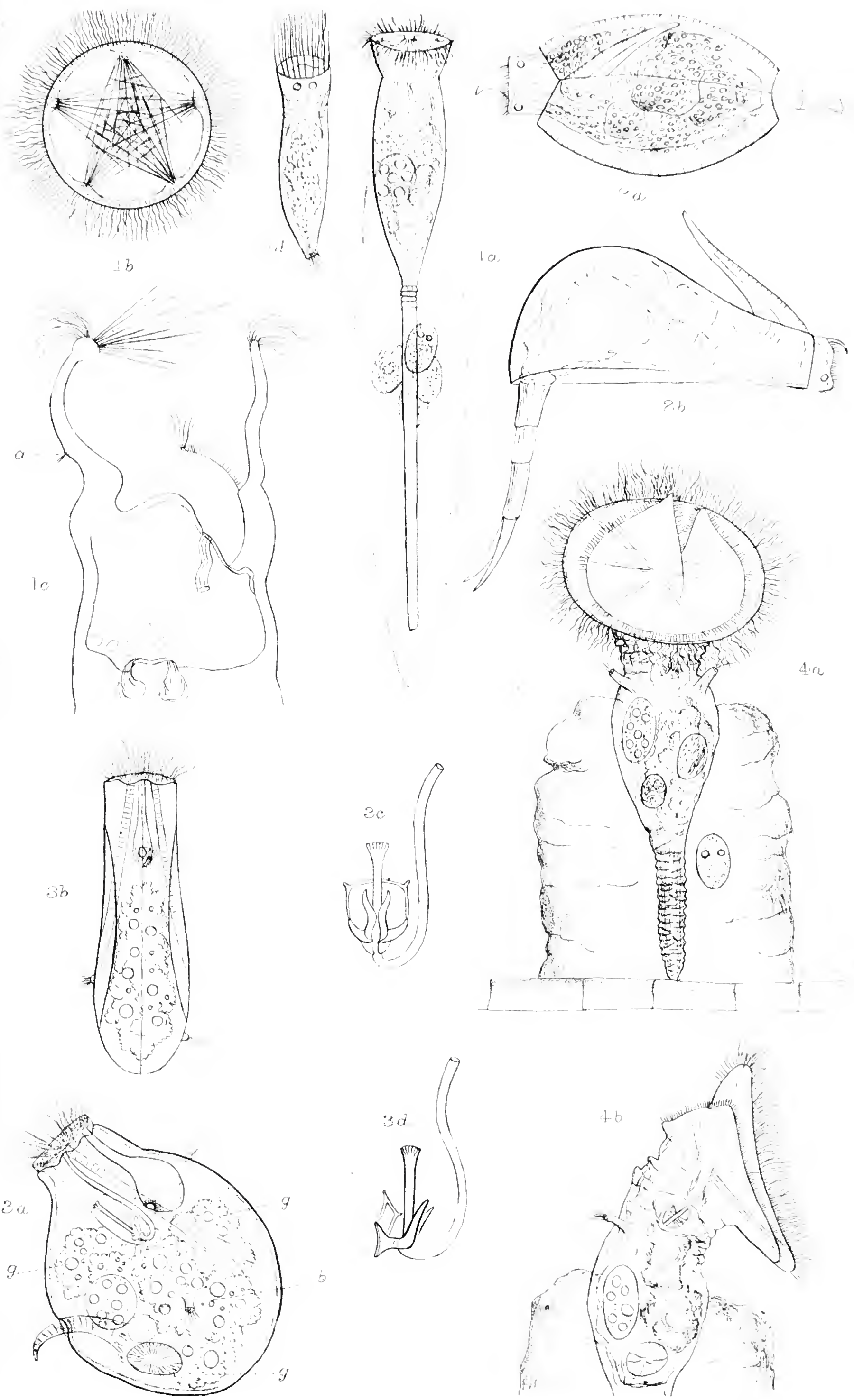


VIII.

H. M. Bernard del.

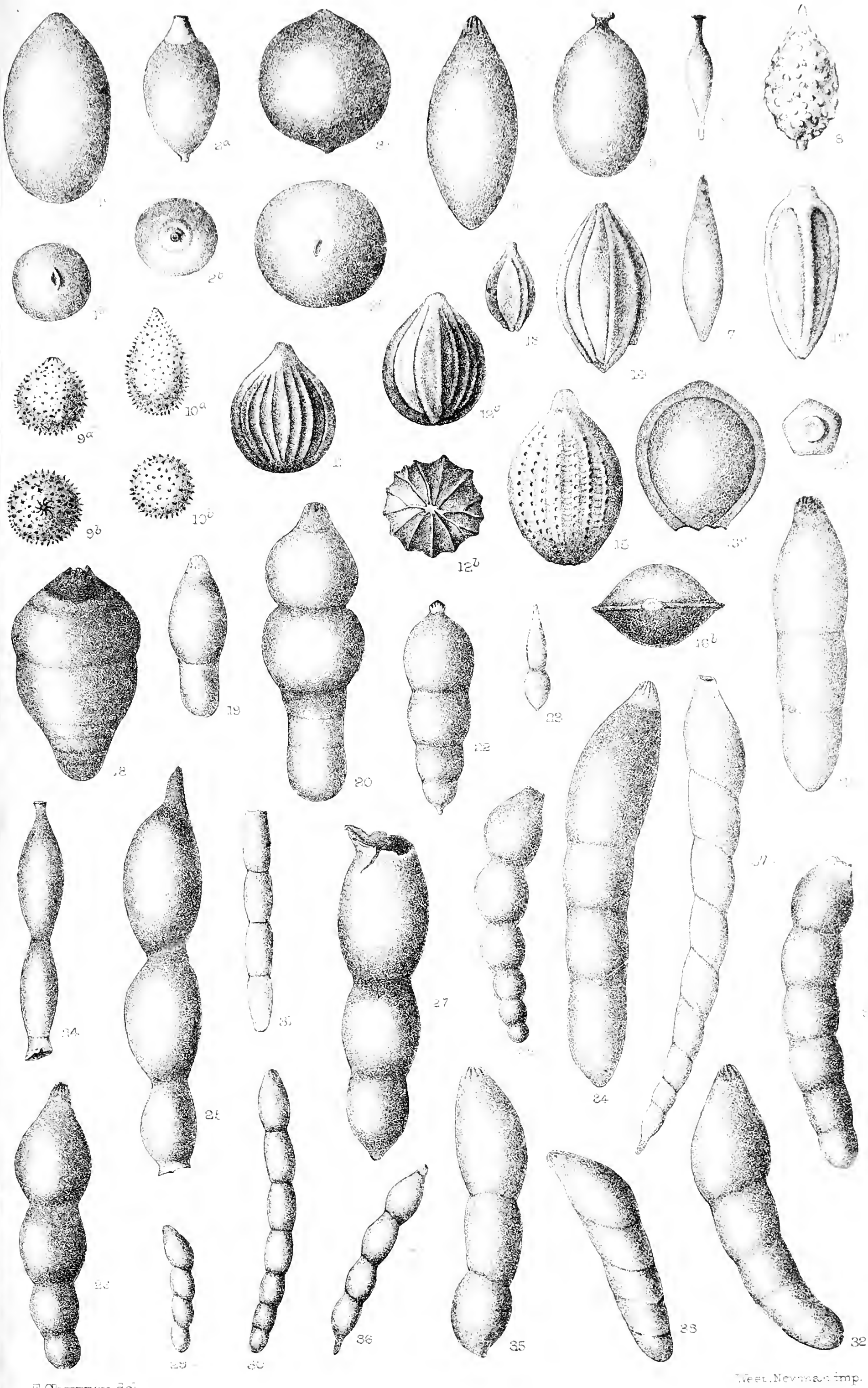
Collotype by Morgan & Kidd, Richmond.

Digestive Processes in Arachnids.



C.F. Rousselet del. West, Newman lith.

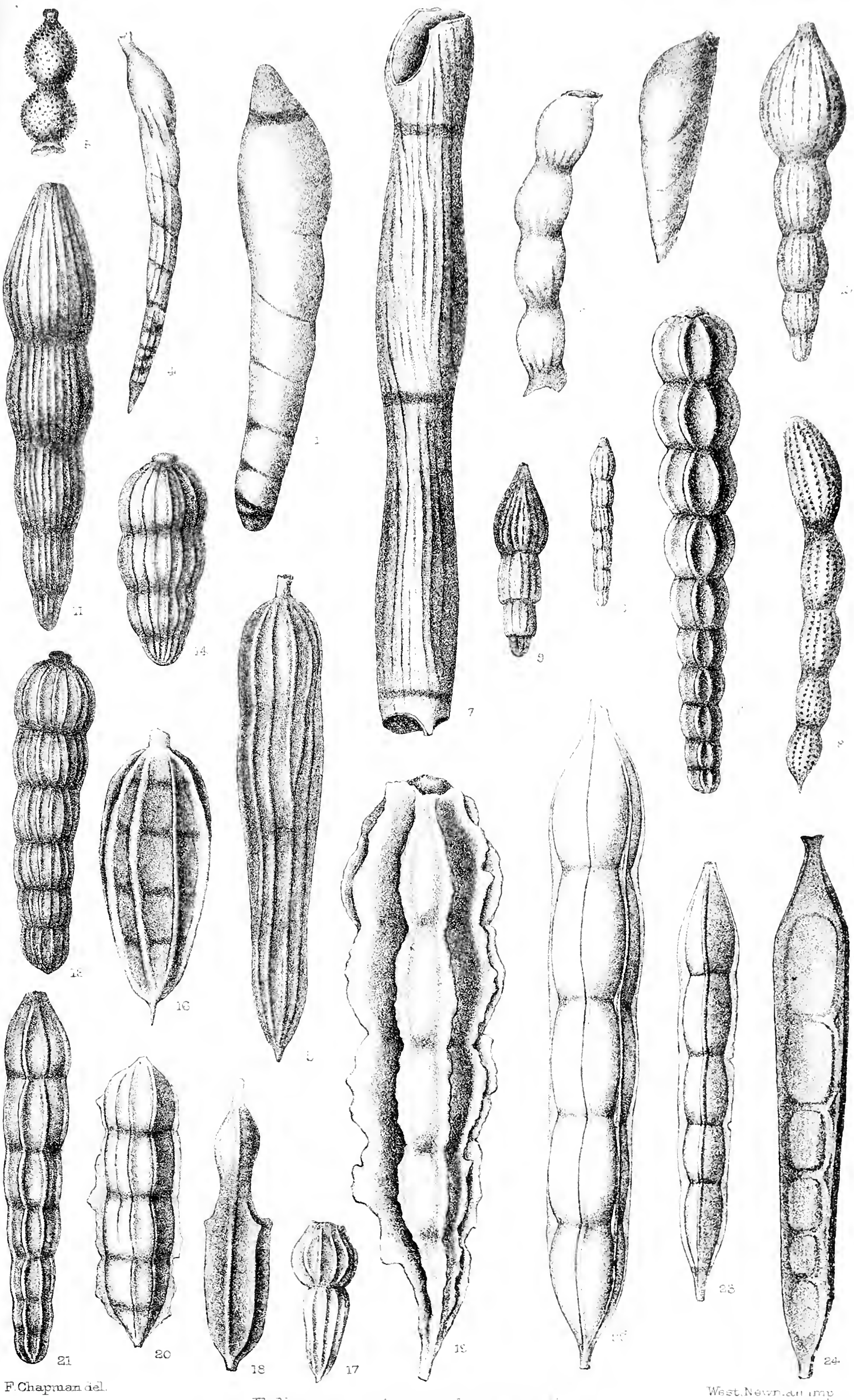
New & little-known Rotifers.



F. Chapman del.

West, Newman imp.

Folkestone-Gault Foraminifera.

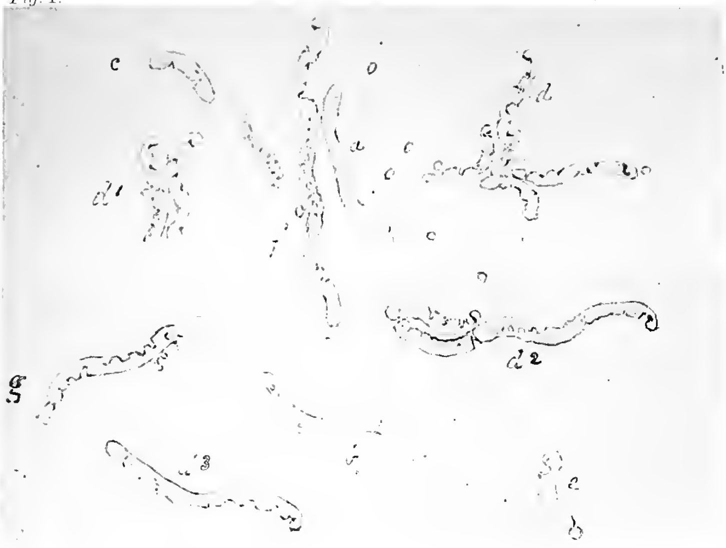


F. Chapman del. West, Newman imp.

Folkestone-Gault Foraminifera.

Journ. R. Micr. Soc., 1893. Pl. X.

Fig. I.



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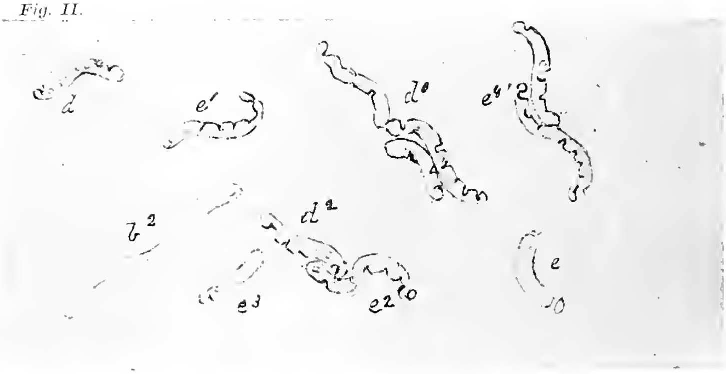

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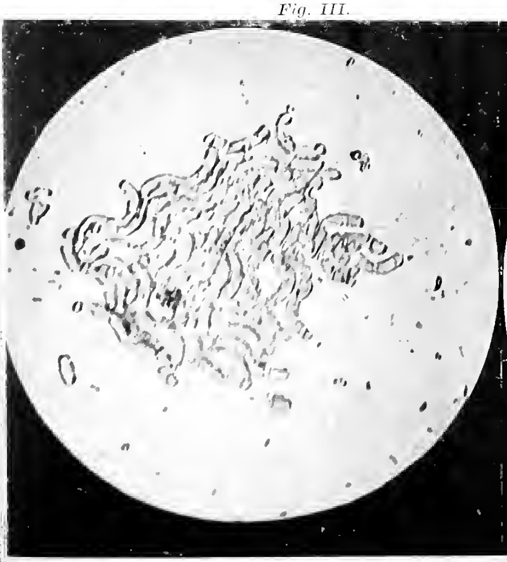

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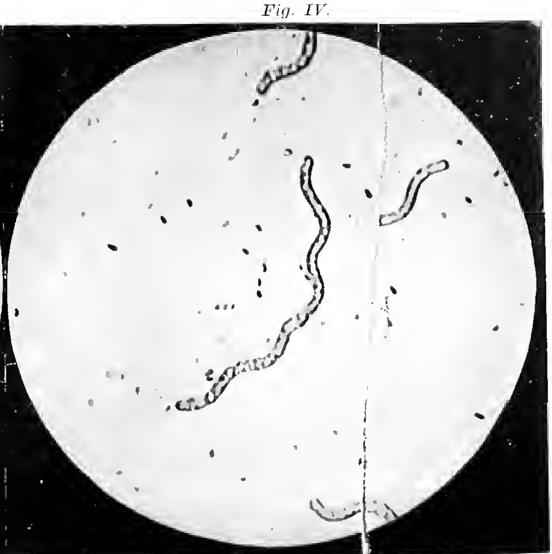

R.L.M. Phot. et del. Ad. Nat.

Collotype by Morgan & Kidd, Richmond.

SPIRILLUM VOLUTANS.