Vol 5 is paged on from Vol 4
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On the Post-tertiary Diatomaceous Sand *of* Glenshira. Part II. *Containing an account of a number of additional undescribed species.* By William Gregory, M.D., F.R.S.E., M.R.I.A., &c.; Professor of Chemistry in the University of Edinburgh. Illustrated by numerous figures drawn from Nature, by R. K. Greville, LL.D., F.R.S.E., &c., and engraved by Tuffen West, Esq. (Plate I.)

Continued from No. XVI, p. 48.

(Read March 26th, 1856.)

24. *Pleurosigma* (?), n. sp. This peculiar form, which is very scarce in the deposit, I have not ventured to name, although it cannot be referred to any of the species in Smith's Synopsis, vol. i.

Form very slightly sigmoid; extremities obtuse. The median line, as may be seen in vol. V, Pl. I, fig. 24, is central at one end, while at the other it seems to approach the margin for a short space just before the apex. This appearance is probably due to the circumstance that the valve does not in this case lie quite flat. There is an elongated oval expansion round the nodule, but imperfect; and I am not sure that this appearance may not depend on some injury to the valve. Length about 0·0053″. I have not been able to resolve the striation as yet, and I conclude that it is of the finest; but until I can examine several good specimens, the description must be imperfect. (281.)

25. *Cocconeis distans,* n. sp. This species was described in my former paper, but a form of *C. Scutellum* was by mistake figured for it; I therefore give a figure of it in fig. 25. Some, judging from the former erroneous figure, have supposed it to be only a form of *C. Scutellum,* but its whole aspect is so peculiar, that those who see the form, which is not very rare in certain densities, are at once struck with it as peculiar. Professor Kelland, without knowing of it at all, at once noticed it in some of the deposit which I prepared for him.

Form always a broad and pure oval. Length from 0·0008″ to 0·0018″. The transverse rows of dots are not above one half of the number of those in the largest and coarsest forms of *C. scutellum,* which abounds here in all its forms, and can be easily compared with *C. distans.* These lines, about 9 in 0·001″, are also formed of much fewer and larger dots, and these dots are all of equal size, except only that those at the margin are sometimes smaller. They are so distant, and the lines of them so few, that the form ceases to have a striated aspect, and appears sparsely dotted. In *C. Scutellum,* of the same size, and of the coarsest variety, there are twice or thrice as many lines, and in each line three or four times as many dots as in *C. distans.* Moreover in *C. Scutellum,* which has the striated aspect in all its forms, the dots are of very unequal size, being smaller in the middle, and increasing in size towards the margin. Again in *C. Scutellum,* the form of this valve is very often, indeed generally, more or less angular, both in the middle and at the apices. In *C. distans,* the dots are quite round, and have a peculiar lustre, so that in a certain focus they appear white and translucent. I have seen this form in recent marine gatherings, but it is scarce. (218.)*

(Since the above was written I have observed another well-marked character in this species. The granules or dots are placed on faint white transverse bars, which, in some positions, or in some lights, are easily seen. I have also lately found *C. distans,* in considerable abundance, in a recent marine gathering, of which I hope to lay an account before the Society next season. In this gathering I have found two remarkable forms, which may perhaps both be varieties of *C. distans,* but one of which, though allied to it, is probably a distinct species. One of these has the faint white bars above described, and, on the whole, my observations tend to show that *C. distans* is not related to *C. Scutellum.*

I may here mention that *C. costata,* to be presently described, also occurs in the new recent gathering, and that this form also is entirely distinct from *C. Scutellum,* although Professor Smith, in his second volume, has conjectured it to be a form of that species.)

26. *Cocconeis radiata,* n. sp. This very beautiful form is rare in the deposit, compared with most of the others. It is represented in fig. 26.

Form oval. Length about 0·00075″. It has strong, distant rays, proceeding from a small, oval central spot, and, so far as I know, it is the only oval form which is radiated. The rays appear to increase in width as they approach the margin, and are crossed by a series of concentric elliptical lines, from the margin to the centre, giving to the valve a singularly rich appearance. Rays about 18; concentric ellipses about 7 or 8. This form has occurred as yet only in this sand. Fig. 26* represents an abnormal form of it. (282.)

27. *Cocconeis costata,* n. sp. This pretty species was described in my former paper, but the specimen there figured was an inferior one. I give a better in fig. 27. It is not rare in the lighter densities.

* So numbered in Part I.

Form a broadish oval. Length, 0·0005″ to 0·001″. Median line strong; no nodule. The transverse lines are strong entire costæ, which I formerly described as double lines. This is only apparent, something on the form of the costæ causing their margins to come out strongly. The space between each pair of costæ is striated at right angles to the costæ, a character only seen on close inspection, and which I have observed since my former paper. This is a perfectly characterised species, which I have found pretty frequent in the recent gathering above mentioned. (219.)*

28. *Cocconeis* (*?*) *lamprosticta,* n. sp. This form is somewhat scarce in the deposit, and I have considerable doubts as to its belonging to this genus. For the present, however, I place it there, as I have not yet been able to see any other view than the one figured, of which I have found a considerable number.

Form between elliptic and obtuse rhombic, inclining rather more to rhombic. The central nodule is not strongly marked, but the median lines terminate in two small expansions, between which is a considerable space. Length from 0·0028″ to 0·0033″. Striæ about 12 in 0·001″, very conspicuous, formed of dots, somewhat like those in *C. distans,* and as widely apart. There is a narrow blank space on each side of the median line. The dots have the same shining aspect as in *C. distans,* but the form is much thicker and more strongly marked.

The resemblance of this form, which is represented in fig. 28, to *C. distans* in several characters, led me to refer it to the same genus. But in some specimens, apparently of the same form, the median line is a mere blank or raphe, and the dots are rather square than round. These specimens, as Dr. Greville pointed out to me, seem rather allied to *Biddulphia* or *Zygoceros,* genera which possibly ought to be united, and which, at all events, are very imperfectly known. If the present form, fig. 28, belong to *Biddulphia,* it ought to exhibit the characteristic and peculiar front view of that genus; but for this I have sought in vain. It is possible that there may be two forms; one a *Cocconeis,* or possibly a *Navicula,* the other a *Biddulphia* or *Zygoceros.* I figure the most frequent, and leave the question to continued observation. (282.)

Before quitting this genus, I may mention, that in this deposit both *Cocconeis Scutellum* and *C. Placentula* are among the most abundant forms, and that both of them exhibit a remarkable extent of variation. According to many, the form I figured in my first paper as *C. speciosa* is a form of *C. Scu-*

* So numbered in Part I.

tellum, but I have considerable doubts on this point. The form figured by Roper as *C. concentrica* is referred in like manner to *C. Placentula,* but this also is doubtful. In the Glenshira Sand both of these are frequent; and there is another form, allied to *C. concentrica,* but differing still more from *C. Placentula.* This form is a curious one, but I have not yet been able to study it properly.

29. *Amphora* (?) *rectangularis,* n. sp. This is a pretty little form, which I refer to *Amphora* on account of the crossbar in the middle of each valve; otherwise I should have referred it to *Amphiprora.* Represented in fig. 29.

Form of the entire frustule nearly rectangular, narrow, with the corners somewhat rounded. The middle space is widest at the ends, and in the centre; narrower between these points. The striated portions are crossed by a straight bar, opposite to which the outline is slightly constricted. Length from 0·0025″ to 0·0045″. Striæ fine, transverse, about 40 in 0·001″. Besides the central constriction, the external margin is very slightly undulated towards the ends. (283.)

30. *Amphora elegans,* n. sp. This form is frequent, as is also the preceding; but it seldom occurs entire, and the figure, fig. 30, is that of the detached valve.

Form of the entire valve oval, elongated, with truncate extremities. Length from 0·001″ to 0·0025″. The two halves are separated by a rectangular space. The curve line in each valve is peculiarly gentle and beautiful. Each valve is crossed by a line or bar in the middle. Aspect hyaline; striæ very fine, transverse, inconspicuous.

(I have lately found it entire in the recent gathering above mentioned.)

31. *Amphora plicata,* n. sp. This is another hyaline species. Fig. 31 shows the entire frustule, which is frequent; but its parts are often shifted or displaced.

Form nearly rectangular; broad, corners rounded, ends truncate, the middle part of the outline being slightly convex or elliptical. In some it is quite straight. The curve line in each valve very deeply curved, the curve coalescing with the margin near the ends, and projecting much towards the nodules in the middle. The part of the valve external to this line is very faintly marked with transverse striæ, difficult to be seen, from the hyaline character of the form. The median space is marked by strong vertical, or rather concentric, slightly curved lines, which appear as folds, like those of paper plaited and then partly opened out. I have named it from this character. It is a beautiful and striking form, but apt to be overlooked from its transparency. (284.)

32. *Amphora biseriata,* n. sp. This is another remarkable species of the genus, which is not at all rare in the deposit. It is represented in fig. 32.

Form of the entire frustule nearly rectangular, the corners being rounded. Sometimes it is a little elliptical in the middle, at others it is a little incurved there. It is often rather narrow. Length 0·003″ to 0·0045″. The two valves are connected by a narrow rectangular space. The curve line in each valve is not conspicuous, from its projecting so very little from the margin in the middle part, and running very near the margin all the way to the ends. The striation is coarse, transverse; striæ about 18 in 0·001″. In each valve the striæ are traversed by faint white vertical lines, which are only seen when the focus is adjusted to them, and then appear to divide the striæ into vertical bands of short transverse bars. Sometimes two such lines are seen on each side. I have named it from this peculiarity; but it is well characterised by its form and peculiar striation.

I do not feel quite sure that I have rightly referred this form to *Amphora;* but the curve lines certainly exist, and there is no other known genus to which it can be referred. (285.)

33. *Amphora lineata,* n. sp. This form, which is represented in fig. 33, varies a good deal, and occurs sometimes much longer and narrower, without the recurved ends, and with more and stronger vertical lines in the median space. I have not had time to obtain figures of the other forms, and this one is not so characteristic as others.

Form oval, sometimes broad, at other times long and narrow, nearly linear. Ends recurved, but in some this is very slight indeed. Lateral parts distinctly cross striated. Median space marked with fine but distinct vertical, or rather concentric lines. The form here figured approaches to *A. salina,* Sm., but there are others which have no resemblance to that form, and in which the vertical lines are stronger, and cover the whole valve, so that no lateral transversely striated part can be seen. It is possible that the latter are the true *A. lineata,* and that the form figured may be a form of *A. salina.* Length from 0·0015″ to 0·0025″.

I am inclined to believe that the form I consider as the typical *A. lineata,* not here figured, is the same with a lineate Amphora which Dr. Greville has found in the sand from Trinidad already mentioned. (286.)

(In the recent gathering above referred to, I find the form which I call *A. lineata* frequent. I shall give a better figure of it on an early occasion.)

34. *Amphora obtusa*, n. sp. This is one of the most striking forms in the deposit, in which the detached valve, as seen in fig. 34*, is by no means rare; while the entire frustule, fig. 34, is very scarce. The detached valve has also occurred to Dr. Greville in the Trinidad sand above alluded to.

Form of the entire frustule nearly rectangular, broad, the ends very broadly rounded. The outline of the detached valve is generally a little convex on the outer margin, occasionally it is very slightly incurved there, as in fig. 34*. The ends of the valve are generally very obtuse, but, as in fig. 34*, sometimes produced to a sort of beak. The inner margin of the valve is gently undulated, so that it was not easy to suppose two of them in opposition till the entire frustule, fig. 34, occurred, in which the margin appears more nearly straight. The two valves are in close opposition, except at the centre and just at the ends; but I have also seen them separated by a narrow rectangular space. The curve lines are strongly marked and strongly curved, projecting in the middle nearly to the centre, and near the ends almost coalescing with the outer margin. There is a nodule at the middle point of each curve line, and also near each end of the valve; but here the outer margin seems to bend inward in a curl and form the nodule, which is apparently on a different plane from the rest of the inner curve line. Length about 0·0037″ to 0·004″. The valve is transversely striated. Striæ very fine, about 70 in 0·001″. They cannot be seen on all parts of the valve at the same time, because the valve is very thick, and the parts on opposite sides of the curve line are in different planes. (287.)

35. *Amphora crassa*, n. sp. This and the two following species possess a most remarkable and peculiar structure, which makes me very doubtful whether they belong to this genus. If they do, they will form a well-marked sub-genus. It is, however, possible that it may be found necessary to form a new genus for their reception. The first of them, *A. crassa*, is represented in fig. 35.

Form nearly rectangular, rather narrow; corners rounded, ends truncate. Length from 0·002″ to 0·0032″. The whole visible surface of the valve is divided into about eight vertical bars, which seem to converge on the ends. The curve lines project half way across each valve in the middle, but retreat rather suddenly to very near the outer margin, and run along it, almost coalescing with it. The vertical bars are transversely striated, and the striæ are coarse and broad, about the same width as those of *Pinnularia borealis*, Ehr. (*P. latestriata*, W. G.) There is no appearance of separation between the two valves, nor have I seen the detached valves of this form. As its structure much resembles that of the next species, I shall not here dwell on it. (288.)

(In the recent deposit so often alluded to, I find *A. crassa* not unfrequent, and I have there seen the detached segments, which are very remarkable—so much, that I at first took them for an entirely new form.)

36. *Amphora Grevilliana,* n. sp. This form, of which the entire frustule is represented in fig. 36, and the detached valve, or rather segment, in fig. 36*, is the most remarkable of all the forms here described, as *Synedra undulata* was of those figured in the former Paper.

Form of the entire frustule varies from rectangular, to somewhat elliptical, or rather broad elliptical, with broadly truncate ends, the ends being convex. Length from 0·003″ to 0·0045″. Like the preceding, the whole surface of the frustule is made up of vertical, or rather concentric bars, the middle one appearing straight, the others slightly curved, and converging on the ends. There are blank lines or narrow spaces between these bars, of which there are seven or eight, not so closely set as in the last species. As in the last, the lateral curve lines project half way across each valve in the middle, but curve back rapidly to the outer margin, along which they run to the ends. The bars are transversely striated. Striæ conspicuous, but much finer than in *A. crassa.* The frustule has very much the appearance of a cask or barrel, but appears to be four-sided or prismatic, as seems also to be the case in *A. crassa.* Colour dark brown.

The detached segment, as seen in fig. 36*, is arcuate; the dorsal margin convex, and in some long specimens straight, bending forward at the ends to a kind of projecting beak. The inner margin, which is faint, is nearly straight, but between the central nodule and each end it is slightly incurved. Within it is a much more strongly marked and more incurved line, the two halves of which meet in a strong nodule. Beyond this again, is another line forming one curve, convex towards the inner margin in the middle, and concave at the ends. Beyond this is a still stronger line, which in the middle is concave towards the inner margin, and towards the ends is concave in that direction. The whole is marked with strong, conspicuous, moniliform, transverse striæ.

For a long time I did not connect the two forms, fig. 36 and fig. 36*. The latter I took for a form of *A. Arcus,* figured in my former Paper. But at last, when Dr. Greville pointed out some of the differences, I returned to the study of it, and soon found specimens of the entire form, fig. 36, in which the markings of fig. 36* could be seen through them, as well as others, fallen in part asunder, which demonstrated the connection. I then named it in compliment to Dr. Greville, who had thus led me to trace the relation between the two forms.

But although it is certain that the form fig. 36* is a part of the entire frustule, fig. 36, it does not appear to be the half of that frustule, nor such a part or single valve as usually occurs in *Amphoræ;* for if we suppose two such parts in apposition, as we may see in *A. ovalis,* or in several of the *Amphoræ* I have here described, such as *A. obtusa,* the result would not be, as in *A. obtusa* or *A. ovalis,* the entire form, but something quite different. I have seen two segments thus in apposition, but too late to be figured. The effect is exactly that of a section through the middle of the supposed frustule, and resembles what is seen when an orange is cut in half. On the other hand, the entire frustule, as we see it in fig. 36, which, after all, may be but half of the entire form, appears as if it were formed of parts like fig. 36*, which are thicker on the convex margin than on the concave one, placed next each other in the same way as the parts or segments of a melon. Of such segments we see the backs of seven or eight in the view seen in fig. 36. But as the frustule is not cylindrical, though convex for a large part of its periphery, but rather prismatic, it is probable that there are two sides, like that seen in the figure, opposite to each other, and two others at right angles to these, also opposite to each other, and perhaps narrower. The former, the broader sides, are convex, like the sides of a barrel; the others probably flat. The latter most likely represent the rectangular median spaces in the common forms of *Amphora,* and the line of junction of the two half-barrels, as we may call them, will pass through these narrower sides. If this be correct, then the view, fig. 36, may be either that of the entire frustule or barrel, or that of the half-barrel seen from the convex side. I think I have seen specimens of all these views, namely, of the entire frustule, which is darker in colour, of the half seen from the convex side, and of the half seen from the flat side, or looking on the plane of a section through the middle of the narrower sides of the frustule. But I have not yet seen any specimen lying on the narrower side, and thus showing the line of junction. This is probably because the convex side is so much broader.

It will be seen that the bars, which are the thick backs of the segments, converge like those of an orange or melon, to a point on the terminal surface, which is therefore also convex. I have not been able to see this surface as if looking directly down on it, although the form is not rare in the coarser densities; but I have no doubt that the frustules may be picked out and examined in water or some other fluid in which they can be turned round so as to show all the faces.

The above description applies, *mutatis mutandis,* to *A. crassa,* and, as I believe, also to *A. Arcus;* and although these forms all exhibit some points of agreement with *Amphoræ,* as hitherto known, yet the peculiarly complex structure of each half of the frustule seems to be a character so marked, as to require a new genus for those forms in which it is found. I do not, however, venture to establish such a genus, but am satisfied to direct the attention of observers to the existence of this remarkable structure, (which appears also to occur in *A. costata,* figured in the 'Synopsis,' vol. i,) in the hope that it may be more thoroughly investigated and more satisfactorily cleared up than I have been able to do it. I should here add, that possibly *A. biseriata,* the structure of which is both obscure and peculiar, may belong to this group, and that even *A. plicata* may be found to be related to it. (289.)

(*A. Grevilliana,* as well as the next species, occurs in the recent gathering already alluded to.)

37. *Amphora Arcus,* n. sp. Of this species, individual segments were figured in my former Paper. I had not then seen it entire; but since then I have found that one of the complex, barrel-shaped forms in the deposit belongs to it, and is either the entire frustule or half of it. Like *A. Grevilliana,* it varies considerably in length, but the entire or half frustules I have seen have been shorter than many of the detached segments. The general structure and form resemble those of the preceding species; but the segments are simply arcuate, having the form of a strung bow. The entire frustule has the form of a barrel with ribs and bars, and all parts are easily distinguished from *A. Grevilliana* by their coarser striation, and by the coarsely moniliform character of the striation. As the segments were formerly well figured, I give here a figure of what is not the entire form, but is more probably only one half of the barrel. This is represented in fig. 37. (213.)*

38. *Amphiprora minor,* n. sp. This species, represented in fig. 38, is not very rare in the deposit.

Form elliptical, long, and rather narrow, the central part slightly constricted. The inner margin of the lateral parts is concave towards the middle, leaving a long, narrow, truncate,

* So numbered in Part I.

elliptical median space. The lateral parts are marked with somewhat coarse transverse striæ. Length about 0·0025″. (290.)

39. *Amphiprora lepidoptera*, n. sp. This beautiful form is also not unfrequent in the deposit. It is in some degree allied to *A. alata*, but not only is it much longer, it has also a totally different aspect, not being hyaline as *A. alata* is, but conspicuous, from the absence of this peculiarity. It has also a brown colour. It is frequent in some densities, and very uniform in its characters.

Form nearly rectangular, with rounded ends, rather narrow, strongly and sharply constricted in the middle. The median space is broader than the lateral parts or alæ. There are well-marked nodules on each side where these parts meet and join the transverse terminal margins. The alæ are finely, but distinctly marked with transverse parallel striæ. Length from 0·004″ to 0·006″. Colour a clear brown, especially on the alæ. This is a very elegant form, but being thin, it is often met with fractured. It is shown, of a good deal less than the average length, in fig. 39. (291.)

(While this sheet was going through the press, I have ascertained that the form figured in the first part of this communication as *Apr. vitrea β ?*, is the S. V. of *Apr. lepidoptera*. Professor Smith, in his second volume, refers it to *Apr. elegans*, from which, however, it is at once distinguished by the acute and apiculate extremities, as well as by its general aspect and finer striation.)

40. *Amphiprora recta*, n. sp. This is a smaller species, still more nearly rectangular than the two preceding. It is frequent in the lighter densities. An individual, a good deal broader than the form usually is, is shown in fig. 40.

Form nearly rectangular, very slightly constricted, or rather incurvate in the middle; the corners rounded, the ends flat. Median space wider at the ends than in the middle. Lateral parts transversely striated; striæ fine, but distinct. Length from 0·002″ to 0·0045″; breadth variable, the longest being always narrow. There is an appearance of a central nodule in each valve, besides the two terminal nodules; and the valve on the S. V. must look like a *Navicula* or *Pinnularia*. But I have not been able, though the form is very frequent, to see any S. V. which I could refer to it. At first I took the frustule for the F. V. of a *Navicula* or *Pinnularia;* but the halves are united as in *Amphiprora;* the striation extends over the greater part of the F. V.; and lastly, the valves, even when separated, do not lie on the S. V., as is almost invariably the case with those genera. I have therefore referred it to *Amphiprora*. (292.)

41. *Campylodiscus simulans,* n. sp. This is a fine form, and frequent in the coarser densities, though, like nearly all the forms described in this Paper, it has not yet occurred elsewhere. (I find it in the recent gathering above referred to, and I am informed by M. de Brébisson that it is the same as his *A. Thuretii.* But as I had found and named it, and even communicated it to M. de Brébisson long before his Paper appeared, I retain my own specific name. M. de Brébisson's figure is not characteristic, or I should sooner have recognised the identity of the two forms.)

Form frequently orbicular, and also frequently exhibiting the peculiar flattening at one side, and pointed projection opposite, with the saddle-like flexure of the valve so characteristic of the genus. But the orbicular individuals often do not seem to possess this last character.

From two points, near to each other at the circumference, two lines proceed, diverging gradually to the middle, and converging again to two points opposite the first. These lines bound the median space which occupies, in the middle, about one fourth of the diameter. It is marked with coarse transverse striæ, divided in the middle by a blank line or raphe. From the margins of this space proceed, on each side, about twelve diverging lines, which, for rather more than a third of the distance to the circumference, are strong and black. Each line then splits into three, the two outer diverging a little, and near the margin meeting in a semicircular termination, and thus forming, on each of the short black lines, as a stalk, a lotus flower; the semicircular ends of these flowers meet all round, forming an ornamented inner margin. Beyond this lies a circular outer margin, and the short space between is transversely striated. At the points where the stalks of the lotus flowers divide, the third or middle line proceeds straight on from the stalk, and terminates abruptly just where the flower begins to expand into the head. Diameter from 0·003″ to 0·004″.

I have thus minutely described the markings of this form, which is well figured in fig. 41, because in my former Paper I figured another form, of a different genus, the markings of which are almost, if not quite identical with those of the form here described. That was figured as a large variety of *Surirella fastuosa;* and although I had not then studied the structure so minutely as I have since done, and the figure is not perhaps exactly as I would now make it, yet it will be seen that even that figure shows the resemblance.

The only difference, except that of form, which I can perceive is, that in the *Surirella,* the median space is narrower, and not divided by a raphe. But it varies in breadth, even in the *Surirella*, and is probably only narrower there because the form is oval: and as to the form, the *Surirella* occurs frequently of so broad an oval as to be all but orbicular. Then, as we have seen, the *Campylodiscus* is most frequently orbicular, and not saddle-shaped. Indeed, as the *Surirella* varies much in form, being often panduriform, I think it quite possible that it may also occur orbicular, or as nearly so as the *Campylodiscus* I have figured.

The question here arises—Is it possible that these two forms should belong to the same species? And I am not prepared to answer this question in the negative. It is true that at present they are in different genera; but I would remind the student of these forms, that not long ago, nay, perhaps even now, *Campylodiscus spiralis*, as we call it, figures in Continental works as *Surirella flexuosa*. There is, therefore, a natural affinity between the genera, if really different; and in that case, *C. spiralis* and the form here described may be forms exhibiting the transition from one genus to another; it seems, however, more probable, that there may be no essential distinction between these genera. I have omitted to state that both forms, the *Surirella* and *Campylodiscus*, are equally frequent in the Glenshira Sand. (293.)

42. *Campylodiscus bicruciatus*, n. sp. This beautiful form is by no means so frequent in the deposit as the preceding. Fig. 42 represents it.

Form nearly orbicular. Median space square, marked with two sets of coarse lines, at right angles to each other, giving to this part a fenestrate appearance.* From each side of this square proceed two triangular or conical prongs, or prolongations to the inner margin, which their points touch. These prongs are strongly striated, each pair transversely to its course. From the corners of the square proceed, from each corner four lines to the inner margin, which, as in the preceding species, is formed of small semicircles, convex outward, and joining the points of the sixteen lines and those of the

* I have some reason, from recent observations, to suspect that the fenestrate aspect may depend on the fact, that the two valves are so placed, that the lines in one are at right angles to those in the other. If so, this is probably the normal position, for I have not seen any example of the valves lying obliquely. Of course, in the supposed case, the single valves will exhibit only four prongs; and this I think I have seen. But, if this be the case, it is not easy to see how, if the cross bars are seen through the upper valve, the open spaces should come out as clear as if the two valves lay with the bars coincident. Mr. West informs me that he has seen this form in an exotic marine gathering.

eight prongs, forming spaces, which differ in shape from the different origin of the boundary lines. Between the inner margin and the outer one, the narrow space is transversely striated. Diameter of disc about 0·027″. (294.)

43. *Tryblionella apiculata,* n. sp. In my former paper I figured *T. constricta,* which name I find has been adopted by Professor Smith. I had also observed this one, but had not then satisfied myself that it was distinct. Having since then found it in recent gatherings, alone, that is, without the shorter *T. solæiformis* or *constricta,* I am inclined to regard it as distinct, especially as I understand that Professor Smith thinks that I had included two forms under *T. constricta.* I may here add that Dr. Greville has found in the Trinidad sand, a short, broad, slightly constricted and apiculate form, which seems to be a *Tryblionella,* allied to these. This last I have also since observed in the Glenshira Sand, though perhaps a little smaller. It is possible that all three may be forms of one species. Fig. 43 represents *T. apiculata.*

Form linear, narrow, slightly constricted in the middle; extremities apiculate. Keel strongly marked in many specimens, striæ fine but distinct, about 45 in 0·001″. Length 0·0015″ to 0·0017″. The striation is peculiar, for in many specimens it is easy to see not only transverse, but also oblique striæ. This character was first observed by Dr. Greville in the Trinidad form, so far as I know, but I have since observed it in all the forms, though not in every individual. These forms require a more full investigation than I have been able to give to them. That here figured, or one apparently the same, occurs in a recent gathering from the Cumbrae Isles in the Clyde, with only fresh-water forms, but so near the sea, that the *Tryblionella* may possibly be marine. In Dr. Greville's Trinidad sand, both marine and fresh-water forms occur. (295.)

44. *Nitzschia distans,* n. sp. This form is frequent in the deposit; want of space, however, has prevented its being given on this plate.

Form of the F. V. rectangular, the corners rounded. In some specimens I observe a small expansion, analogous to that in *N. spathulata,* but smaller, on each side near the extremities. This is not seen in the figure, having probably been absent from the individual figured, or not seen by the artist from its transparency. The markings are unusually distant, hence the name. They appear to be almost moniliform, and, under a high power, appear as if constricted in the middle, so as to be nearly divided, while faint longitudinal lines appear to pass from one bead to that opposite to it in the next transverse line. S. V. nearly rhombic, narrow; but the angle in the middle is, as it were, rounded off, and not well marked as in *N. angularis*. Extremities very acute. Keel central, prominent, with the same distant markings as appear on the F. V., only here they are seen as puncta. Length about 0·003″. (296.)

45. *Nitzschia socialis*, n. sp. This pretty species is remarkable from its occurring, in the prepared material, after boiling with acids, in groups of six, eight, ten, twelve, or more, without any apparent connection between them. One of these is represented in fig. 45.

Form of the S. V. linear lanceolate, narrow; extremities acute. Keel central. Puncta closely set. Valve finely but very distinctly marked with transverse parallel striæ; striæ 30 to 36 in 0·001″. F. V. rectangular. Colour yellowish-brown. Length about 0·0032″. The valves also occur detached; but the groups are very frequent. This form may possibly be a Homæocladia, but it seems quite distinct from any of those figured by Professor Smith. (297.)

46. *Nitzschia insignis*, n. sp. This fine species is not very rare in the deposit, though often fractured, and the F. V. is very seldom seen. The F. V. is shown in fig. 46, the S. V. in fig. 46*.

Form of the F. V. linear, rectangular, with obtusely rounded ends. Puncta distant. Lateral parts transversely striated. Striæ conspicuous, especially on the S. V., where they traverse the whole valve. Length from 0·007″ to 0·015″. Puncta about 6 in 0·001″. Striæ about 30 in 0·001″. Keel on the S. V. not quite central. S. V. slightly bent at the ends, opposite ways, in some individuals; in others perfectly straight.

This species, in length, and also in form, resembles the straighter forms of *N. sigmoidea*, from which the conspicuous striation at once separates it. From *N. Brébissonii* it is distinguished by the aspect of the F. V., which in *N. insignis* is much longer and narrower, and quite straight, besides having a long blank rectangular space in the middle. In *N. Brébissonii* the F. V. is striated across the whole valve, except a narrow raphe, and the valve is sigmoid on this view. It cannot be confounded with *N. scalaris*, having much finer markings, and being a much slenderer form than that species. It evidently belongs, however, to the same group. It is further distinguished from *N. scalaris* by the absence of the rounded swellings out near the ends of the F. V. (298).

I have not yet found this, or either of the two other species of *Nitzschia* here described, in any recent gathering. They are probably all of marine origin.

(All three species occur in the recent gathering above named.)

47. *Eupodiscus sparsus,* n. sp. In my former paper I figured, under the name of *Eupodiscus Ralfsii β,* but doubtfully, a fine disc, which is frequent in the coarser densities of the Glenshira Sand. I pointed out that, although in some points agreeing with *E. Ralfsii,* as I had seen it, (for no description of that species had yet appeared,) it yet differed from it in the absence of the peculiar elongated angular blank spaces, which in *E. Ralfsii* are scattered over the surface. Since then, I have examined many fine specimens of both, as both are frequent in the coarser densities, and I find that *E. Ralfsii* appears almost invariably blue or purple when seen with a low power, such as the two thirds, or even the half, and sometimes even with the quarter or one fifth. These blue discs of *E. Ralfsii* always showed the angular blank spaces. On the other hand, *E. sparsus,* as I call, provisionally, the new disc, is never blue, but always buff-coloured, or brown, or occasionally colourless, even under the low powers. In many specimens, no blanks whatever occur; in some, occasional blanks appear, but look like the effects of injury.

The figure in my former paper gives a very good idea of the general aspect of *E. sparsus,* but I must add, that in that individual, the granules of which the rays are composed are set much closer than is often the case. In this particular a good deal of variation is observed.

On a close inspection of the more sparsely grained discs, I observed a very curious and beautiful structure, which I have found, in great perfection, in the rather small disc represented in fig. 47, which is most accurate.

In this disc, the diameter of which is 0·0019″, there are twelve principal and equidistant rays formed of round dots, not at all closely set. Of such rays, in the common size of the discs, diameter 0·003″ to 0·0035″, there are usually eighteen. Between the twelve principal rays, which meet in the circumference of a small circle, formed round the centre by the terminal dots of these rays, are twelve shorter rays, which stop short, as far from the circumference of the central small circle, as that is from the centre. On each side of these shorter secondary rays are three similarly dotted lines (in the larger discs four such lines), which are not rays, but are strictly parallel to the secondary rays on each side of which they lie, and of course, in each of the twelve primary segments, parallel also to each other.

In consequence of this very peculiar arrangement, it is obvious that the lines, parallel to the secondary rays, cannot reach the centre, if produced, nor can they meet the secondary rays, but in that case would meet the primary rays at a very acute angle. They stop short, however, of the length of the secondary rays, as these do of the primary, and to about the same extent, each line, as we go from the secondary towards the primary rays, becoming shorter than the preceding one, till the third and last on each side is reduced to four or five dots, and there are often seen, in the larger discs, after the fourth of these parallel lines, one or two dots, indicating the presence of a fifth, for the extension of which no room has been left.

It is evident that so remarkable a structure must amount to a specific, at least, if not to a generic distinction. It will be observed that the successive shortening of the lines, from the centre towards the circumference, produces a good many blank spaces, which, however, are so symmetrical, as not to catch the eye as blanks, as the blanks in *E. Ralfsii* do, which, besides being irregular as to position, are smaller and more numerous. Nevertheless, although I have not yet had time to examine *E. Ralfsii* minutely, I rather think that its structure is, essentially, like that of *E. sparsus,* although in *E. Ralfsii* the dots are both larger and more closely set. Whether this be the only cause of the blue colour I cannot say; but I find that individuals of *E. sparsus,* in which, as already stated, the rays and dots are very close, still retain their brown colour, only darker. It is possible that the blanks in *E. Ralfsii* may prove, when closely examined, to be the result of the structure above described, when the rays and dots are close; yet this does not explain how *E. sparsus* should often occur, both when sparsely and closely marked, without any of the peculiar blanks of *E. Ralfsii.* The individual here figured, probably from its smaller size, and especially from the sparseness of the markings, is colourless; while, as I have stated, *E. sparsus* is usually of a paler or darker brown.

I presume we shall have a description of *E. Ralfsii,* and probably of its varieties, in vol. ii of the 'Synopsis.' In the meantime I venture to direct the attention of observers, both to the very remarkable structure so well seen in fig. 47, and to the differences in colour and other points between *E. sparsus,* and what is generally believed to be *E. Ralfsii,* although I am inclined to believe that both forms possess the same general structure, and the same arrangement of the markings. (299.)*

* On comparing again several discs of both kinds, I find that the arrangement is the same in both, but that in those of *E. Ralfsii,* which appear blue, as most do, the dots are always large and very close, while in *E. sparsus* they are small and further apart. In one specimen, which I have not had time to figure, the dots are very small indeed.

(In the recent gathering above referred to, *E. Ralfsii* is frequent, and I have found its colour, under the ², to vary from purple to dark blue, bright

48. *Synedra Baculus,* n. sp. This form is not at all rare in the deposit, and I cannot refer it to any of the *Synedræ* in the 'Synopsis,' vol. i. It is certainly not *S. superba.*

Form linear, rather narrow, very nearly of equal width throughout on the S. V.; ends obtuse; F. V. rectangular. The valve is transversely striated. Striæ rather conspicuous, and traversed by faint longitudinal lines. Length from 0·01″ to 0·018″ or even 0·02″. It is represented in fig. 54 (300.)

I have now to mention a few forms, which I do not venture to name, partly from not having yet been able to study them fully, and partly because I have not been able to refer to all the works I wish to consult. One or two of them may probably prove not to be *Diatomaceæ.*

49. *Orthosira* or *Coscinodiscus?* This disc, represented in fig. 48, is frequent in the deposit, and I have not been able to trace any view but that which is figured, or consequently to ascertain whether it be an *Orthosira,* which it may be, or a disc of some other genus, or finally a discoid diaphragm or dissepiment, belonging to an *Orthosira* or some similar form.

Diameter from 0·001″ to 0·0025″. Margin transversely striated. General surface marked with very fine short lines, apparently devoid of any regularity of arrangement. These are very difficult to resolve; but it is easy to see, all over the surface, small distant puncta, scattered sparsely, without arrangement or symmetry. The disc is convex. (301.)

50. *Coscinodiscus* or *Actinocyclus?* This disc is not very rare, but less frequent than the last. The same general remarks apply to it. It will be figured in connection with our communication on the Clyde forms, want of space having compelled its omission here.

Diameter, as in the preceding case, from 0·001″ to 0·0025″, but often as much as 0·003″. Colour brown. The whole

blue, pale blue, greenish blue, green, and yellowish green; and, in a few cases brown, passing from brown to purple. I have also seen one or two individuals of a buff colour, exhibiting the angular blanks which characterise the blue ones. On the other hand, *E. sparsus* is always brown, buff-coloured or colourless. When the two forms occur together, *E. sparsus* is seen to be in general much larger and much flatter, and it does not exhibit the angular blanks, which, as I suspected, are the results of the arrangement I have described, in *E. Ralfsii,* where the rays and granules are both closely set, and the granules larger. The largest examples of *E. sparsus* are in general the least coloured, probably because the granules are even less closely set than in the smaller discs, and the angular blanks are entirely absent. Whether these differences, producing so great a difference of aspect, be specific or not, I must leave to others to decide. At present, I am at a loss to account for the fact, that two discs may occur, of the same size, and both buff-coloured, one of which shows the angular blanks, while the other exhibits no blanks whatever.)

surface is marked with very fine granulations, among which may be observed faint rays, especially towards the margin, which is transversely striated, indicating a regular symmetrical structure. I have not been able to determine the genus; but as it seems to be cellular, I think it likely to be a *Coscinodiscus*. There are also two or three other discs which I am unable to name; but I have not had time to obtain figures of them. (302.)

51. *Campylodiscus.* (?) This form, represented in fig. 50, has occurred to me several times. At first I took it for a *Coscinodiscus*, but on closer inspection it is found not to be truly orbicular, and rather to resemble a *Campylodiscus*. It does not agree with any of the species in Smith's 'Synopsis;' but as it may be an immature form, I leave it for further investigation.

Form quasi-orbicular, flattened a little at one side, and projecting a little at the opposite part. The markings consist of large sparse dots, arranged in a way which is partly radiate, partly in parallel lines, somewhat like *Eupodiscus sparsus* above described. There is some appearance among these lines of a broad rectangular cross, but not distinctly brought out. No central space, the dotted lines meeting in the centre. It is possible that it may, after all, be a *Coscinodiscus*. (303.)

(This form occurs, not unfrequently, in the recent gathering of which I have spoken above. It is sometimes, as in the figure, not exactly round, but it also occurs perfectly orbicular. I hope to be able to study it more fully. It has some resemblance to *Eupodiscus tenellus*, Bréb., but I cannot see in it the characteristic protuberance of *Eupodiscus*.)

52. *Amphiprora.* (?) This little form is frequent in the deposit, and I have conjectured it to be an *Amphiprora* from its resemblance in form and general structure to that which I have above described as *A. recta*. It is represented in fig. 51.

Form nearly rectangular, narrow; the ends rounded, obtuse. Frustule slightly constricted in the middle. The whole surface, except a narrow space in the middle, widening a little at the ends, is marked by transverse striæ, which are conspicuous, radiate, and inclined, about 25 to 0·001″. There is, as in *A. recta*, an appearance of a central nodule visible on each valve, round which the striæ seem to radiate. Length from 0·0015″ to 0·003″.

At first sight this form, as well as *A. recta*, might be supposed to be the F. V. of a *Navicula* or *Pinnularia*. But among all the forms of these genera in the deposit, there is not one which agrees with this in its characters. Besides, the striation nearly covers the whole frustule on the F. V., which we never find in *Navicula* or *Pinnularia*. Moreover, although the form is frequent, the S.V. which, as in *A. vitrea*, would much resemble a *Navicula*, does not occur, or at least I have not been able to find it, although I can trace both the F. V. and the S. V. in all the species of *Navicula* and *Pinnularia* which I have been able to distinguish. For these reasons I suspect it to be of a different genus, probably an *Amphiprora;* but as this is doubtful, I figure it as a form to be further examined. (304.)

53. *Disc.* This form, represented in fig. 52, is in all probability not *Diatomaceous*, but one of the *Polycystineæ*. It is a very beautiful object, and is made up of large hexagonal cells, the disc having a raised border or margin of considerable breadth, crossed by what appear like rings projecting on the circumference. Diameter about 0·002″. Many of the cells, which otherwise resemble those of *Eupodiscus Argus*, or of *Triceratium Favus*, have a punctum in their centre.

Not being familiar with the *Polycystineæ*, I figure this disc in the hope that some one who is familiar with them will be able to say whether it be one or not. It is at all events a fine object, and is very scarce indeed in the deposit. I observe a few very similar discs in an earth sent to me by Professor Bailey, marked, Bermuda tripoli, locality doubtful. (305.)

54. *Oval form*, fig. 53. When I observed this curious form with a low power, it seemed to resemble an *Amphora;* but on closer examination this resemblance disappeared, and I found myself unable to refer it to any genus known to me. Indeed, I have considerable doubts whether it be *Diatomaceous*, and suspect that it may prove, like the preceding, to belong to the family of the *Polycystineæ*. The specimen is unique, up to this time, in the deposit.

General form oval. The upper end seems to show an acute interior point, from which the external covering has been broken away, so as to expose it. At the lower end it appears to terminate in a cylindrical neck, which is truncated near to the body. The surface is marked by concentric lines of large and somewhat distant dots, these lines being arranged in pairs, the two of each pair rather close, but the interval between two pairs much wider. Of these pairs of lines, four are visible. Length about 0·001″. On the whole, it seems to be more like one of the *Polycystineæ* than a Diatom. (306.)

Such is a brief account of the forms I have found in the Glenshira Sand, in addition to those formerly described, and so far as I have been able to complete the examination of them. But several forms still remain, which must be reserved for more full examination.

It will be seen that, including the additional list of previously described forms, and those now first described, the number of species already found in this remarkable deposit, which in my former Paper extended to 234, now amounts to 304; a number, so far as I am aware, very far surpassing anything elsewhere observed, and nearly three times as great as that of the species in the estuarial mud of the Thames, as described by Mr. Roper, which is almost the only deposit, rich both in fresh-water and marine forms, hitherto fully described. The deposits and gatherings described by Ehrenberg have generally been either marine or fresh-water alone. I have shown the probable cause of the mixture of marine and fresh-water forms, but I cannot suggest any satisfactory explanation of the unusual accumulation of species, and can only conjecture that the deposit was formed during a very long period, in the course of which waters from different quarters may have at different times been carried to the spot.

But the Glenshira sand or mud is even more remarkable for the large proportion of new or undescribed forms, than for the aggregate number of species. In this and the former part of this communication, I have described and figured upwards of sixty forms, all undescribed before, so far as my knowledge extended. This is exclusive of several, which are probably varieties of known forms, as well as of eight or ten which I have elsewhere figured as fresh-water species, found by me in recent gatherings, and either new to science or new as British forms, which also occur in this sand, and several of which I first observed in it. It is also exclusive of a good many new forms observed also elsewhere by other naturalists.

Of the sixty forms just alluded to as new, only a very small number have as yet occurred elsewhere, although most of them are frequent in our deposit. From this I conclude that a large number of unknown forms will still repay the observer who looks for them, especially among marine species. (This conclusion is confirmed by the recent gathering above mentioned, in which I find, not only about 40 of the new Glenshira forms, but a number of species entirely new, of which I gave a short preliminary notice to the Botanical Section at Cheltenham.) A very extensive acquaintance with our fresh-water Diatoms, of which I have minutely searched gatherings from not less—probably many more—than 500 British localities, enables me to say that new forms now occur but seldom. This is strongly in contrast to the results here described, where one deposit, in great part of marine origin, has yielded more than sixty new forms, the great majority of which have not yet been found elsewhere.

This leads me to observe, that while some dislike the labour of searching for forms in such complex mixtures as the deposit before us, I cannot help thinking that it is worth while to undergo this labour. Had we waited until the most curious of these forms should have occurred in a comparatively unmixed or pure state, many years must have passed before they became known. And although we cannot, for example, make sure of finding in every slide specimens of such remarkable forms as *Amphora obtusa* or *Amphora Grevilliana*, and the others of that singular group, yet, to obtain a knowledge of such a group, we ought not to grudge the trouble of mounting a few extra slides. The Glenshira Sand, even when purified as much as possible, and sorted into densities, is indeed loaded with mica in the coarser, and a very complex mixture of forms and mica in the finer densities. But the results speak for themselves, and I am very far from regretting the time and labour I have devoted to the investigation.

In conclusion, I would mention that the Glenshira Sand will supply observers not only with the new forms, except, perhaps, two or three that are very scarce, but with fine specimens of many known forms which are not always easily procured elsewhere. Of these I may name *Amphitetras antediluviana*, the strongly emarginate variety being frequent, the square one less so; *Stauroneis pulchella*, of the largest size, extending to 0·01″ or more, and varying much in form; (this is *Stauroptera aspera* of Ehrenberg;) *Coscinodiscus radiatus*, fine, varying much in the size and aspect of the cells, and possibly including more than one species. *Coscinodiscus concinnus*, mentioned in the 'Synopsis,' vol. ii; *Navicula convexa*, very fine and large; *N. Jenneri*, extending to 0·008″ or more in length; *Pinnularia megaloptera*, Ehr., of which *P. lata*, Sm., is most probably a short variety. This form occurs so long as 0·006, but more generally 0·004 to 0·005. It is, however, rather scarce. *Epithemia Hyndmanni*, very fine and large; *Coscinodiscus excentricus; Eupodiscus crassus; Campylodiscus Hodgsonii*, this is rather scarce; *Surirella fastuosa*, large and fine, sometimes very large and constricted in the middle, in which case it much resembles *S. lata*, and, it is possible, may pass into that form. *Synedra superba; Nitzschia bilobata*, rather scarce. *Amphiprora vitrea*, very fine; *Amphiprora elegans*, sometimes very large. *Na-*

vicula Smithii (olim *elliptica,* Sm.), very fine. *Himantidium majus,* large. All these occur, with some commoner forms, in the coarser densities, along with the larger of the new forms.

I shall be glad to supply observers with the Glenshira Sand in its natural state; and would recommend them, after it has been boiled in acid, to separate it into densities in the way described by Mr. Okeden. The coarsest portions in which any forms occur, contain so few as to be worthless. The next densities contain the forms above enumerated, as well as the larger among the new forms, with others; and the finer densities contain all the middle-sized and small forms. When well prepared, the entire *Amphora Grevilliana,* for example, is by no means rare in the coarser density, where it is accompanied by *A. Arcus, Campylodiscus simulans, Navicula maxima, N. formosa, N. latissima, Eupodiscus sparsus, E. Ralfsii, &c., &c.*

P.S.—I find I have omitted to mention two species, which are admitted in vol. ii of the 'Synopsis,' as British forms, and which occur in this deposit. These are *Navicula Lyra,* Ehr., and *N. retusa,* Bréb., both marine forms.

I must take this opportunity of expressing my obligations to Mr. West for the great pains he has bestowed on the engraving of the numerous figures above described.

A Micrometer Object-finder. By R. J. Farrants, Esq.

(Read April 30th, 1856.)

A sure and ready method of determining the position of a microscopic object on the glass slide which contains it, so that it may be registered, and the object be brought into the field of view of the microscope, at any time and with any instrument, is still a desideratum with microscopic observers. Ingenious suggestions have indeed been offered, from time to time, with a view to supply this want; but that none of them have fulfilled the requirements may be inferred from the fact that no one of them has obtained general acceptance. I do not doubt that an object may be found, if its place on the glass slide has been accurately registered, with any of the "Finders" at present before the public; still, though the result may be sure, with none of them is the method of determining the position of the object, in the first instance, of ready application.

The plan of Mr. E. G. Wright, of Hereford, published in the 'Quart. Journ. of Micr. Science,' vol. i, p. 301, consists in fixing to or engraving upon the stage of the microscope two scales at right angles to each other, and reading off from these scales the numbers against the end of the glass slip, and the lower edge of the object-plate, when the object is in the field. This plan may be efficient, but is of very limited applicability, being useful, even to the person who adopts it, only with the particular instrument with which the position of the object has been registered.

Other methods more generally applicable have not yet been very generally applied. It is therefore not unreasonable to presume that all such are deficient in some quality essential to their utility. It appears to me that the deficiency is their not affording ready means of determining the position of an object in the first instance. With most of them it is necessary that the "finder" should be applied to the stage, and be accurately centred before any use can be made of its scales. This is the case with the "Universal Indicator" of Mr. J. W. Bailey, described in the 'Quart. Journ. of Micr. Science,' vol. iv, p. 55, and with the "Finder" of Mr. T. E. Amyot, described in the same work, vol. iv, p. 151. On the plan of Mr. E. G. Wright, also, it is necessary to "adjust the moveable stage exactly square," before the scales are of any use. Now the necessity of observing these conditions as preliminaries to the use of the finder, must frequently prevent its being employed, and that too in cases where the want of it is most felt. It must often happen that an observer in examining a glass slide meets with some remarkable object, a frustule or valve of *Diatomaceæ,* for instance, a peculiar crystal, or some particular cell occurring either in vegetable or animal structure, which he would like to examine more attentively at another time; but not expecting, and therefore not having provided for his having occasion to register the position of any object, he is not able to do so, or at least, as the first step, before he can adjust the stage and apply the scales, he must lose the object whose position he desires to register, chiefly because of the difficulty of finding it; then, after the necessary adjustments have been made, the object must again be sought for. In practice, no doubt, the observer frequently concludes that this tedious operation may as well be deferred until he shall want the object for further examination, and so the registry is not made at all. In using the finder of Mr. Tyrrell (see 'Quart. Journ. of Mic. Science,' vol. i, p. 234), it is true that there are no preliminary adjustments to be made, yet with it also the object must be lost in removing the glass from the stage to place it in the finder, and must be again found before its position can be registered.

The terms latitude and longitude have been already made use of in reference to the place of a microscopical object on a glass slide. The convenience and aptness of the terms are a sufficient reason for continuing to employ them.

Latitude refers to the position of an object with respect to the width of the glass. Longitude refers to its position with reference to the length of the glass. Latitude therefore will be determined by a line parallel to the sides of the slide which would pass through the object, and the distance of such line from one or other of the sides of the slide, expressed in terms of a scale that has been determined upon, will denote the latitude of the object. The distance from one of the ends of the slip of a line parallel thereto, expressed in like manner, will be the longitude. Latitude, then, will be measured by horizontal lines, and longitude by vertical ones.

Now, if the latitude of an object can be determined with precision, and if the line corresponding thereto can with accuracy be made to coincide with the transverse diameter of the field of view, the object itself may be brought into view by simply moving the glass slide along the stage.

The ledge at the bottom of the object-plate, against which the slide rests when the body of the microscope is in an inclined position, is a line from which the latitude may be conveniently estimated, for as the lower edge of the slide rests against this ledge, the distance from it to the line on which the object is situate is the latitude required. For determining the longitude, it is convenient that the object-plate be furnished with a stop on one side (preferably the left), against which the glass slide may be made to abut. This may consist of a narrow slip of brass, half an inch in length, projecting a little above the surface of the plate, and having two pins on its under surface to drop into two small holes drilled in the object-plate to receive them. Such a stop is applied and removed in an instant, and affords a line from which the longitude may be measured, as certainly and as conveniently as latitude is measured from the ledge on which the slide rests.

The scales to be used in determining the position of an object are ruled on a slip of glass, or other material, of the size ordinarily used for microscopic purposes, viz., 3 inches by 1 inch. Let the centre inch be ruled with horizontal and vertical lines, at regular distances apart, say 50 to the inch; the superficial square inch will thus be covered with small squares: this done, the observer is supplied with the means of accurately determining the position of any object. These scales are available at any moment, no preliminary arrangements are necessary before they can be used, and the readings being made under the microscope may be made with greater exactness than is possible in reading scales applied to the stage which can be seen only with the eye, at most aided by a lens.

I have had ample experience of the efficiency and utility of the method of registration, the details of which are given below, having used it for several years, though with very imperfect scales; indeed, they were nothing more than lines 25 to the inch, scratched with a writing diamond on the centre inch of an ordinary glass slip, the vertical and horizontal lines being on different glasses, or on different sides of the same glass. These scales afforded the means of registering and finding any object with the $\frac{2}{3}$-inch object-glass, but the divisions were neither sufficiently regular nor minute enough to be used with advantage with an object-glass of higher power. Of late, through the kindness of Mr. G. Jackson (to whom I am much indebted for the trouble he has taken in the matter, and for which I pray him to accept my best thanks), I have been enabled to make trial of different scales, ruled with that precision and neatness which are so well known to and appreciated by all who make use of the micrometers ruled by that gentleman. These scales, and the mode of using them, I will now describe as briefly and intelligibly as I can.

Since objects are usually placed as nearly as possible in the centre of the slide on which they are mounted, it rarely happens that any specimen is found within an $\frac{1}{8}$th of an inch of either edge of the slide, and the $\frac{3}{4}$ths of an inch square in the middle of the slide is the space within which most objects will be found; and since nothing is gained by having more lines ruled than are actually wanted, while the counting is thereby rendered more troublesome, it has been thought better not to extend the ruling over a greater surface than $\frac{3}{4}$ths of an inch square.

The scales ruled by Mr. Jackson, which I now use, and would recommend, are formed by horizontal and vertical lines, ruled on the same surface of the glass, at a distance of $\frac{1}{100}$th of an inch apart; every fifth line is thicker, and consequently more conspicuous than the rest, besides, the centres of both series are distinguished by double lines; and by these means the counting is greatly facilitated: there are in each series 72 lines (the centres being double), which include 70 spaces, of which 35 lie on each side of the central double line in each direction; a space $\frac{7}{10}$ (·7) of an inch square in the middle of a glass slip is thus covered with a series of squares, 4900 in number, the sides of which are $\frac{1}{100}$th of an inch linear, and the area $\frac{1}{10000}$th of a square inch; of these the field of view with $\frac{1}{4}$-inch object-glass will include nearly 4; or if any square be brought to the centre of the field there will also be visible the half of 4 squares, one on each side of the central one, and nearly a quarter of 4 others, one at each corner of that which occupies the centre of the field.

The mode of using these scales is as follows:—If, for example, it be wished to register the latitude of an object in the field of the microscope (the lower edge of the glass slide, it is presumed, resting against the ledge of the object-plate), bring the object as nearly as possible to the centre of the field; then remove the slide from the stage, and put in its place the ruled slip; observe which line coincides with the transverse diameter of the field, that is, with the position of the object, then count (upwards, as it appears in the microscope) from this line to the end of the series: suppose the 45th line is that which corresponds with the position of the object, then 45 will denote the latitude of that object, that is, its distance from the lower edge of the slide. At any future time, and with any instrument, this object can be readily found; to effect this, place the ruled slip on the object-plate, the lower edge resting evenly against the ledge, then bring the upper line (as it appears) of the horizontal series into view, and count 45 from it (this is easily and quickly done by taking advantage of the conspicuousness of every fifth line), make that line coincide with the transverse diameter of the field of view; the ruled slip may then be removed from the stage, and the slide containing the object be put in its place; the object sought now lies somewhere on the line which corresponds with the transverse diameter of the field, and if the glass be slowly moved across the stage will soon come into view.

It is generally sufficient to determine with exactness the latitude of an object: if, however, it be thought desirable to register the longitude also, this may be done by proceeding in a manner altogether analogous to that just described, the only difference being that it is the position of a vertical line passing through the object that is now to be ascertained, and its distance from the end of the slide. Now it is that the lateral stop will be found convenient; it is not, however, indispensable, since a temporary expedient may be made to supply its place, or the lateral edge of the object-plate may be taken as the line from which the longitude is measured; in that case, the end of the slide containing the object must be brought even with the edge of the object-plate, and the object being brought into view by means of the lateral stage movements, the slide is then to be removed, and the ruled slip put in the same position, that is, with its end abutting against the lateral stop, or exactly even with the side of the object-plate, as the case may be; the vertical line coinciding with the vertical diameter of the field of view will then correspond with a vertical line on which the object is situate; suppose this line is the 40th (from the right of the series, as seen in the microscope), the number 40 will then express the longitude, and will denote its distance from the left end of the slide. It is scarcely necessary to remark, that the slide, as well as the ruled slip, must always be placed on the stage in the same way, that is, with the same edge always uppermost: to ensure this it is well to adhere constantly to some plan; for instance, the rule may be always to keep the label on the slide to the right hand.

If the longitude has been registered as well as the latitude, the object will be found by proceeding as follows:—First find the latitude by bringing the horizontal line on the ruled slip denoted by the number into the centre of the field; then, taking care that the end of the slip is close up to the lateral stop, or even with the edge of the object-plate, bring into the centre of the field the vertical line denoted by the register; the ruled slip may then be removed from the stage, and the slide with the object being put in its place, the object will be in the field; and if the observations and manipulation have been made with correctness, will be at or near the centre.

If the eye-piece have an indicator it will be convenient to bring it into the field, and to move the object to its point; the line on the ruled slip which corresponds with it may then be ascertained with the greatest exactness. If there be not an indicator, still, as the eye-glasses will seldom be so clear as not to have some mark or speck of dust, any such accidental mark that may be observed may be made to serve the same purpose as the point of the indicator.

An object once found need never be lost till its position has been determined and registered; for without moving the stage or object-plate, the slide with the object may be taken off the stage, and the ruled slip be put in its place: this may be moved upwards by the hands while the horizontal lines are being counted, and to one side (the right) to enable the observer to count the vertical ones; these being duly noted the ruled slip may be taken away, and the glass with the object be again put on the stage. If no movement of the stage have been made the object should be seen in the same position as at first; the accuracy of the register can thus be at once ascertained, or any error be detected and corrected.

As may be expected, it in fact seldom happens that any line on the ruled slip will exactly coincide with the position of an object, which is more frequently found to lie in the interval between two lines. It is better therefore to make the register refer to the spaces instead of to the lines. The number 45 then, for example, denoting the latitude of an object, will indicate that its position is in the space expressed by that number.

To register the position of an object it is only necessary to put down in figures the numbers which denote the spaces observed; for instance, the position of the object just supposed to have been ascertained would be registered thus:

Lat. 45. Long. 40.

It will save trouble if an arbitrary significance be given to position. Thus it may be determined that the first number shall always refer to latitude, in which case the register might stand thus:

$\frac{45}{40}$ or 45 : 40.

I prefer the latter, because the figures better admit of any appendix which may be used to modify their significance. For example, the object whose position is found to correspond with the square denoted by 45 : 40 may lie nearer to the upper line than to the lower one, or the contrary; now this may be clearly indicated by a short line added to the figures. Thus, if the object lie nearer the upper line, that may be indicated by a short line above the figures, $\overline{45}$; if the object lie nearer the lower line the fact may be indicated by a line below the figures thus, $\underline{45}$. Similarly the greater proximity of an object to the vertical line on the right or left of it may be shown by a short line before or after the figures, as $|40$ $40|$, the meaning of the line so placed is obvious. Again, if the position of the object coincide exactly with a line on the ruled slip, that may be denoted by drawing a line through the figures thus, ~~45~~; if then the position of any object be registered thus, ~~45~~ : $|40$, it will signify that its latitude corresponds with the 45th horizontal line of the ruled slip, while its longitude corresponds with the 40th vertical space, but that it is nearer to the line on the left side. In this way then four positions in respect of each square may be clearly pointed out, and the area of each square being the $\frac{1}{10000}$th of a square inch, it follows that the place of an object can be assigned with an exactness nearly approaching the $\frac{1}{40000}$th of a square inch. As the field of view with the $\frac{1}{4}$-inch object-glass with the first eye-piece shows nearly the whole of four squares, or the whole of one square, and a part greater or less of eight others, it is scarcely possible with only moderate care that an observation should be so inaccurate as that an object whose position has been registered should not be brought into the field of that glass. If sufficient attention be paid in ascertaining and recording the position of the object, it may almost as surely be placed in the field of an $\frac{1}{8}$th or a $\frac{1}{12}$th.

In registering the position of an object as determined by these scales, a somewhat different plan from that already described may be and is adopted by some. Thus, taking advantage of the clear determination of the centres of both scales, with a view to reduce the counting to a minimum, the reckoning may proceed from the centre in all directions. The horizontal lines may be counted from the centre upwards and downwards for latitude; the vertical ones too may be counted from the centre right and left for longitude. On this plan the latitude of an object registered on the previous plan as 45, would be registered 10 below the centre. If it were 25 on the first plan, according to this one it would be 10 above the central line; this line being taken to represent the equator, the terms north and south may be used with reference to it. In like manner east and west may be used in reference to longitude, to signify the position of a vertical line right or left of the central one.

The manner of registering the observations will make no difference in the result, and is a mere matter of detail which every individual may settle for himself. The only important things are that both the observation and registration be accurate.

Report *of the* Committee *appointed by the* Microscopical Society *for the purpose of ascertaining the most convenient form of* Finder *for indicating the position of* Objects *under the* Microscope.

(Read June 25th, 1856.)

An apparatus for registering the position of any number of minute objects contained in a slide, and for readily finding any one of them, either under the same microscope, or any other, has for some time been a desideratum with observers; and various plans have been proposed. The Council of the Microscopical Society have therefore thought fit to appoint a Committee to consider the subject, and to suggest some means of accomplishing the object, of such a simple and inexpensive character as would merit universal adoption.

The Committee have held three meetings, besides having had communications by letter, and they now proceed to lay before the Society the result of their deliberations.

They consider that a finder, in order to be universally adopted, should possess the following properties:

1st. It should be applicable to any microscope, whether furnished with stage-movements or not; and it should not preclude the use of these movements.

2d. It should not require fresh labels to be placed on the slides, or any mark or index to be made on them.

3d. It should not be necessary to remove the slide or finder for the registering or finding of every separate object.

4th. The divisions on the index should be easily read.

5th. It should allow the microscope to be used in the inclined position; and—

6th. It should be cheap, and simple enough to be constructed by any one possessing a moderate amount of mechanical skill.

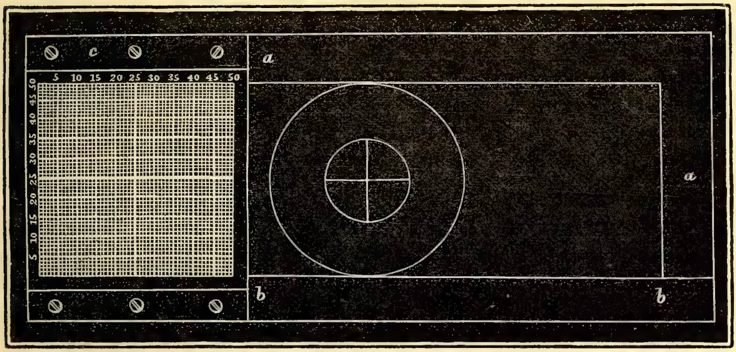
In the plans which they recommend for carrying out these requirements, the Committee lay no claim to originality; for they have merely selected materials from what has been already proposed, and arranged them in a modified form. They are therefore free from the prejudice which an inventor would naturally feel in favour of his own ideas.

Whatever modification an individual may contrive for his own convenience, in the form of the finder, the same standard of measurement should be adopted; and the measurements or distances of objects must be taken relatively to the same fixed point. This point should by no means have reference to any part of the microscope (which would be fatal to a *universal* system), but should be considered as a point *in the slide itself*, upon which the object is mounted.

The slides recommended by the Microscopical Society (three inches by one) are now so generally used that it is not worth while to propose a method of meeting exceptional cases; therefore the above starting point may, under all circumstances, be represented by the intersection of two crossed lines taken as perpendiculars, one and a half inch from one end of the slide, and half an inch from one side. As it would be difficult and troublesome to rule this cross on every slide, it is preferable to have one plain slide as a standard, with the cross occupying the position above named. The measured distance being taken strictly from *one* end and *one* side, the corner common to them should be marked with an arrow-head, in order to avoid the error that would be occasioned if the glass were not cut of the *exact* dimensions, and the wrong end were used in the adjustment. These lines should be ruled with a diamond point, filled with plumbago, and covered with thin glass.

It now remains to explain the application of this fundamental starting point for rendering all forms of finders universal.

First, with respect to microscopes without stage movements. Fig. 1 *a, a,* is a carrier, made either of metal or



wood, whose outside dimensions are three and a quarter inches long by one and a half wide. Along the lower margin is fixed a raised edge, one quarter of an inch broad, for the slide to rest against. There is a hole one inch in diameter in the carrier, the distance of whose centre is one and a half inch from the right-hand end.

On the left-hand end is fastened to the raised edge, or slip, a piece of brass, *c,* one and a quarter inch square, having a sufficient space beneath it to allow the thickest slide to pass under, and abut against a stop at the end; by this means an inconvenient length of the carrier is avoided. The upper plane surface of this plate contains the index, which may be printed on enamelled paper, and contains one square inch, divided by lines at distances of one fiftieth of an inch, crossing each other at right angles. The two lines which cross the centre each way are considerably thicker than the rest, and are numbered 25 (being half the number of the divisions); and the intersection of these is always the starting point for making the adjustments. Every fifth line from this is rather less in thickness, and is numbered at the side; the intermediate ones being as fine as may be convenient for distinct observation. The exact position in which the paper index is pasted on is not of material consequence, provided it lies square with the carrier.

The method of using this finder is as follows:—First take the *standard,* and place its marked end against the abutment under the index-plate of the carrier, and see that it rests upon the bottom ledge. Then place them both together under the microscope, with an object-glass attached. By sliding up or down the vertical moving straight edge (with which every plain stage should be fitted), and by shifting the carrier sideways against this edge, bring the cross into the centre of the field. A moveable index, or hand, is now made to point to the centre, or crossing of the thick lines on the index-plate, and there fixed fast. This hand, or pointer, is simply a thin, flat piece of brass, turned round like a hook or staple, having the longest limb ending in a point, and the shortest slotted, to be clamped to the under side of the fixed stage-plate, by means of a milled-headed screw passing through the slot.

The longitudinal adjustment of the pointer is performed by thrusting it endways, and the transverse by turning it sideways. Now look through the microscope again, to ascertain if the cross on the standard is still in the centre of the field, and coincident with the adjustment of the pointer. If so, remove the standard, and replace it by the slide containing objects whose position is either to be registered or found. If the pointer is not in the way when not in use, it may remain fixed; and readjustment by the standard will be unnecessary except for occasional verification. It is now evident that the centre of the field is represented by the pointer on the index-plate at an invariable distance; therefore, if the carrier be always moved in straight lines at right angles, the pointer will indicate the latitude and longitude of the object under the microscope at the time.

Although the centre of the slide is taken as the most convenient point for adjusting the index, it is best to consider the lower horizontal line on the index-plate as the equator, and the left-hand perpendicular one as the first meridian; by which means all the latitudes will be north, and the longitudes east; and, if the first figure be invariably appropriated to the latitude, the registration will be very simple. Should it be necessary to register smaller quantities than the fiftieth of an inch, the amount may be estimated with sufficient accuracy, and added as a decimal figure; and this will be found much easier in practice than the reading of very fine divisions.

In registering a large cabinet of *Diatomaceæ, Desmidieæ,* &c., it will only be necessary to number the slides, and to enter on a printed list of these objects, the number, latitude, and longitude where they may be found. By these means any specimen may be placed under the microscope in less than a minute.

The finder may be applied to microscopes having stage-movements by merely laying the carrier against the horizontal straight edge on the top plate; and, after fixing the rotary plate (if there be one) by a pin passed into a hole drilled through this plate and the next, the adjustments already described may be made, using the milled heads for the purpose. In those microscopes which have the longitudinal and perpendicular sliding plates divided into fiftieths of an inch, the principle of a universal finder may be applied in a very simple manner. The rotary movement being fixed in the above mode, there must be a stop, consisting of a strip of plate brass, with one end turned up, to form an abutment, and the other slotted and passing under the head of a screw in the top plate, so as to move with sufficient friction to retain its position.

The graduated scales should then both be set to read 25, and the standard placed on the stage. Then bring the cross into the centre of the field by shifting the stop laterally, and moving the top plate, or straight edge, perpendicularly, taking care to keep the standard hard against both its bearings. When this has been effected the standard may be removed, and, if any slide be placed in the same position against the stop and ledge, the objects in it may be registered and found by means of the graduated scales, freely using the stage-movements for the purpose, but being careful not to shift the top plate or sliding stop.

This form of finder is to be recommended where rectilinear stage-movements exist, on account of its simplicity. A substitute for the graduated scales may be obtained by cutting off the edges from two of the square index-plates here described, and cementing them in the most convenient situations.

Another method would be to fasten one of the entire square scales on the top plate of the microscope; but this would involve the necessity of a pointer, as in the case of using the carrier.

Having now described a finder that can be used either with the most simple form of microscope, as a temporary addition to the ordinary stage-movements, or as permanently incorporated with them, we by no means desire arbitrarily to assert that these plans are the best that can be devised. The subject is still open to improvement; but, whatever modification is adopted, in performance of our duty we strongly urge the necessity of basing them all upon *one similar standard of measurement,* taken from a *fixed point on the object-slide itself.* If this be done, objects registered by one observer may be found by another, though each may use a finder of a different form; the difference affecting merely convenience in using.

There is one observation arising from this subject, although not strictly a portion of it, which the Committee wish to make. If, by reason of defective workmanship, or errors caused by the use of adapters, different object-glasses are not in the same line of centre, a readjustment by means of the standard will be required on changing the objective. We therefore call attention to the great convenience it would be to all users of the microscope if every maker would adopt the same pattern for a screw, a proper steel gauge being provided for the purpose. At present it not unfrequently happens, on applying another object-glass to a microscope, that it has to be built upon a system of three or four adapters, to the manifest detriment of its performance. If all our principal makers will acquiesce in this, we shall be most happy to give our assistance in establishing the best form of screw.

As our endeavour has principally been to determine the means by which a uniform system of registration may be obtained, we have not thought it necessary to make any critical inquiry as to the respective merits or defects of the plans already published; we have borrowed freely from them; and we have also received valuable practical suggestions from Professor Quekett and Mr. Hislop, for which we here tender our thanks.

(Signed) GEORGE JACKSON.
CHAS. BROOKE.
F. H. WENHAM.

BRIEF REMARKS *upon* CELL-GROWTH *in the* BRYONIA DIOICA. By NORRIS F. DAVEY, Esq., M.R.C.S. Eng.

(Read June 25th, 1856.)

HAVING been much interested by Mr. Wenham's recently published views with regard to the development of vegetable cells, I felt a strong desire to repeat his observations. After having seen all that he describes in the *Anacharis,* it occurred to me, that if a plant of very rapid growth were subjected to examination without detaching the embryonic parts from the main stem, the actual transition of protoplasm into cells might be observed. As I have not been disappointed in this hope, I am desirous of communicating my success to the Microscopical Society.

The plant which, for various reasons, I selected for examination is the common Bryony; it is peculiarly well suited to the purpose, as it is hardy, of rapid growth, and its long, slender shoots are easily brought under the microscope. The method of examination I adopt is as follows:—a plant of Bryony being potted, and sufficient time having elapsed for recovery from the shock of removal, one of the strongest shoots is deprived of its leaves, &c., near the apex, until the soft plastic masses of embryonic parts are brought into view; these are washed with pure water to remove fragments, and placed in a compressor in water under the microscope.

In consequence of the tapering form of the apex of the shoot, I have found some difficulty in compressing the soft parts without crushing the thicker stem beyond; I have therefore devised a form of compressor for the purpose, which answers exceedingly well. It consists of a slip of glass, 3 inches by 1, and a thinner one, 3 inches by $\frac{3}{4}$; these are hinged together at their margins with tape and solution of shell-lac in naphtha; the tape is thus fastened firmly to the glasses, and rendered waterproof.

Into the acute angle formed by these glasses when opened a little, the prepared shoot is introduced, with plenty of water; the pressure is applied by bringing down the bars of the stage clip upon the upper glass. In this manner I have easily succeeded in applying moderate pressure to the extreme apex, without crushing the stem through which it derives its nourishment.

I will now proceed to state what I have observed, premising that I do not profess in this brief communication to touch upon all the points connected with cell-formation, nor to attack or defend theories, but simply to state the fact that I have seen the actual transition of soft plastic masses into a cellular condition, and to describe what appearances were presented during that transition.

After the young shoot has been in the compressor for a short time, the semitransparent, granular mass, which is the most recently formed, is seen to augment gradually in bulk, and from being nearly colourless or of a yellowish colour, assumes near its centre a decided yellow-green. The edges of this mass, when subjected to slight pressure, are seen to consist of an elastic material, full of granules, but otherwise destitute of structure; after a short period, this granular mass presents a spongy appearance, numerous irregular cavities being developed in it. Some of the larger cavities exceed the smaller ones in the proportion of 3 to 1. After a variable period, the cavities become better defined, and the substance intervening between them appears thinner. The larger cells are then subdivided by septa, apparently of the same plastic material; these septa are formed at one side of the cavity, and stretch gradually across it, and when they have reached the opposite side, coalesce with it, and thus divide the cavity into two. All this has been made out by Mr. Wenham, from the examination of the parts in successive stages; and I have actually seen it occur in the bryony.

As soon as the embryo leaf of the Bryony has become so far developed that its cells have assumed a somewhat regular form, and its central parts have acquired a greenish colour, small, transparent, rounded projections (embryo hairs) make their appearance at its margin; these are faintly granular, rapidly increase in length, and soon develop a cavity or cavities in their interior; after their cavities have increased in size, and their walls have become more marked, they commonly assume a kidney-like form, and a septum of protoplasm passes across to the opposite side and effects division of the cell; the hair is thus divided into cavities of tolerable regularity. After these cells have become more shaped, the growth of the hair is continued in the direction of its length by globular masses of protoplasm which form at its extremity; these, in the case of hairs upon the leaves and stalks, generally elongate, and sometimes further subdivide, the result being a pointed hair of six or seven joints. In the case of the flowers and flower-stalks, the hairs do not attain the same form, but mass after mass of protoplasm is added to the extremity; these retain more or less of their globular shape, and form empty spaces within them of the most irregular form and number; some of the terminal masses have no cavities, but, when the flower is mature, shrivel up without further development. I therefore believe, that as the flowers attain their growth, their hairs become abortive, and that the latter are not intended to reach the same dimensions and form as on the leaves and main stems. The utmost irregularity prevails as to the number of joints, cavities, &c., in these hairs from flowering parts; some are even bifid: there is, moreover, far greater difficulty in actually watching their changes, as their growth is comparatively slow in their latter stages.

It is worthy of remark, that protoplasm is not only the substance from which normal parts are formed, but it is also the material by which injuries are repaired. If a portion of an embryonic mass be cut partially off, fresh protoplasm is seen to exude to restore the part, cavities form in it, &c., while the nearly detached part loses its vitality and collapses.

With respect to the manner in which protoplasm reaches the distal cells of a hair or a mass, it seems to me to be most probable that it occurs by endosmosis from cell to cell; that endosmosis takes place readily through the wall of an immature cell is certain, for some of the clubbed hairs can be seen to fill and burst when immersed in water.

In every instance in which I have seen protoplasm escape into water it has displayed the tendency to ropy coagulation described by Mr. Wenham, and its granules when diffused in water are in active motion.

Mr. Wenham suggests that the form of embryo leaves may perhaps be given to them by pressure of surrounding and similar parts, but in the case of the Bryony this would not appear to be the case, for the embryo tendrils and leaves, though subjected to the same mechanical support or pressure, seem to have, from the very first, distinctive characters.

I must observe that, in the case of the Bryony, the transitions of protoplasm can only be observed with clearness at the margin of a mass; the thickness of central parts is too great for such easy examination as in the *Anacharis.*

The mere augmentation of bulk is best seen in the case of tendrils.

The phenomena of cell-division are most clearly defined in the hairs: the process appears to be hastened by adding a very small quantity of ammonia to the water.

I have in vain endeavoured to make out the manner in which spiral tubes are formed in the young parts: in most instances the spiral is seen to terminate abruptly, but in two instances I have observed that delicate striations were visible further on than the apparent termination of the vessel, and in every case there seems to me to be a straighter arrangement of the cells between which the spiral is about to pass, than elsewhere, so that probably a longitudinal interval between the cells exists, and this may become lined by a membrane upon which the spiral is developed; but all observations upon this point are rendered difficult and uncertain by the density of the masses between the vessel and the observer.

My observations were made with a power of 200 diameters, and an achromatic condenser.

In conclusion, I will remark that I have purposely omitted what I noticed of cyclosis, &c., as I saw nothing new, and I cannot fix any precise period for the formation of chlorophyll-granules, or a membranous lining to a new cell, as I found very great variety in these particulars. My observations have been made during uncertain and scanty leisure, and are professedly imperfect.

VEGETABLE CELL-STRUCTURE *and its* FORMATION, *as seen in the* EARLY STAGES *of the* GROWTH *of the* WHEAT PLANT. By the Hon. and Rev. SIDNEY GODOLPHIN OSBORNE.

(Read June 24th, 1856.)

HAVING now for many months been engaged in an attempt, by means of the microscope, to trace the nature of vegetable cell-growth, I have great pleasure in laying the result of my investigation before the Microscopical Society.

Nearly the whole of my experiments have been made on the *wheat plant*. By means of various very simple contrivances, I have been able to grow this plant under conditions in which I could watch its actual course of growth with object-glasses as high as the half and quarter inch of Mr. Ross's manufacture.

In addition to observations made upon the plant in actual growth, I have made many hundred dissections of it, at the different stages of its early development; and I have now about one hundred carefully made preparations, embracing specimens of every condition of the progress of the contents of a seed of wheat, from the first indication of germination, to the full formation of the roots, and a growth of green leaf of from six to eight inches.

I have made no attempts to resolve any question in chemistry,—I have made no use of chemical tests. All I have to relate, is what my eyes have seen, and what I am prepared with pleasure to demonstrate from preparations I now possess. Unbiassed by theories I have read, I have sought after only such truths as could be practically illustrated by means of the microscope.

I have used throughout object-glasses, made for me by Mr. Ross, ranging from the two-inch to the twelfth power. The most useful I have found to be his improved half-inch, and a very excellent sixth. It is requisite however, or at all events convenient, to use the twelfth power occasionally, to determine minute features of structure which may be shown with the sixth, but not so clearly as to be beyond dispute.

In this paper I shall confine myself to that period in the growth of the plant, which gives roots of two or three inches in length, and an upward growth of the same height; this will be found to have afforded a very wide field of investigation.

In order to observe the growth of the plant, I pursued the following plan: I procured and constructed small glass tanks, which would rest on the stage of the microscope, their back and front being of thin glass; some were constructed sufficiently shallow to allow of the use of the quarter-inch object-glass.

In addition to these small tanks for observing the actual growth of the plant, I have a few glass jars, in which I suspend circular plates of perforated zinc over water which I treat with various matters; these plates receive the seed, in some instances without any soil, in others with a small quantity especially prepared according to the experiment I am about to make. From these jars I transplant the seeds, as they begin to germinate, into the small stage tanks; they also form my stock of subjects for dissection.*

I will now proceed to relate the history of early root-growth in a general way; I will then enter into the more interesting detail of the formation and character of the component parts of a root.

The first symptom of germination in a seed of wheat consists in the liberating from its surface a species of filamentous network, somewhat similar to the mycelium of many of the fungi which infest vegetables; nearly at the same time, the whole seed is seen to swell, and become, as to its external covering, somewhat transparent. At the germinating point of the seed, there now appears a very small wart-like projection of tough white matter; this puts forth one cone of the same substance, pointing upward,—the future plumule; and several others projected in a straight line, soon to curve downwards and be-

* At the commencement of my investigation into the growth of the wheat plant, I had a small nursery of it growing in my garden; I found, however, that though the results scarcely differed in the two cases, the plants from my jars being free from soil formed the better subjects for preparations than those grown in the ground. If a wheat plant is grown in very fine sifted soil, in one of the glass tanks, which should be so shallow as only to admit a depth equal to that of a root, a half-inch power will show a space between the soil and the apparent outline of the root; a quarter-inch will prove this to result from the intervention of a layer of transparent plasm external to the main structure. If in a similar tank the seed is caused to send roots down into clear water, by pouring in some coloured fluid it will be seen that the coloured particles adhere to this plasm, and cannot touch the actual parenchyma of the root.

come the roots (Pl. III, fig. 1). If this exuded white substance is examined at this stage, it will be found to consist of several layers of cell-texture. The outer one has cells with extremely thin walls; their length is far greater than their breadth, and very often they have no visible contents. The few next layers consist of thick-walled, angular cells, very full of granular matter. We then find smaller cells of the same form, the contents granular, but of a darker colour, with large nuclei occupying the greater proportion of each cell. We now come to the vascular bundle. This consists of tubes of scalariform,* or pitted fibre; I use the term tubes for want of a better, but I am satisfied that these long cells, with their barred and dotted fibre, are not hollow in the true sense of the word. They are firmly held in position by being placed within a mass of simple cellular tissue, which makes up with them the structure I have called "the vascular bundle." In the centre of this bundle, and passing throughout its entire course, are one or more tubes. I assume them to be channels for the sap; when dissected out they give, in a vertical view, two parallel lines of some hyaline substance, united by a highly transparent membrane, and enclosing granular matter.

A transverse section of one of these sap-tubes, made at the base of a root (Pl. III, fig. 2), shows two kidney-shaped outlines, enclosing in the space formed by their concavity a circular space, very similar in appearance to one of the nuclei found in cells. These bundles of fibre, with their investing layers of cells, are connected with the germinating point of the seed, by thick-walled, cellular texture (fig. 3), the spaces or cells being very full of a dark granular matter, in which globules of some oleaginous substance may be made out. The immediate connection of the epidermis of the plumule with that of the roots, is also a space of cellular texture, the cells of which, when divided vertically, are found to have their walls formed in minute cavities. The only idea I can give of a section of one of these cells is that of a series of pipes which have been bent into circles, laid upon one another, cemented together, and then a vertical section made through them, so as to expose their several inner faces. I find that cells of a very similar structure to these, will in the end assume the character of annular fibre, (*Vide* note at the end.)

The cones of protruded substance of which I have spoken soon burst their outer coat of cell-texture. At this early stage a root cone, if dissected out and placed under the sixth object-

* I use the word *scalariform* simply to mark the character of that species of vessel which has a ladder-like appearance.

glass, presents a very interesting object. At its apex there is what I must call a free capsule of cells (figs. 4 and 5), somewhat lozenge or diamond shaped at the extremity, but becoming longer and more narrow towards the base. These, as the rule, have well-formed nuclei within them; they have this peculiarity,—that they appear sometimes regularly disposed, so as to form, cell with cell, a perfect cone; at other times they are separated into groups; again, it will often happen that many of the cells will appear to be isolated. They take this varying position from their being formed in, and held together by, a highly elastic and very transparent membrane.

This free capsule envelopes the inner apex of the growing root; but there is, as a rule, a clear cell-less space between its base and the part of that apex which it there covers. Very frequently the cells at the base of the capsule will be seen to project from the side of the root at an acute angle (fig. 5.) Beneath this cellulated cone or capsule, the growth of the root, throughout its whole progress, proceeds as I have already described it; the only difference from its very early stage being, that the scalariform fibre in the vascular bundle assumes a more defined form, and the whole structure larger proportions. The capsule, however, is never missing, nor have I ever found it to vary in its structure and general details.

It is these capsules, I believe, which botanists have named spongioles. I have a preparation in which I have succeeded in getting a view of the apex of a capsule *in situ*; as it were, looking down upon it (fig. 6). A sap-tube is seen bedded in a series of cells, which surround it in concentric circles, giving, under the sixth power, the appearance of a small dahlia.

As the rule, every root, at a certain period of growth, unless it is forced by heat or some very fertilizing matter, very soon puts forth rootlets and suckers. The suckers consist of long, narrow, cell-like structures (fig. 7), the result of cell growing on cell, and the absorption of their walls of separation. They contain fine granular matter, and at their extremities there is a cavity of peculiar form always full of it. They take their origin from cells in the parenchyma, and may be traced through every stage of their growth.

Besides these suckers, small lateral roots spring from the parent root (fig. 1 DD). Their structure is identical with that of the root itself; when detached and put up as preparations, they afford a beautiful illustration of the various forms of cells.

The nature of their growth is this:—The epidermis of the main root slightly bulges outwards; on this a mass of granular matter is seen to accumulate; in it are a great number of nuclei, enclosed in minute egg-shaped vesicles (fig. 8 *h*), each nucleus being situated at the lesser end of the oval space in which it is contained. External to this granular matter, certain hyaline, thread-like processes (fig. 8 *i*) are seen interlacing with each other, forming thus an irregular network. A vertical section of that portion of a root which is producing one of these lateral roots shows a small vascular bundle, anastomosing from the centre bundle of vascular fibre in the root itself. This is surrounded with concentric circles of small cells, disposed with the utmost regularity. The new vascular bundle, with its envelope of cellular textures, now protrudes a cone-shaped apex into the external accumulation of granular matter; that matter, with its network and numerous vesicular bodies, becomes to this protruded cone what the free capsule or spongiole is to the main root. It speedily assumes the true capsular form. The small vesicles expand most rapidly; their outer walls become in contact the one with the other, and by this compression they are forced into that peculiar form which is ever characteristic of the inner cell-structure of a capsule. The outer network appears now to resolve itself into a certain predetermined form of structure; it is seen in union with a plasm, highly elastic, and equally transparent; this fills up spaces to which what appeared as mere threads are now the walls or septa; and thus that peculiar external coat of cells I have already described as seen on the point of a root, comes into a visible existence (fig. 9). Simultaneously with this assumption of their normal outline, are seen the nuclei so generally found in them. These cells, bedded in the plasm in which and of which they are formed, now partially subdivide, and the whole rootlet (fig. 11) thus obtains all the outward form and internal structure of the parent root, to which it is connected—without by a common parenchyma, within by the vascular bundle with its cells, which has anastomosed from the parent root. The base cells of the capsules of the roots and rootlets are gradually brought into connection with the parenchyma. Perhaps it would be more proper to say that the parenchyma is formed by the gradual addition of the lower cells of the capsules, to former cell-texture of the same kind, which has become the epidermic covering of the root. I believe it will ever be found that there is a clear space of membrane or plasm between the base of the capsule and those of its cells which were last drawn in to be incorporated as part of the parenchyma.

Exterior to the cellular parenchyma, I long suspected that there was a coating of some hyaline plasm investing the whole structure of the root; this, by the process of *colouring*, which I shall presently describe, I now can easily prove to be the case. It is highly transparent and is seen as a clear glass-like envelope to the substance it invests; I will call it "epidermic plasm;" I believe it to be identical with the connecting membrane or plasm by which the cells of the capsules are held in position. If the point of a growing root is removed from the plant, and the capsule separated on to a slide of glass, a drop of fluid added, and then some compression made with a thin glass cover, by a patient manipulation of the illuminating portions of the microscope, this plasm is very easily made out.

Having dealt with the general features of the growth of the root, I will now turn to that of the plumule or leaf. A section made with care through the white substance, from which the plumule and roots both protrude, gives a beautiful view of the early formation of the former. Several layers of an oval-headed cell-structure are seen, the one longer than the other, *i.e.*, more advanced in growth, the shortest or youngest being very small. When detached from each other their outline is that of a blunt spearhead (Pl. V, fig. 19); at this stage their substance consists of a cellular texture, of which the cells are very small as to their actual area, with rather thick walls of plasm. Towards their base, in the centre of each, is the well-defined indication of an upward line of spiral fibre. These are the embryo leaves. They have the same epidermic plasm as the roots, and into it are seen to project small points, the future hairs on the leaf of the plant. They have capsules, so far as I can make out, identical in structure with those of the root, although adhering more closely to the substance covered, and the component cells do not separate in the way they do in that part of the plant.

As these young leaves prepare to enter into the outer world they fold themselves longitudinally into a very small compass (Pl. V, fig. 29), and carry on with them, until they have obtained an inch or so of growth, a straw-coloured cellular envelope of stout texture (Pl. V, fig. 30); this appears intended to protect them as they force their way through the soil and on their first exposure to the weather in the outer world. It has occasioned me some surprise to find the chlorophyll or green colouring matter existing in leaves at so early a stage of growth, that I can hardly attribute its existence to any action of light.

The spiral and other fibre given off into the leaves originates from a mass of the pitted or dotted cell-tissue which is seen in the centre of the white substance, from which, as I have stated, plumule and roots both grow. If a section is carefully made through this substance, in a direction which will include the lower part of the plumule and the commencement of the roots, we get a view of the basis of the whole vascular system. A large number of pitted cells are seen, some passing downwards to branch out into bundles, one to every root; these, as soon as they reach the base of a root, assume a modified scalariform appearance; others branching upwards to the leaves assume either the spiral character or that of a double band, of which one part is scalariform, the other annular, or the broad spiral breaking up into rings. The origin of all these vessels would seem to be similar—cells of a long, ovate form, so indented or pitted, that with proper illumination their surface presents a reticulated appearance (Pl. V, fig. 37); where they join at their extremities they widen, their intermediate walls absorb, and thus one long vessel is produced by the conjunction of many distinct cells.

Turning now from general structure, I will enter more into detail as to the formation of those cells of which every vegetable structure is composed.

If a seed of wheat is permitted to so far germinate, that the plumule and roots are thoroughly developed, it will, by pressure upon a glass slide, give out a certain amount of milky-looking matter. If this matter is mixed with a few drops of distilled water and spread out over the surface of the glass, as it dries up I have ever found it to assume the same appearance—that of nearly parallel lines connected at irregular distances by curves, presenting an appearance of the form and character of cellular tissue. I only mention this fact, as one that, with others, has led me to believe that the formative matter of a seed in this stage of germination has a direct tendency to resolve itself into a form characteristic of the tissue which is so wonderfully to be educed from it. As far as I can trace the changes within a seed germinating, it appears that, by the breaking up of its outer tissue, the moisture requisite to decompose its contents is admitted. The granules of the starch now burst and become mere vesicles, having exchanged their normal outline for one more oval; their concentric markings and hilum, for a plane surface extensively lacerated by that bursting of their tissue which has liberated their contents. The formative fluid at this stage is found full of these torn vesicles of the starch granules, with a large amount of glutinous and also of active molecular matter.

In the next more advanced stage of this matter I obtained some of my best specimens by the following simple means:—I put a certain quantity of the milky matter expressed from seeds, whose roots and plumules had grown about half an inch, into short glass-pointed tubes, with very small terminal apertures, adding to it a very little water; I then suspended these tubes in jars full of water, covered with tinfoil; these I kept for ten days in a dark, warm cupboard. I now found that a large globule of a light brown matter had exuded, and was attached to the points of the tubes; this I carefully removed, and made into a preparation capable of being examined with my "twelfth" object-glass. I now obtained some further insight as to the forms into which the fluid contents of seeds germinating are resolved; from this and many other experiments, I have arrived at the conclusion, that the formative matter, at that stage immediately preceding actual cellulation, is composed as I shall now describe it. There is a very transparent glutinous matter, only to be traced at its edges, when floated out into distilled water or any clear fluid; in this there is a large quantity of granules of a peculiar form (Pl. V, fig. 32); with the sixth power they have an appearance similar to that of vibriones, but still being clearly of quite a different character. By the use of the twelfth power, with good illumination and a careful manipulation of the instrument, their peculiar form can be well made out. I call them "double ovate granules;" they seem to consist of two very minute oval vesicles, which have become united, or it may be of vesicles of that form, originally single, but which by a process analogous to that followed by some *Desmidieæ* have become double; they have a molecular movement, but this is not universally the case, and I am not satisfied that it does not arise from their contact with other active molecular bodies.

In addition to these double ovate granules, which I consider to be vesicular, there is a large quantity of some thick granular matter evidently made up of most minute atoms, the characters of which I cannot trace out; there are also a great many true molecules in constant motion; they are very similar to, but smaller than those I have often taken on glasses exposed to the atmosphere.

By some curious law the double ovate granules voluntarily dispose themselves in a manner which, by leaving clear spaces between groups of them, gives the appearance of a somewhat vaguely defined cell-texture; the molecular atoms, by as evident a law, will be found to hold with regard to each other, as the rule, a relative distance so regular as to force upon me the conviction that it is in their very nature to resolve themselves into certain set forms (Pl. V, fig. 32).

I had observed that, whenever a lateral root commenced its growth on a plant in one of my stage tanks, there was an external secretion of a brown granular matter; I have already described its general features; I have frequently removed some of this, and submitted it to the sixth and twelfth powers: this gave me a view of the formative matter in a further advanced stage. There were the double ovate granules and the molecules, but I now get true cell-formation and nuclei in their earliest existence (fig. 33).

Imbodied in the mass were globular bodies, whose external surface afforded a distinct circular outline; they were full of granular matter very closely packed: in their centre was a spot or ring, and even within this I have often made out another spot; these were nuclei with nucleoli, which latter had also their own nucleoli. Some of these were deeply imbedded in the formative matter; others, more upon its surface, were seen contained in small vesicles or cells, inclining to the oval form. At the edge of the mass the use of a $\frac{1}{4}$-inch power had permitted me to see the thread-like transparent processes to which I have already alluded; now the matter itself was removed on a slide, and submitted to the higher powers, I found these threads to be of a beaded structure: after-experiment leads me to believe that this network is in reality the outline of walls of separation in the plasm, which invests the whole mass of formative material.

If the capsule of a root, when very young, is removed to a slide, and there in some clear fluid submitted to pressure—flattened out between two pieces of thin glass—the outline of many of the long cells will appear in a series of curves (Pl. IV, fig. 12, 12*); it will be also seen, that where two cells are a little separated, the curves of their several outlines are in exact opposition to each other, the evident result of their recession from the spaces which they had enclosed when in conjunction. I followed out this observation, until I arrived at the conviction that the cells of these capsules, or spongioles, arise from a floating out of a highly elastic plasm, its self-separation into many individual spaces, which again divide into more; the curves or indentations in the respective walls of separation expanding as they separate, again to unite and enclose spaces which are to be fresh cells.

It was the desire to trace out this feature of cell-growth which led me to seek the means of giving colour to the formative matter. To my delight I now found that whilst the mass would take up or involve the pigment, the actual cell-walls and epidermic plasm would not. I now obtained preparations of these long cells of the capsules, on one side empty, the whole of the other side full of the pigment (Pl. IV, fig. 19), this coloured portion affording the exact form of the cells I had seen to separate by an apparent splitting of the beaded division; the use of a high power now enabled me to see at the inner edge of the coloured portion of the cell, the growth of the future line of division.

I have just said that the cell-walls will not take up the coloured matters I use; the viscous hyaline matter in which the formative granules and molecules float will do so to a certain degree. I am inclined to think this is of a different nature from what I have called "epidermic plasm." I am of opinion that all the granular and molecular matter I class as "formative matter" exists imbodied in a very thick transparent fluid, that it is this which effects the various combinations of cell-contents; I have succeeded in colouring it, but I have my doubts whether the tint I have given does not in reality proceed from exceedingly small coloured granules, which are so closely incorporated with it as to impart their own tinge; when a well-filled and coloured cell is bruised out upon a slide, the intimate connection between the coarser material and this viscous matter is clearly shown.

The epidermic plasm I have never yet found to take any colour from any of the means I have used to paint the internal matter of the cells; although so elastic as to often resist the strongest attempts I can make to separate it from the structures it invests, when broken up, its edges have the appearance of broken glass. I believe this plasm to be equally the integument of every individual cell, as it is of every combination of cells. In portions that I have succeeded in detaching, I have observed the vesicles containing nuclei, the latter highly coloured; also the early stage of the beaded network of which I have spoken.

It is impossible to value too highly the help given to the study of cell-growth, from the use of colouring matters applied to the growing plant. Amongst others it reveals this curious fact—that the smaller the organism into which the pigment can enter the more highly painted will it appear (Pl. IV, figs. 23, 28). This arises, I believe, from the circumstance of the formative matter being more closely packed in the smaller spaces into which it is received; the plasm enveloping colour and formative matter alike, when it contracts upon them to form the nuclei, so closely aggregates the granules that their whole mass acquires a deep colour. In the small cells, which are so beautifully distributed in the vascular bundle, the walls preserve their full transparency, the contents take an evident amount of colour; a clear outline shows the vesicles containing the nuclei; these nuclei are seen very highly coloured. You have thus under the object-glass several generations of growth, each painting itself with a distinctive shade drawn from a common source of identical colour (Pl. IV, figs. 24, 25). Under every feature of cell-growth, the nuclei and the aggregations of formative matter which tend to nucleolar growth, will always be found to present a much deeper colour than the formative matter in the same cell with them.

I do not consider all masses of formative matter, tending to the globular form, within cells, as nuclei. There will often be a mass of granular contents, somewhat globular, seen at one edge of the middle of a cell (Pl. IV, fig. 14), on which it is impossible to make out any membranous investment; it will gradually increase by taking to itself more of the mass of similar matter contained in the cell, or by its own expansion, until it occupies a very large portion of the cell-cavity; a line of separation then appears above and below it, caused by the formation of two new cell-walls or divisions in the cell, in which this process is taking place; this mass of granular matter now assumes a quadrangular outline, entirely filling a space separated for it in the cell by the new walls. The portions cut off by the interposition of this new formation increase by expansion, as it does itself, and thus one cell becomes three (Pl. IV, fig. 27).

With regard to the true nuclei, those with a well-defined outline and the nucleolus within them; before these take any visible part in the work of cell-propagation, with scarce an exception, I see the gradual formation of the egg-shaped vesicle of which I have spoken; this vesicle is seen to increase its proportions, the nucleus for some time remaining inactive at the broader end; a new cell is thus formed, apparently within an old one; when it has attained a matured dimension the nucleus seems to break up or disperse within it; after an interval a new nucleolar formation is seen, prepared, I assume, to follow the same course.

Besides these processes of cell-growth—that from an irregular aggregation of cell-contents (Pl. IV, figs. 16, 17, 18), and that by the vesicular investment of a nucleus—there are combinations of cell-contents into masses with oval and other outlines, which I cannot trace as taking any part in cell-propagation; they will often be seen in the matured parenchyma, of a long, oval form. I am inclined to regard them simply as a secretion from the cell-walls, often absorbed, to be again secreted in the same form.

In portions of a plant where the growth is very vigorous I frequently find two, sometimes three, nuclei in one cell, very often two in one vesicle (Pl. IV, fig. 28). The use of colouring matter has also given to me evidence of another process of cell-growth. I have stated that where the formative matter becomes closely aggregated, either in nuclei or in the masses with a less defined form, it takes from the pigment a darker hue. This has shown me that the cells in some root structure are produced on what appears to be a very simple plan. A large amount of the formative matter will have taken up the colour used; on its surface you trace a network of plasm floated out; the lines of this will be seen to dip down into the mass, and to form septa of some breadth, thus dividing the granular coloured matter into quadrangular cells: by close observation with a high power it will be seen that these septa are not composed simply of the deposit of one layer of plasm, but of several (Pl. IV, fig. 27). The matter thus divided and coloured will occasionally (it may be from the action of the preservative fluid I use) shrink up into folds within each division; it is then made evident that besides the cell-walls the granular contents of a cell are enveloped or blended in their own particular tissue.

After giving much attention to the subject, using the highest powers of the instrument, and many different kinds of illumination, I have arrived at the conviction that nuclei, when seen in cells, either alone or with vesicular investment, are exterior to—have a separate existence from the other granular contents of the cell. Now, I am quite satisfied that the plasm which forms the cell-walls consists of several layers; if, as I conjecture, these layers are continuous, *i. e.*, extending without interruption from one cell to the next, I can easily conceive the facility with which a cell formed external to the surface of the enclosed granular matter could extend itself between any of these layers, and thus force its way into a distinct existence, increasing the bulk of the structure of which it formed a part. I am confirmed in this view from observing the extremely elastic nature of the cell-wall plasm. The apex, even of the youngest root, requires considerable pressure before it can be so broken up as to admit of being made into a preparation capable of being studied with a high object-glass.

A transverse section of a root will sometimes show the dark masses of young cells, when in vigorous growth, forcing their way through the angular spaces formed at the points of contact of the divided cells; frequently they will be seen pushing their way on one side of the interior of those cells. I hold, then, these nuclei to be a very close aggregation of formative matter, by some law combined in the globular form, and sustained in that form by means of the viscous material in which all such matter is suspended; that by another law, a highly elastic vesicle is secreted external to a nucleus; in its progressive expansion it forces its way, utterly independent of the other contents of the cell, into a layer of the plasm of which the cell-wall is constructed, until it has itself obtained the dimensions and general character of the cells of that particular portion of the vegetable structure to which it belongs; that then the nucleus within it expands by the general separation of those particles of matter of which it is composed, until it has filled the space formed by the new cell which had been its *matrix*. The cell, now matured and occupied by the contents thus derived from the nucleus, absorbs some of them, and then, either by entire fresh secretion, or partly by that agency in combination with some portion of its original contents, a fresh nucleus is produced, to run the same course.

That the epidermic plasm of these vegetable structures can secrete formative matter on its external surface, I have no doubt whatever, for I have again and again watched the process. I see no reason to doubt but that the plasm of the cell-walls has the same power with regard to its internal surfaces. On this power of external and internal secretion of tissues, which involve every portion of the organisms to which they belong, I think a sound theory is to be founded as to the whole process of vegetable cell-growth.

Those who pursue this investigation will for ever find instances in which matured cells would seem to be isolated. I am satisfied that, in reality, this is never the case. They may be accidentally torn apart, or floating out from each other on or in the plasm in which they are produced, from its exceeding transparency they may appear to be separated, but when *in situ* with regard to the structure to which they belong, they are ever in connection either with the walls of neighbouring cells or with those wonderful layers of elastic membrane whose evolutions and convolutions form a protecting, secreting, absorbing, and assimilating surface, extending to every portion of the system of vegetable structure.

I have now grown wheat plants rooted in spring water, distilled water, in a solution of alum, in spring water coloured with carmine, vermilion, and indigo. I have treated the water in which they were growing with various fertilising matters. I have grown them in thin layers of soil suspended over water, mixing with that soil various ingredients, and pigments, and bronze powder. I have now plants, with a foliage of fourteen inches, growing in a strong solution of prussic acid and cyanide of potassium. It would be too great a trespass upon your patience to give all the various results of these experiments. The general conclusion at which I have arrived is, that, though what I call the epidermic plasm does absorb moisture from the soil, in fact requires moisture to preserve its elasticity, combining in the formative matter it secretes some of the matters presented to it, in whatever medium it may grow, still the great sources of plant health and strength are obtained by means of the capsules or spongioles, the *termini* of every root and rootlet, and also by the absorbent cells ever found at the extremities of the numberless suckers; for it is at these points that I find the cell-structure ever greedily taking in whatever of foreign matter I have succeeded in introducing into the *media* in which I have grown the plants. The action of anything placed in the medium in which plants grow, which is injurious to them, is at once shown by its action upon their roots and lateral processes, the capsules losing many of the characteristics of healthy action. It is a curious feature in these experiments that, although deep roots give a great deal of green leaf to the plant, yet when pernicious substances or fluids stint the roots by injury to the spongioles, *for a time* there is nevertheless an active leaf-growth. I am also strongly impressed with the belief, that the hairs with which the surface of the leaves of cereals are so regularly studded, receive from the atmosphere and introduce into the leaf-structure those atmospheric elements so necessary to its growth. I have never yet traced any circulation in any part of the plants on which I have experimented, but I have seen active molecules at the base of some of these hairs, and in one instance crystals of the character of oxalate of lime.

When the spongioles are poisoned or mechanically injured, the internal cells of the root are imperfectly developed, they appear as mere quadrangular masses of granular matter floated or imbedded in hyaline plasm, with few aggregations of the matter, and very few nuclei, these being irregularly formed. Distilled water is an easy means of proving this fact, a rather strong solution of alum, also soil mixed with the bronze powder, which latter binds the soil into a hard mass. There can be no doubt but that the plant requires not only certain chemical constituents to secure its health, but that these must be offered to it, when growing in a medium, allowing the utmost freedom to the capsules of the roots, rootlets, and to the suckers. I am satisfied a highly pulverized poor soil would grow better plants than a close, hard, tenacious soil, however fertilised.

I will now briefly remark upon those beautiful structures known as scalariform, spiral, annular, and dotted fibre. In the leaf of the wheat I find the true spiral,—the annular, the scalariform; in the roots I find only the latter, with an accompaniment of dotted tissue. At the very earliest stage at which, by dissection, a view can be obtained of leaf and root formation, the fibres proper to each are discovered, the spiral completely formed, the scalariform in active formation; the former turning upwards to the leaves, the latter separating into bundles and going downwards to the roots.

The formation of the scalariform fibre can be with ease traced. A large number of pitted oval cells, of considerable size, flow down as so many streams from the centre of the base of growth. Some are seen with their end walls already absorbed, and their centre diameter contracting. A section of them made at this stage, shows that the pits in their walls extend in lines around their whole internal structure; these now unite, so as to form furrows or folds. By looking into a tangental section of one of these cells, you may see in the interior an appearance as if the whole had been built up after the manner of a wall, for the divisions between each pit or depression are not quite obliterated. A small piece of such a cell, detached and flattened, has all the character of a fine hyaline network. Being anxious to discover in what form one of these scalariform fibres became developed at its extreme point, I have made several preparations of the vascular bundle, with the outer cell texture removed. By this means I have found that each of these processes push on in their growth exactly on the principle by which it commenced; they become periodically more contracted, and end in long, narrow, complete cells, with toothed edges, more similar to those of the fibres seen in the crystalline lens of the eye of a fish, than to anything else with which I can compare them.

I have one preparation, in which I have a beautiful specimen of this scalariform fibre, in close contact with true ribbon-like fibre disentangling itself, and perfect rings of the annular; this is from the plumule. None of these vascular tubes can I succeed in colouring. I have no doubt but they are formations developed from elastic plasm, and by some law, assuming, according to their situation in the plant, their own peculiar character. It is easy to conceive that the folds of the scalariform could become annular; that the annular might be modified to become spiral; but I can form no conception as to the process, by which from an apparently homogeneous substance, the separation of two differing systems of vascular tubes is so produced, as to send the one more simple system to the roots, another, with all the varieties of structure, to the leaves.

With regard to the leaf, I believe the chief office of the spiral fibre is to support and give general strength. It will be seen here to anastomose, small branches passing from one main vessel of this fibre through the cellular substance, to unite with another similar vessel. I have never detected this, as existing in the case of the scalariform vessels of the roots. These I believe to be also formed for the direct purpose of strengthening the structure with which they are incorporated. They become a species of elastic skeleton to an organized body, where every purpose requires that it should at the same time be supple and yet strong. The only anastomosis to be seen in these vascular fibres of the roots, is where one of them gives off a bundle to a lateral root. Although I have succeeded, by the use of the air-pump, in forcing a little coloured fluid between these fibres and the cell-texture which invests them, I can introduce nothing into their own substance.

When I look at what a wheat root has to do; how it has to force its way and introduce its lateral branches through all manner of crevices, and amongst all kinds of material in the soil, I am struck with wonder at the beauty of the contrivances by which the spongules or capsules, constructed of highly elastic material, can float their onward way; consolidating as they grow, and having within them the growing organism of a scaffolding sufficiently strong to bear up, in its deposited order, all the necessary structure; and yet sufficiently pliable, to follow that structure in any course it may be compelled to take, however tortuous.

By growing the wheat plant over spring water, and then submitting the leaves to a continued boiling in nitric acid, very beautiful preparations of the pitted tubes and the rings of the annular fibre are obtained. If there are casts in silica of the original vessels the silice must be taken up from the water.

I will only now add, that I will with pleasure give any further explanation upon any point on which I have now touched, and any information as to the manner in which I have made my experiments. I believe a close study of the growth of plants, by means of the perfect instruments we now possess, if pursued, not by mere amateurs like myself, but by men of real scientific knowledge, would lead to most useful results. Science has done a good deal in teaching us how best to enrich our soils. Histology may yet throw valuable light on the processes, by which the plant takes up for itself the food we offer it. A close study of the mechanism employed by nature, will show to us in what form, and under what conditions, fertilizing matters can be best applied, so as to secure their most perfect assimilation.

Allow me also to say that, in my opinion, no student of animal physiology can pursue this course of research without being struck at every step with the very strong analogy existing between the development of vegetable and animal structure. I will not trust myself to enter into this subject further than to declare, that every day's work on vegetable structure has given to me a new interest in every page I read which relates to the structure of animal. I cannot but think we are approaching a time when the microscope, in the hands of men of science, will prove in these two fields of God's wonder working, the existence of a strictly analogous principle, developing and sustaining animal and vegetable life, with only that much of difference in the processes which the obvious purposes of the two existences would lead one to expect.

Since I have put to paper what I have now read to you, I have made a few preparations which I think it may be interesting to describe before I show them. I have stated my belief, that the roots of the wheat take in nourishment for the plant from the medium in which they grow, by means of their capsules, and those on their rootlets. I should have perhaps better expressed what I mean if I had said at these points of their structure. Wishing to make some experiments on the action of poisons, I grew a small crop in a strong solution of prussic acid with cyanuret of potash added to it, I found this gave a very vigorous growth to roots and leaves. Just as the root had acquired about four inches of length I applied my colouring matter to the fluid in which they grew; I wished to see whether this would be taken up anywhere but at the above points. I will show you that it was not, that the parenchyma or outer cell-texture is colourless, that the capsule-cells are strongly painted; that as they have pushed on nothing has been left in the matured cells *coloured* but very small nuclei, excepting only along the whole course of the vascular bundle; here what I call the pith-tubes will be seen to have imbibed the pigment, and it can be traced along their whole course, *i.e.*, along the whole course of the growth made since the solution was coloured.

There is another curious and, to me, most interesting result from this experiment. I have said, I believed the nuclei to be aggregations of the formative matter in plasm, I have also said that this plasm, though clearly elastic, at times gives the appearance, when broken up, of broken glass. Under the twelfth power, nuclei which I have managed to break within their cells, present the appearance of minute glass beads of coloured glass which have been crushed. It is true the nuclei grown in this solution differ from any I have before seen, in their extreme minuteness, the utter invisibility of the granules within them; still, there they are with their nucleoli in *situ.* The pigment has made them tell a tale which I scarcely think any other means would have extracted from them.

Note.

Since the above paper was read, at a meeting of the Microscopical Society, I have made some further investigation into the origin and growth of those vessels of which I have spoken, as pitted, scalariform, annular, and spiral. The earliest stage at which I can trace this vascular form, is in the shape of cell-wall, with very minute pits or depressions arranged in an order with regard to each other, either linear or spiral, the cells themselves being generally ovate. As soon as their *termini* become absorbed, and they thus become portions of a continuous tube, the pits are seen to enlarge and assume a long oval character; these pits are based with a very thin membrane, and in this a small dark spot is perceived, the commencement, as I believe, of actual perforation. At the next stage the entire basement membrane has become absorbed, and the perforation of the cell-wall is now complete in a series of oval apertures. In some instances these are so directly in line that, as they elongate and break into each other, the tube-wall is cut into straight lines, consisting of that part of its texture which existed between the original rows of pits; and thus those bars are produced which characterise the ladder-like tube seen in the root of the wheat, and in other portions of many plants.

For a considerable time I was perplexed by observing certain dots or circular spaces, whose close conjunction at the ends of the bars, formed as it were, the sides of the ladder of which the bars were the steps; I at length solved the mystery; I find these vessels, at that stage of their growth when they assume the scalariform appearance, are pentagonal, the dots being nothing more than the action of the light at the angles, the divided cell-wall being also at the said angles rather thicker than at any other portion. I have made preparations clearly proving this to be the case in transverse sections of these tubes. By tearing out the bars they come away in a ribbon of fibre, spiral, but yet such a spiral as would result from the twisting wire tightly round the surface of a pentagonal block of metal, and then unwinding it so as to partially release it from the form into which it had been thus forced.

The annular vessels—those in which distinct rings are seen—are formed upon a similar principle, but in this case the cell-wall is first pitted and afterwards perforated in true lines, and thus it becomes eventually cut up into ring upon ring; these are with ease separated, and are seen to be also pentagonal. Thus, from a mere dotted or pitted texture on the walls of the true cells, is produced; first the scalariform character, and this, according as the direction of the pits may be, assumes, when they run into each other, the spiral or angular form.

If one of these tubes is split up, or cut vertically, at that stage when the perforations are complete, the edges of the divided structure present a series of squared projections, with clear spaces between them.

With regard to the spiral fibre found at the very earliest stage of vegetable growth in the plumule, I cannot trace its formation; it seems to come to maturity simultaneously with the earliest growth of the vegetable substance in which it is seen, not being subjected to the same pressure as that I have described above, which grows more gradually, and is bound up in a mass of other cell-structure which has grown in advance of it; it does not assume the pentagonal form. I can form no theory as to its production; I cannot find it in the seed, but I find it complete at the earliest stage in which I can dissect any of the substance protruded.

I cannot discover any exterior wall or membrane enveloping these formations; I believe them to hold their position by being built in by the surrounding cell-texture of the plant; in the roots of plants they are themselves an external protection to the sap-tubes I ever find in the bundle formed by them. I have made several preparations of vascular tissue of the most eccentric form, such as I cannot resolve into either annular or spiral, I am inclined to believe that these are often the result of the pressure of the covering glass. I have never yet been able to trace any visible contents in any of these vessels.

On LAAP, *or* LERP, *the* CUP-LIKE COVERINGS *of* PSYLLIDÆ *found on the* LEAVES *of certain* EUCALYPTI. By THOMAS DOBSON, Esq., B.A., of the High School, Hobart Town. Communicated by GEORGE BUSK, Esq.

(Read April 30th, 1856.)

THE white saccharine substance called "lerp," by the Aborigines, in the north-western parts of Australia Felix, and which has attracted the attention of chemists, under the impression that it is a new species of manna, originates with an insect of the tribe of *Psyllidæ,* and order *Hemiptera.*

According to Latreille ('Dict. Classique d' Hist. Nat.' art. *Psylla*) only six species of this genus are known, and these are all proper to Europe.

The three species described in this paper are, in all probability, new to entomologists.

The larvæ of several insects avail themselves of their peculiar secretions to form a rude tent-like protection from their enemies and the weather. Those of the *Crioceres* are concealed under an irregular mass, having the appearance of macerated leaves. The *Cassidæ, Coccidæ,* and *Psyllidæ* are hidden under a cloak of white cottony filaments flowing from the articulations of the body. The *Psylla Eucalypti* enjoys a more profuse supply of glutinous pabulum than its European congeners, and is thus enabled to construct a more artificial and effective dwelling. It is, perhaps, owing to the remarkable dryness and mildness of the winter just past that these insects have been obtainable in their various phases of transformation at all times during the last four months. The white conical tents of the larvæ and pupæ may be readily detected on the leaves of the lower branches of the stunted gum-bushes in the Government domain here; the groups of minute ova are not so obvious, and the perfect insect is seldom seen abroad. It is more often met with in a quiescent state, after it has cast off its pupa skin, and while its wings are yet moist and shrivelled up. Its existence in the perfect state is either very ephemeral, or it escapes observation by its incessant restlessness, and the peculiar faculty of leaping, to which it owes its generic name.

To the unaided eye the eggs appear like small yellow granules scattered in groups on either side of the leaf, and unprotected by covering. (Pl. II, fig. 1.)

Under the microscope they are seen to consist of a translucent pyriform membrane inserted into the leaf by a pedicle, and containing an amber-coloured fluid of somewhat darker hue near the neck or fixed extremity. Just before the exclusion of the larva, the egg bursts longitudinally from its free extremity. The body of the larva is nearly transparent, except the eyes and dorsal vessel, and resembles in form that of the subsequent pupa. An early stage of the pupa's growth is shown in fig. 2. A thick uniform cylindrical thread of a transparent viscous fluid issues from the anal aperture, and terminates in a considerable globule.

Finer filaments proceed from between the rings of the abdomen, near the extremity of which are two principal excretory glands. At almost every articulation of the body and limbs the microscope reveals minute globules of this white fluid.

Four lateral tubular cases contain the rudimentary elytra and wings.

Fig. 2 also exhibits the first framework of the conical roof. Portions of the strong central thread have been turned up the back by the bifurcated tail, one extremity of each portion rests on the leaf, the others meet together and form a rough apex to the framework over the back of the insect. By turning round its body the finer filaments are passed from rafter to rafter in the inside, until they form an open basket-like covering, and combine into one thin glutinous cup-like sheet. The subsequently secreted fluid oozes out in drops at the base, and hardens and elevates the original roof on the wall formed by these accretions. This occasions the appearance of superposition, and the lateral displacement of the apex observed in most of the specimens of old lerp. (Fig. 5.)

When the pupa is about to undergo its final transformation, it escapes from its skin through a fissure down the back, eats its way out of the cone through a round hole, and leaves the skin within.

But when the base is not too firmly attached to the leaf, the pupa creeps out from beneath, and throws off its skin on the leaf. The perfect insect is represented in fig. 4. The antennæ are filiform, and have ten articulations. The two first are much shorter and thicker than the others, and the last is terminated by two hairs. Two elongated parallel tubes compose the "sucker," as it is improperly called, with which the insect pierces the leaf, and procures its juices. The eyes are prominent, globular, and compound. Immediately behind each eye is an *ocellus*. In many individuals a third ocellus appears in the central furrow which divides the head longitudinally, and therein they agree with the general character of the genus according to Latreille, Milne Edwards, &c.; but in others, as in fig. 4, this central ocellus is replaced by two ocelli separated by the furrow. This duality of organ accords well with analogy, and disposes me to believe that what has been hitherto considered a third central ocellus is really a combination of two minute ocelli, whose proximity and oblique position render them incapable of separation by our microscopes.

The wings are much longer than the body, and nearly colourless. The elytra are longer than the wings, almost of the same consistence, and deflexed. The abdomen is of a rich emerald green, and is terminated by two pointed projecting pieces, which play an important part in depositing the eggs and constructing the roof. The feet are furnished with two hooks, and a small membranous bladder. These vesicular appendages, as well as the antennæ, are continually in motion. The insect seems to prefer locomotion by running and leaping to that by flight. The male is somewhat smaller than the female, but presents no prominent difference in other respects. The description given by Dr. Anderson in the 'Edinburgh New Philosophical Journal' for July, 1849, of the form and structure of the small white cones, is sufficiently minute and accurate. The tuft of hairs seen on most specimens consists of portions of the thick central thread which have failed to retain their hold on the surface of the leaf. If Dr. Anderson is correct in stating that the saccharine taste of lerp is confined entirely to these external hairs, there must exist a remarkable difference between the usual excrementitious matter of which these hairs are composed, and that secreted and expelled from between the abdominal rings, &c. In insects which subsist on vegetable juices, the salivary vessels are developed in an extraordinary degree; and whether the fine silky filaments exude from the salivary glands, as in the caterpillar, or are elaborated by a special secretory apparatus, it is quite conceivable that their nature may be very different from that of the excrementitious matter which has been subjected to the action of the various organs composing the intestinal canal. The ants are extremely fond of lerp; and the beautifully marked spider whose dwelling is a gum-leaf folded and laced together by white threads, has generally one or two tenanted cones and a large ball of fluid lerp within its abode.

I have recently met with another species of *Psylla* located on the red-curled leaves at the extremities of fresh young shoots, and protected by a different kind of lerp. The edges of the leaf are turned over so as nearly to meet; and within each of the two grooves thus formed is a series of white opaque shells of an elongated oval shape. (Fig. 3.)

They are of a waxy consistence, and tasteless. The lower part is a thin film adhering to the surface of the leaf; the upper is much thicker, and covers the insect enclosed as in a bivalve shell. Overlapping each other like the scales of a fish, the upper valves form two rows down the sides of the leaf. The perfect insect (fig. 7, nat. size) is about one half larger than the cone-forming *Psylla,* the head and prothorax are of a bright yellow, the remaining segments of the thorax are dark brown, the abdomen a yellow green, and the elytra yellow, with two elongated dark brown spots at each tip.

When my attention was first directed to this subject, more than four months ago, I found, besides the common white lerp and its occupant, a larger and differently coloured lerp, with its peculiar *Psylla,* surpassing in beauty and structural development the species already described. The eggs of this third species are of a deep black-red colour, sometimes disposed in groups, sometimes isolated, and occasionally on the same leaf as those of the first kind. The colour of the larva is a reddish brown. The first shell-like coverings are little transparent, and in many parts quite opaque and dark brown. Its form is remarkably like to that of one valve of a cockle-shell. (Fig. 5.) The apex or hinge is always well attached to the leaf. As the insect grows, the digestive or secretory functions seem to be more perfectly performed, and the material of the covering become of a rich canary-yellow colour, and very translucent. The shell of yellow lerp varies in diameter from one third to one half of an inch.

The strong threads all rise from near the point of attachment, which is at the cleft of the heart-shaped base, and arching over meet the leaf.

Around this fixed point the leaf is always more or less dried up and discoloured. A thick tuft of curling hairs rises from the neighbourhood of the apex. The finer striæ, which are disposed parallel to the surface of the leaf, and line the roof, are quite distinct and separate from each other. Around the base is a broad flat band of an open reticulated texture. A white filmy carpet, composed of extremely fine threads crossing in all directions, completes the interior of this beautiful structure. The pupa and perfect insect are twice as large as those which fabricate the white lerp.

The head and thorax are more highly coloured, and the abdomen of a warmer green. (Fig. 6.)

The elytra and wings are diaphanous, but the wing-cases of the pupa, and the elegant symmetrical nervures of the elytra of the perfect insect, are of a bright scarlet colour.

[Under each of these limpet-like coverings there is usually found one or two little drops of a thickish, nearly transparent, and sweet fluid, like honey, deposited there no doubt by the insect after enclosing itself, to become a resource probably in case of protracted imprisonment from any unfavorable state of the season as to temperature, humidity, &c. The insect would appear to be very susceptible to changes of temperature, and perhaps to atmospheric influences generally; for I have observed that, when a twig having leaves, with the white cones plentifully scattered over them, is brought in and kept for a few hours in a warm apartment, the perfect insects disengage themselves and are seen to flit about in numbers. —J. M.]

The foregoing Paper, which was originally read before the Royal Society of Van Diemen's Land on the 11th of September, 1850, and published in the 'Papers and Proceedings' of that body, Vol. i, part iii, p. 235, was brought before the Microscopical Society by Mr. Dobson on the 30th of April, 1856, and he at the same time exhibited numerous and well-preserved specimens of the yellow variety of Lerp, a form which appears hitherto to have been undescribed. The variety examined and described by Dr. Anderson ('Edinb. New Philosophical Journal,' July, 1849) was of the white kind, and, as it would now appear, the product of a distinct species of *Psylla*. To Mr. Dobson, therefore, is due the credit of describing three distinct species of *Psylla* and two additional forms of lerp, and of ascertaining, beyond doubt, the correctness of Mr. Newport's surmise that the substance itself is produced by the insect, and is not a mere exudation of the plant. Mr. Newport, however, seems to have been ignorant of the true position of the insect by which this production is afforded.

The comparative novelty of the subject, and the importance of Mr. Dobson's communication, which appears hitherto to have wholly escaped the notice of entomologists in this country, appear to afford sufficient reason for the republication of his Paper in the 'Transactions of the Microscopical Society.' The figures, with the exception of figs. 8 and 9, are taken from those given in the original paper. The two additional figures were prepared from specimens of yellow lerp, kindly afforded to Mr. Busk by Mr. Dobson for examination.

In this examination the points to which attention was more particularly directed were—

1. The structure of the yellow conical crusts.
2. The chemical reactions of the substance of which they are composed.

1. The general appearance of the crust is that of a more or less conical dome, the apex of which is usually excentric. The surface is covered with long, shaggy, hair-like fibres, and the whole is of a canary-yellow colour and brilliant appearance, like that of spun glass or sugar. The cup is very loosely attached to the inferior surface of the leaves of a species of *Eucalyptus,* and the substance is very brittle. A portion placed on the tongue affords a sweetish taste.

The texture of the crust, examined under a low power, very closely resembles that of the sugar-baskets made by confectioners, and the mode in which it is constructed would appear to admit of explanation upon the supposition that the larva throws out loop over loop of a glutinous material much in the way that an artist in glass constructs his fragile toys (fig. 8). The insect, however, follows a definite plan in its operations; for the edge of the limpet-shaped crust is pretty regularly dentated, the dentations being all very nearly of a length. From the point of each dentation two divergent branches arise, which meeting with those springing from the adjoining dentations, a second dentation opposite the interval between those of the former row. In this way more or less regular reticulations are formed, across which slender threads of the same substance are drawn in the most irregular manner. This structure is also shown in fig. 8. The older or more central part of the dome is thickened by subsequent deposition, and the interstices in this way become nearly filled up. The outer surface of the cone is beset with numerous long, curved, hair-like processes of a very curious conformation, and one not very easily accounted for. Each hair, which in length may equal the semidiameter of the cone, arises abruptly from one of the thicker trabeculæ, and is of pretty uniform diameter throughout. Its surface, however, differs very remarkably in different parts. Towards the point (fig. 9 *a*) it presents a moniliform appearance, and is otherwise smooth and polished; and in this part it is usually somewhat compressed. This condition exists for about one sixth of the length of the hair. In the remaining portion the surface is marked by fine longitudinal crenate ridges (fig. 9 *b*), which present a beautiful appearance under the microscope. The hair is apparently solid and homogeneous throughout, and certainly not tubular as stated by Dr. Anderson.

2. With respect to the chemical composition of the crust, it would appear, from the action of reagents, to present all the properties of pure *starch*. It is turned blue by iodine, is unacted upon by cold water, and with difficulty dissolved in boiling water, and then not wholly, a sort of membranous residue being left as in starch grains. Alcohol and ether in the cold have no effect upon it. The sweetish taste perceptible when a portion of lerp is placed upon the tongue may probably be due to the rapid conversion of the amyloid substance into sugar, under the influence of the saliva.

In the Paper by Dr. Anderson, above referred to, a more complex composition is assigned to this substance. But it is not improbable that the samples of lerp operated on by that chemist might have undergone some change, and thus have contained more highly oxidized compounds than appear to exist in the unaltered crusts. One thing is perfectly certain, that the entire substance is coloured blue throughout, and homogeneously, by a watery solution of iodine, and that in *cold* water no change whatever is effected in it. Dr. Anderson's statement, moreover, that starch grains, in the usual sense of that term, are contained in lerp, does not accord with our observations either upon the white or yellow kinds. The substance, in short, appears to be constituted of a homogeneous amyloid substance which, from its morphological characters, would seem to be spun out of the body of the larva in a semifluid or glutinous condition, and afterwards to harden into the transparent vitreous substance of which the crusts are composed.

Dr. Anderson states that the lerp (white) examined by him consisted of—

Water . . .	15·01
Sugar (grape) .	49·06
Gum . . .	5·77
Starch . . .	4·29
Inulin . . .	13·80
Cellulose . .	12·04
	100 00

The fact that many species of *Psylla* and other homopterous insects afford starchy and sugary secretions is notorious, though no very precise chemical examination of most of these substances appears hitherto to have been made. A familiar instance of the kind is presented in the *Honey-dew* of the *Aphis*, a genus very closely allied to *Psylla*. The larva of *Psylla Betulæ*, according to Mr. Curtis, and of other species of the same genus, is covered with a white cottony secretion, and their excrement (as it is termed) is said to form threads or masses of a gummy sucreous nature. But an observation most to the point as regards the present subject occurs in the 'Mémoires pour l'histoire des Insectes' of the illustrious Reaumur (tom. iii, p. 357, pl. 29). In his description of *Psylla Buxi*, he says, "Il parait porter au derrière un morceau de vermicelli, dont la figure a été mal moulée, car la couleur comme la figure de cette matière ressemble assez a celle de la pâte filée appellée *vermicelli*." He notices further that "il sort de l'anus," and that it dissolves on the tongue, having a taste "un peu sucré et qui est agréable; c'est un espèce de manne qui n'a pas les désagrémens de la manne ordinaire." He observes also, that there would be no difficulty, in many places, in collecting this sort of sugar in considerable quantity.*

In conclusion, it may be remarked, that the "Lerp" would appear to be a substance well calculated to form a substitute for sugar or malt in distillation. It would seem to occur in sufficient quantity to render it worth collecting for such a purpose.

* Appended to this account of *P. Buxi* is a figure of the larva, in the act of manufacturing the *vermicelli*, which so closely resembles the central larva in fig. 2 that the latter might almost be deemed a copy of it.

MICROSCOPICAL SOCIETY.

February 11th, 1857.

George Shadbolt, Esq., President, in the Chair.

This being the annual general meeting of the Society, the following Reports of the Council and Auditors were read:

"The Council in accordance with their usual custom have to make the following report on the progress and present state of the Society.

"The number of members reported at the last anniversary was 241, including two associates and two honorary members; since that time 30 ordinary members have been elected, making a total of 271. This number must, however, be reduced by three deceased and one resigned, leaving a final total of 267. The Council have, therefore, to congratulate the Society on the steady increase of the number of its members. The library has been increased by various donations; but with regard to the collection of objects, the Council have to express their regret that but one addition is recorded to have been made to that important department of the Society's property, and trust that on the next occasion they shall be enabled by the liberality of the members to present a more favorable report.

"The Auditors' Report, which follows, gives the state of the finances, which the Council are happy to state appear to be in a prosperous state, the balance in the treasurer's hands being £51 16*s.* 9*d.*, an increase of about £21 on the last year's balance.

"The 'Journal' has been distributed gratuitously as usual, and arrangements have been lately made by which it is expected the members will be enabled to receive it as it may be published in a more satisfactory manner than heretofore."

Dr. From February 27, 1856, to February 11, 1857. **Cr.**

				£	s.	d.
Balance from the previous year				37	14	4
For entrance of members				54	12	0
Compositions (which have been invested) as per contra				21	0	0
Annual payments—						
For 1854	2	2	0			
1855	11	11	0			
1856	24	3	0			
1857	127	1	0			
1858	5	5	0			
				170	2	0
Copies of 'Transactions' sold, deducting commission and advertising				3	9	6
Two dividends on 3 per cent. consols to January, 1857				10	4	2
				£297	2	0

	£	s.	d.
By Rent of room, one year	30	0	0
Salary of Curator	4	4	0
Assistant-Secretary	21	0	0
Stationery, postages, carriage, &c.	10	2	10
Ray Society	1	1	0
Commission to Collector	12	5	6
Purchase of consols	20	0	0
Transactions	91	2	0
Printing (Newman)	9	16	0
Repairing microscopes	4	7	0
Expenses of soirée, gas, oil, and attendances	34	6	11
	238	5	3
Balance	58	16	9
	297	2	0

11*th February*, 1857.

M. S. LEGG, } *Auditors.*
W. H. INCE, }

The President then delivered the following address.

The President's Address *for the year* 1857.

By George Shadbolt.

Ever since the formation of the Microscopical Society, it has been the undeviating custom for the president at each recurring anniversary, to present to the members a species of intellectual balance sheet, or rather profit and loss account of the acquisitions to microscopical science during the past year.

It is not without some considerable diffidence that I enter upon this duty, especially retaining, as I do, a vivid remembrance of the masterly and comprehensive productions of my immediate predecessor in this chair, Dr. Carpenter—a gentleman pre-eminently qualified for such a task; but as the performance of it by the individual who has the honour to fill the presidential office for the time being is imperative, I shall proceed to do so to the best of my ability, without further hesitation, trusting to your indulgence for any shortcomings of which I may be guilty.

Since our last anniversary we have held as usual eight ordinary meetings, at which have been read *eleven* original papers, *one* repetition of a paper which had previously appeared in a colonial publication devoted to science, and *two* reports from sub-committees appointed by the Council to make special recommendations upon points connected with subjects upon which uniformity of system seems to be desirable. I cannot therefore consider that the session has been by any means a barren one, in quantity at least; neither will a close investigation of the quality of the matter afforded for our mental repast prove less satisfactory.

At all of the meetings, very animated and instructive discussions upon the subjects of the various papers have also taken place, and it is much to be regretted that the income of the society is not sufficient to permit of measures being adopted for securing a permanent record of much valuable information that is thus drawn forth.

It is true that at *two* of the meetings we were unsupplied with any paper, in consequence of illness in one case, and professional engagements in another, interfering to prevent the preparation of matter provisionally promised; but even under these adverse circumstances discussions upon subjects interesting to the followers of microscopical science spontaneously arose. It is manifestly impossible for the Council as a body to undertake the *manufacture* of papers, as even if practicable, the quality of such productions under pressure would in all probability be of a very inferior character—it is to the members alone that we can look for such papers as are of general interest; the *raw material*, if I may so term it, in the shape of observations, exists in abundance, and requires simply recording upon paper to render it available as a source of much profit to all concerned.

I cannot refrain from remarking, that in transmitting an article to the 'Journal' alone, one source of fruitfulness is entirely disregarded; the mere reading of such in our society appears to communicate an impulse to the auditors to go and do likewise, which is further strengthened by discussion. But in order to obviate any inconvenience from the absence of communications at any of our future meetings, it has been decided by the Council, that at each one a *special subject of discussion* shall be announced from the chair, to be entered into at the *following assemblage;* and thus it is hoped that those interested in the subjects selected, will have some inducement not only to attend and bear a part in such consideration, but also to collect such facts that fall in their way, or may be able to educe, as are in any way connected with it.

Any papers that may be received will take precedence of the subject proposed; but should there be *no* papers the discussion will then be the special occupation of the evening.

It is hoped that by this measure, not only will an awkward hiatus be avoided, but that the various suggestions thrown out will tend of themselves to give rise to the production of more formal communications.

Of the eleven original papers read at the various meetings the classification is as follows, viz.:

On Animal Physiology	2
On Botany and Vegetable Physiology . . .	6
On Manipulation and Microscopic Adjuncts . .	3
	11

The two reports belong also to the latter class, and the paper alluded to as a repetition may be classed with the first named, making in all a total of 14.

I may also mention that in one of the papers classed amongst the botanical, certain speculations relative to geological science are included.

Of these relating to Animal Physiology, the first in order was from the pen of Mr. Bowerbank, "On the structure and vitality of the Spongiadæ," consisting of the substance of some observations presented at the last meeting of the British Association, at Cheltenham, together with a considerable amount of new matter since ascertained. In this paper the author endeavoured to show that sponges consist principally of *sarcode,* strengthened sometimes by a species of siliceous or calcareous skeleton, having remarkable reparative and digestive powers—and consequently a most tenacious vitality.

As an instance of the singular powers of reparation, he mentioned that having sometimes cut a living sponge into *three segments* and *reversed the position* of the centre piece, after the lapse of a moderate interval a complete junction of the parts became effected, so as to render the previous separation indistinguishable.

This paper was not permitted by the author to appear in the Transactions of the Society, being still in an incomplete state, further investigations upon the subject being also in progress.

The paper by our respected secretary, Mr. Quekett, "On the white substance surrounding the Coccus infesting the Vine," contained, as might have been expected, many interesting observations, especially as regards the wax-producing organs of insects; but as our knowledge in this direction is still very rudimentary, I cannot forbear urging those who are in want of a *special* object for the exertion of their microscopic energies, to turn their attention to so promising a field for useful results.

Somewhat connected, as regards the subject, with the preceding paper, is that communicated by Mr. Busk—originating with Mr. Dobson, of Hobart Town, and previously published in the 'Proceedings of the Royal Society of Van Diemen's Land,'—On Laap, or Lerp, the cup-like coverings of Psyllidæ found on the leaves of certain Eucalypti." To this paper was appended some remarks and observations on the structure and chemical nature of the said coverings, by Mr. Busk, which that gentleman describes as closely resembling the sugar baskets made by confectioners, and consisting chemically of nearly pure starch, not indeed in a form in which that material is usually met with, but constituted of a "homogeneous amyloid substance," affording a sweetish taste when applied to the tongue, probably being converted into sugar under the influence of the saliva. Under the action of iodine and other reagents it comports itself precisely as ordinary starch; but the point of special interest appears to be the fact of its production by *animal* agency, and though of course it is not unreasonable to conclude that it is primarily derived from the vegetable substances on which the animal feeds, its subsequent elimination in a form in which the chemical properties are persistent is somewhat singular.

As it appears from Mr. Dobson's observations that the substance occurs in *considerable quantities,* Mr. Busk suggests that it might be worth collecting for the purpose of using in distillation as a substitute for sugar or malt.

Amongst the papers classed under the head "Botany and Vegetable Physiology," the first that claims our notice is that by Dr. Gregory, Professor of Chemistry in the University of Edinburgh, "On the Post-tertiary Diatomaceous Sand of Glenshira."

This is a continuation of a paper commenced in the preceding year, containing a description of upwards of 200 known species of Diatoms, together with some twenty or more previously undescribed. The present one adds many more new species to the list, while that of the known forms is also extended, making a total of some 300 already observed in this gathering, unparalleled for richness of yield, and which the author intimates will require another paper to complete the description. It appears that about 600 slides have been carefully examined, a task, however delightful, that must have been intensely laborious; only those who have worked in this particular field can be fully alive to the amount of labour required.

Dr. Gregory is doing good service, not only in making us acquainted with new forms, but also in a point of equal importance, that of drawing attention to the *variations of form* occurring in the *same species,* in a similar manner to that adopted by our late president, Dr. Carpenter, as regards some of the Foraminiferæ. In fully working out a subject of the kind under consideration, it is not the larger and more striking forms (the most elaborate, if I may so term them) that occasion the greatest amount of labour, but the more minute and abundant ones, the οι πολλοι, where some ten or a dozen dissimilar forms, to the careless observer, appear as one species, until certain slight but constant peculiarities are discovered to predominate in some individuals.

In investigating the smaller Diatoms, especially those with minute markings, great assistance may be derived by using a *moderate* power and noting the peculiar colour assumed by the frustules, as was pointed out by Professor W. Smith. The colour being due not to any inherent dye, but to the well-known property of fine, close lines in producing apparent colour by *interference of the undulations of the luminous rays;* hence the tint assumed is to a certain extent an indication of the mutual proximity or remoteness of the markings on the various frustules.

The next paper on my list is Professor Henfrey's "Notes on some fresh-water Confervoid Algæ, new to Britain," being descriptive accounts of the *Pandorina morum* of Ehrenberg, the *Apiocystis Brauniana* of Nägeli, and the *Clathrocystis æruginosa,* Henfrey = *Microhaloa æruginosa,* Kützing, which that observer can only have seen, as Mr. Henfrey considers, in a dried state, as it does not agree with Kützing's description of the genus referred to.

As might have been predicted, Mr. Henfrey's descriptions are careful and minute; he has, however, erred in classing *Pandorina morum* amongst the Algæ *new to Britain,* it being one that I myself, and I believe many other microscopists, have met with very frequently for the last ten years or more. Mr. Henfrey has, however, corrected the inaccurate account of the organization that was hitherto generally received.

It will be as well to consider the *three next* papers together, for though each has its distinctive peculiarities, they all bear closely upon the same important subject, viz., the early stages of the vegetable cell.

The papers are—"On the Vegetable cell," by Mr. F. H. Wenham; "Brief remarks upon Cell-growth in the *Bryonia dioica,*" by Mr. Norris F. Davey; and "Vegetable Cell-structure and its formation, as seen in the early stages of the growth of the Wheat plant," by the Hon. and Rev. Sidney Godolphin Osborne.

All of these papers tend to controvert the cell-theory of Schleiden and Schwann, so far as the doctrine of multiplication by self-division from unity is concerned; and from the careful observations made by Mr. Wenham on the *Anacharis alsinastrum,* an aquatic plant, *confirmed* by those of Mr. Davey on a terrestrial one—the *Bryonia dioica*—it is abundantly manifest that *simultaneous development* of many cells obtains, as one mode, at least, of increase. Of course it is not contended that increase by simple division does not take place, but that this is not the only, or, according to Mr. Wenham, the principal method of multiplication. When a somewhat startling statement is made by a microscopic observer, the first question which naturally occurs to the mind is this, Does he understand the manipulation of the instrument? and the next, Can he rightly interpret what he sees? Now every one who is familiarly acquainted with Mr. Wenham, must, without hesitation, answer both these questions in the affirmative; but we do not stop here—his observations, as far as facts are concerned, are confirmed by those of Mr. Davey, and to a great extent by those of Mr. Osborne. Of course much misunderstanding might arise in a question of this nature as to the true definition of a vegetable cell; but as my predecessor entered at length upon the question in his address last year, I cannot do better than recommend a re-perusal of that document, containing, as it does, a most lucid disquisition upon the subject.

I should have before remarked that Mr. Wenham's paper was partly in reply to some animadversions on his statements in a previous paper, and partly a continuation; while Mr. Davey's was confessedly the result of investigations upon a different kind of plant, undertaken with the special object of testing the accuracy of Mr. Wenham's revelations.

I have hitherto said but little respecting Mr. Osborne's paper; not because it is in any way contradictory to the theory promulgated by Mr. Wenham; on the contrary, strongly confirmatory of the same: but it actually describes the *simultaneous formation of numerous* cells from the protoplasm direct, not as an accessory, but as a prevailing mode of production in the embryo plant.

This admirable paper is one of the highest interest, characterised by acuteness of research, accurate illustration, and novelty of manipulation, the author having successfully introduced colouring matter into the cell-structure in such a manner as to reveal secrets in Nature's handicraft otherwise unattainable. Those who take a special interest in this much contested question would do well to refer to figs. 32 and 33, Pl. V, of the illustrations, and page 112 of the text, to see how positively Mr. Osborne affirms the simultaneous development theory.

As a finale to the papers belonging to this section, we have Professor Quekett's, "On Fungoid Growth in decayed and living wood." The author shows how much unsuspected injury to the timber may arise from broken branches, or injudicious pruning of trees, when the circumstances are such as to afford favorable conditions to the growth of fungi; and in many cases the thread-like fibres of mycelium can be traced permeating every part of the trunk and branches. An opinion was also expressed as to the cause of attraction to wasps, presented by hollow trees, being the dried whitish substance of the fungus alluded to, which, on examination, appears identical in structure with the material of which the cellular nests of these insects are composed.

The reading of the latter paper gave rise to some short observations from our assistant-secretary, Mr. Williams, on a fungoid disease of the grape vine, as noticed by him some years previously.

In the manipulatory and mechanical department, we have from Mr. Wenham a paper "On a method of Illuminating Opaque Objects under *the highest* powers of the Microscope." This is a problem, the solution of which has been attempted by numerous adepts in manipulation with only very partial success, until Mr. Wenham accomplished it by means as ingenious as they are simple. Of course, with a one-twelfth objective, or any higher power, the use of a Lieberkühn is simply an impossibility, while a plane reflector, as previously suggested by Mr. Brooke, reflects the light too feebly to be of service in most cases; and furthermore, there is no very ready means of *intercepting the transmitted* ray when a plane reflector is used. Mr. Wenham's happy idea of making the *upper surface* of the *thin glass* covering of the object its own reflector, by *internal total reflection*, not only enables us to illuminate with the requisite brilliancy, but also renders available objects *mounted in balsam*, or some other medium, which would otherwise often be useless for examination by very high powers. The principle involved precludes the use of specimens that are mounted dry, for this method of examination; to those who are acquainted with optics the reason will be at once apparent; to those who are not the explanation would be tedious, and occupy more time than could be reasonably devoted to it this evening.

From Mr. Hislop we have been favoured with the description of a piece of apparatus for compressing objects while being mounted; and Mr. Farrants furnished a paper "On defining the position and measuring the magnitude of microscopic objects." This latter being a subject that has occupied the attention of many microscopists recently, it was thought desirable to appoint a committee to consider and report upon the best form of a *universal finder*, so that an object being noted by one operator, might readily be found by others, although by a different instrument and apparatus. The report of the committee will be found in the 'Transactions,' and fully carries out the conditions imposed.

The consideration of this question involved another point of scarcely less importance, or rather gave rise to its consideration; the desirability of inducing the various instrument-makers to adopt one uniform size and mode of attachment for objectives, so that they may be used upon various instruments indifferently without the aid of *adapters*, these being found to interfere very materially with the correct performance of the higher powers especially. A satisfactory report upon this point also appears in our 'Transactions,' and I cannot but congratulate my brother-microscopists upon the prospective comfort we may shortly hope to enjoy in consequence of the adoption of its recommendation.

In considering the sum of our doings, one cannot help remarking that research upon vegetable far preponderates over that on animal physiology, which is somewhat noticeable when we consider the number of members attached to the medical profession upon our list; but we also perceive that there are some subjects in particular in which very much more might be done. I will indicate a few of these, in hopes of inducing some of our most zealous operators to enter into "pastures new." To begin with, there is a large class of marine productions known generally as *Nullipores,* of which very little else is known, or if known, not recorded—and offering a wide field for research. Again, amongst lichens, mosses, and the more minute cryptogamic forms, there is still very much to be done.

In entomological science we rarely have observations, and when these do occur, they are not often more than isolated facts; that is, not connected directly with any *systematic* inquiry into special matters of obscurity. In this science especially much good might be done by a careful examination of all species known under the general name of *blights,* for though *much* concerning them may be known to entomologists, I am convinced that there is *much more* that still remains unknown, and is likely so to remain without microscopical aid. And lastly, during the forthcoming spring, I would urge upon those members whose special study lies amongst the Desmidiæ, the great interest attaching to the subject of the development of these Algæ from their spores, a phase in their history still involved in considerable obscurity.

I have to mention the names of three of our members who have been removed from amongst us by the hand of death, viz.—F. J. Bell, F.G.S., E. Allcard, F.L.S., and George Gwilt, F.S.A., &c., of whom the two latter were members at the original formation of the society. Mr. Gwilt, besides being an accomplished scholar, was an architect of no mean pretensions, an astronomer, an archæologist, and deeply versed in the science of numismatics.

As regards the progress of microscopical science, its great importance as an accessory in all branches of natural history, in medical jurisprudence, anatomy, geology, &c., is all but universally acknowledged; hence the rapidly increasing number of our members, which now amounts to 267, being 26 more than at the corresponding period of last year; while the large number of superior instruments sent out by our three most celebrated opticians, viz., Messrs. Powell and Lealand, Andrew Ross, and Smith and Beck, during the past year, testify to the fact that *quality* is in equal estimation with quantity.

The *three* makers just named have supplied, during the past year, no less than 217 instruments of the higher class; whilst the last-mentioned firm has *also* sent out 175 educational microscopes, of which 60 only were of their cheapest kind, making a total of no less than 392 instruments fitted for accurate scientific investigation.

But even this number, large as it is, does not comprise the whole, or anything like the whole, of those that may fairly be classed under this category; for there are now in London alone several makers who, though they may not as yet attain to the excellence of those already quoted, are treading so closely upon their heels, that the productions of those in the *second rank* closely approach those of our first makers *as they were some few years ago.* Consequently, to comprehend the entire quantity of real working microscopes put into circulation for the last twelve months, we should add those supplied by Mr. Salmon, Mr. Amadio, Mr. Ladd, M. Pillischer, and some others. The four makers quoted have collectively issued 115 of the large instruments, and 243 students' and medical microscopes; consequently this number, added to the 392 previously quoted, gives us a total (a *mininum* total) of 750 brought into operation in one year; for there are doubtless some not included in this list,—and be it understood that the whole of these were effective, working instruments. Surely this plentiful sowing ought to make us reap plenteously.

With such exquisite microscopes as we have been for the last few years in the habit of using, anything like improvement might almost be regarded as "gilding refined gold;" yet progress has been made even here, and still the cry is "Excelsior."

Messrs. Powell and Lealand have made an objective of *very high quality,* equivalent to $\frac{1}{16}$ inch of focal distance, of very large aperture (alleged to be of 175°—but of this hereafter)—which for performance is deserving of the highest praise.

Mr. Ross has constructed a $\frac{1}{8}$-inch object-glass of 140° angular aperture, having that great desideratum, a *reasonable distance from the object under observation,* and that possesses very fine defining quality, uninjured by *an extraordinary* amount of power in the eye-piece.

Mr. Thomas Ross has also effected a *considerable* increase in the apertures of the lower powers, having availed himself of the advantages to be obtained from the various qualities of glass which can now be procured, together with certain facts developed during his researches connected with the improved construction of lenses for photographic purposes.

The aperture of the $1\frac{1}{2}$-inch objective now extends to 20°, while the 3-inch, 2-inch, 1-inch, and $\frac{2}{3}$-inch have a corresponding increase, and all bear well the very severe test of an unusually powerful eye-piece, thus also affording to the microscopist an additional range in the choice of amount of amplification.

Messrs. Smith and Beck have also extended the aperture of their $1\frac{1}{2}$-inch objectives from 14° to 20°.

I have also had the pleasure of examining, with great care, two object-glasses of high power, constructed by a gentleman to whom microscopists are deeply indebted, who has not only favoured us with the result of important investigations relative to vegetable development and other subjects, but who has done more to stimulate the professional opticians to elevate the standard of excellence, as regards their manufactures, than any other microscopical devotee. I allude to Mr. F. H. Wenham, whose absence from our gatherings, though only temporary, is a source of regret to many. Mr. Wenham's mechanical skill and persevering industry, conjoined with an ardent zeal for the prosecution of science generally, have enabled him to compete successfully with our first makers; and the two object-glasses in question are such as would be coveted by the most fastidious. The one is about equal to $\frac{1}{14}$ inch focus; the other, according to my calculations, about $\frac{1}{20}$, though the artist himself calls it $\frac{1}{25}$; but be this as it may, with an aperture of only 150°, its performance is of the very highest order and beyond all praise.

In both of these lenses, Mr. Wenham has adopted a variation upon the usual method of adjustment for thickness of glass covering to the object, which, in my opinion, deserves imitation by our professional opticians. The improvement I mean consists in *two points*, viz., in causing the *back combinations* of the lens to be the moveable portion instead of the front as is usually constructed; and secondly, in allowing the motion to be more rapid, the whole movement of which it is capable being effected by a quarter turn of the collar. Thus constructed, the requisite adjustment can be made with greatly increased facility, and, with the assistance of the ordinary fine adjustment, *without losing sight of the object under examination* during the operation, an amount of convenience not to be credited but by those who have worked with both kinds of objectives.

From the remarks that I have made upon aperture, it will be perceived that I differ materially from my predecessor in my appreciation of this element of utility in a microscopic object-glass.

It is perfectly true, as stated by Dr. Carpenter, that with an objective of *large* aperture the perfection of its delineation is more confined to *one plane*, and that consequently a *general view* of the object under consideration cannot be so well attained; and secondly, that the manipulation is much more difficult with an extended than with a contracted aperture.

The very delicacy of one's tools of course demands an extra amount of skill in their use; but is it not possible to unite the advantage of a large aperture with the convenience of a moderate one in *the same object-glass?* To this an affirmative reply may be given; for I have in my possession objectives made for me by Messrs. Smith and Beck, with a diaphragm removeable at pleasure, so that for objects requiring aperture for their definition, that quality is attained with the most trifling amount of trouble to the manipulator, while for general use the aperture is contracted within moderate limits. Of course such a construction, to be effective, involves the proper correction for *large* angular aperture, in which case the lens will perform equally well when it is temporarily reduced. Messrs. Smith and Beck have fitted object-glasses in a similar manner for others besides myself, and I cannot but think it would be a great convenience if the higher powers especially were usually provided with this adaptation.

A comparatively large aperture in the lower powers is useful in two ways, both in consequence of the extra amount of light transmitted, first, in examining *opaque* objects, which with such lenses scarcely require any aid from a condensing lens for illumination; and secondly, the flood of light permitting the use of greater power in the eye-piece without too much reduction of brilliancy of the image, thus allowing, for a given amount of magnitude, the use of an objective of lower power than would otherwise be requisite, and consequently, what is sometimes of importance, a greater distance between the object and the lens.

While on the subject of aperture, I cannot refrain from remarking, that I am convinced that in many cases *some considerable error* has been committed in the measurements taken. To satisfy any one of this, it will only be necessary to look at the size of the *front lens* of a $\frac{1}{12}$ or any higher power, when it will at once be evident, by a very simple calculation, that for such a lens to refract a ray of light incident upon it at such an angle as will produce an aperture of 175°, the lens itself must be in *absolute contact* with the object, and no allowance made for the most trifling amount of *fitting* to hold the lens itself in place.

I may remark also, that some of the most marvellous statements made as regards enormous aperture, have been attached to lenses produced on the other side of the Atlantic Ocean; but I am quite unable to ascertain anything approaching to a verification of such statements; and while I know of *several occasions* when special arrangements have been made for comparing the merits of English and American lenses of the highest character, I am unaware of any instance in which the former were worsted; for it has always so fallen out that some untoward event has prevented the actual comparison from being carried out, *though English* lenses have been ready, and English operators eager for the contest.

It is, however, high time for me to pause; I fear, indeed, that a subject so congenial as the optical qualities of our favorite instrument has already seduced me into trespassing too long upon my auditors' patience.

I have to express my great regret that as regards our collection of *objects,* we have the very insignificant number of 340 only—a number that would be regarded as small indeed by *many,* if not *most,* of our members for their own collection. Surely then, as a society, this ought not to be, and I trust that the mere mention of the fact will be enough to cause this reproach to be speedily wiped away.

In conclusion, therefore, let me express a hope that our members will not forget that it is to themselves alone that we look for the means of sustaining the interest of our future meetings.

The Society then proceeded to the election of officers and council for the ensuing year, when the following alteration in the bye-laws was resolved upon, viz.:

That in page 6 of the regulations of the Society, the following alteration be made in the sixth line from the top: instead of the word Secretary, the words "two Secretaries" be inserted, and that in the succeeding regulations the corresponding alterations be made where necessary.

It was afterwards resolved—

That George E. Blenkins, Esq., be proposed as Joint Secretary with Professor Quekett, in accordance with the before-mentioned alteration in the laws.

At the close of the ballot, the following names were announced from the chair, as having been duly elected to their several offices for the ensuing year:

President—George Shadbolt, Esq. *Treasurer*—N. B. Ward, Esq. *Secretaries*—Professor Quekett; George E. Blenkins, Esq.

Four Members of Council—T. H. Huxley, Esq.; E. G. Lobb, Esq.; W. Peters, Esq.; J. H. Roberts, Esq. In the place of Dr. L. Beale; C. Brooke, Esq.; J. N. Furze, Esq.; Dr. Lankester; who retire in accordance with Rule VII.

The Rev. T. Wiltshire, M.A., Rectory, Bread Street Hill; Dr. Cobbold, 27, Upper Seymour Street; James Wyatt, Esq., Coldstream Guards; James Macgregor, Esq., 55, York Terrace, Regent's Park; Joseph Moore, Esq., Grasmere Lodge, Lower Tulse Hill; were balloted for and duly elected members of the Society.

The meeting was then adjourned to a soirée, at which about 350 persons were present.

On a Diatomaceous Deposit *in* Leven Water, *near* Coniston.

By Amos Beardsley, F.L.S., F.G.S., &c.

(Read March 4th, 1857.)

Leven Water is a mountain tarn, a large sheet of water embosomed in the rocks to the north of Coniston Old Man. When full it covers a surface of about eighty acres, and is about twenty fathoms deep. The rocks surrounding this tarn are chiefly composed of hornstone, porphyry, and trap. It is about 1300 feet above the sea-level. The mountains surrounding are for the most part on the north, north-east, and west sides. When visiting this water, in company with some friends, I observed the bottom of it to be entirely covered with a blackish pulverulent deposit, and from a careful examination on different sides of the lake, I found that this deposit extended all round, and though of various thickness, yet in every part it was some two or three feet thick, whilst in others I ascertained it to be six or eight feet. It appeared to be thickest in the vicinity of the rills or streams that, flowing down the mountain sides, empty themselves into the lake. Suspecting this deposit, from its appearance, to consist chiefly of diatomaceous remains, I brought a little of it home, and subjected it to the microscope, and was highly gratified to find that I was correct in my supposition. I have supplied various friends with portions, and all have been pleased with the many forms it exhibits. It is not brought under the notice of the Society as at present having yielded any new species or varieties of diatoms; still it appears to be interesting, as affording a good instance of how a deposit is now forming of considerable thickness, and which may throw some light upon the manner in which other and older deposits have been left.

The Diatomaceæ here found have undoubtedly grown on the sides of the mountains around the lake, and been washed down by the rains, &c., by the rills and streams into the lake, where they have accumulated for ages. I am informed by Mr. Barratt, of Coniston, that the bank which is across the south end of the lake was made about twenty years ago to retain the water for the use of the copper-mines which are in the vicinity, but that two or three years ago the lake was "tapped" twenty-one feet deeper, so that it can now be drawn off to a depth of forty feet. When I visited it the lake was low, and therefore close to the margin, and some feet above it, this deposit was exposed, which probably would not be noticed if the lake were fuller.

I subjoin a list of the Diatomaceæ, which has been kindly supplied me by Professor Smith, of Cork, as the species he has detected in a specimen I forwarded to him for examination. I have little doubt but that many more forms will eventually be observed in it, and from the elevated position at which the deposit occurs, it includes those species which are mountainous, or subalpine chiefly; and in looking over the list, as supplied by Professor Smith, it will be observed that many species are named which have also been found in high Alpine regions.

Observations as to the localities of Diatoms are as yet too contracted to generalise from, still there appears ground for the belief that particular forms are peculiar to different altitudes, and that altitude rather than other causes will give variety of species.

LIST FORWARDED BY PROFESSOR SMITH.

DIATOMACEÆ IN LEVEN WATER.

Eunotia tetraodon.
diadema.
bidentula.
Cymbella Helvetica.
Navicula serians.
rhomboides β.
Bacillum.
crassinervia.
forina β.
Stauroneis anceps.
gracilis.
Pinnularia gibba.
interrupta.
interrupta β.
acuminata.
gracillima.
mesolepta.
lata.
Surirella biseriata.
linearis.
Gomphonema dichotomum.
tenellum.
Synedra biceps.
Nitzschia curvula.
linearis.
Himantidium bidens.
pectinale.
undulatum.
majus.
majus β.
gracilis.
circus.
Achnanthidium lanceolatum.
Tabellaria florealosa.
fenestrata.
Fragilaria undata.
capucina.
Melosira nivalis.
Odontidium mesodon.
hyemale.

[*Note.*—Accompanying the above paper was a packet of the deposit described, kindly forwarded by the author for distribution among the members of the Society; and with it an intimation of his readiness to afford a further supply to any member desirous of receiving one.—EDS.]

On the Organs *of* Cutaneous Respiration; *principally on those of the* Rana temporaria. By George Harley, M.D., F.C.S., Teacher of Practical Physiology and Histology in University College, London.

(Read March 4th, 1857.)

The theory of cutaneous respiration is now regarded as an established doctrine. Among some of the lower animals the interchange of gases by means of the skin is performed in so perfect a manner as to be in itself capable of supporting life. Bischoff, and other observers, found that even certain Batrachia live during several hours after the extirpation of their lungs; the aeration of the blood being accomplished by the cutaneous surface alone. The peculiar function which the skin possesses of absorbing oxygen, and exhaling carbonic acid, is not confined entirely to animals low in the scale of development; it has been traced throughout the whole animal kingdom. Experiments performed on the human subject by Scharling, Valentin, Brunner, Andral, and a great many others, have clearly demonstrated that even the cutaneous surface of man has an important share in the respiratory process. As far as I am aware, however, no one has attempted to describe the construction of the apparatus by which the interchange of gases takes place. The following observations may perhaps therefore prove interesting, from the simple fact of their novelty.

Several months ago, while studying the physiology of cutaneous respiration, I was desirous to ascertain if the skin possessed special organs for the aeration of the blood. With the human skin, however, I found it impossible to arrive at any satisfactory conclusion, and therefore directed my attention to the examination of the skins of animals possessing a more highly developed cutaneous respiration. The frog being easily obtainable, and at the same time well suited for the investigation of this subject, was first examined.

On placing under the microscope a small portion of the epidermis from the back of the animal, the immense number of openings in it immediately arrested my attention. And on examining these openings more narrowly, I found, that what I had supposed to be the mouths of the organs usually designated cutaneous glands, possessed a remarkable resemblance to the stomates of plants.* Each opening appeared

* The observations related in the following pages were made in 1855, and in the latter part of that year I showed the peculiar openings in the skin of the frog to Professors Sharpey and Ellis, and several other gentle-

to be covered with a layer of epithelium cells, and in their centre could be distinctly seen a small aperture not unlike that observed in some stomates. The question at once presented itself, "May not these organs in the skin of the frog which so strikingly resemble the respiratory organs of plants, have a similar function to perform?" Dr. J. Davy* has pointed out that the pulmonary arteries of some of the Batrachia divide into two branches, one of which goes to the lung—the other, very little smaller, to the cutis, and is extensively ramified among the follicles. The veins rising in this position are said to convey back arterial instead of venous blood. Before entering into the consideration of this question, I shall first as briefly as possible describe the structure of the organs alluded to.

It being very difficult to detach the epidermis from the cutis vera of the frog's skin in the ordinary way, I put the body of a frog recently dead into water at a temperature of about 80° or 90° cent.; in a very few seconds the hot water induces a state of rigor caloris which lasts from twenty-four to seventy-two hours; after a short immersion the animal is transferred to a vessel containing cold water, and kept there during several hours. The epidermis gradually detaches itself from the cutis vera, and can be very readily peeled off. A small portion obtained in this manner, when examined with a power of about 70 diameters, looks like a fenestrated membrane. It is seen to be pierced by a great number of openings varying in size from $\frac{1}{30}$ to $\frac{1}{10}$ mm. in diameter, and of a more or less rounded shape, as represented at Pl. VI, fig. 2. These openings are of so considerable a diameter that if the preparation be held between the observer and the light, they are distinctly visible to the naked eye. When magnified with a high power of 200 or 300 diameters, they are seen to be covered with a layer of tesselated epithelium, which is apparently continuous with the most superficial layer of the epidermis. Each of the tesselated epithelium-cells constituting the covering has a well-marked nucleus (Pl. VI, fig. 1), and in the centre of this layer or near it is a cell, differing somewhat in shape from the others, in being rounded, while the rest are more or less polygonal. The circular cell differs still further from the others in having a small aperture instead of a nucleus; it measures on an average $\frac{1}{60}$ mm. in

men, as I imagined at that time that I was the first who had observed them. Since then, however, I have found that the honour of their discovery belongs to Dr. Ascherson.

* 'Researches, Anatomical and Physiological,' vol. i, p. 111.

diameter. The small aperture is of a peculiar triangular form (Pl. VI, figs. 1, 3), as described by Ascherson,* seventeen years ago, not at all unlike the shape of a leech-bite. On examining this aperture minutely (which is easily done with a portion of the superficial layer of epithelium detached from the rest of the epidermis), its sides are found to form three small triangular flaps, or valves, which by their juxtaposition completely close the opening. In some specimens the valves are retracted, and the little gateways appear wide open; the patulous condition of the apertures is, however, not the one most usually observed. Mr. Huxley† has described the trifid apertures as being disposed between three epidermic cells, and not as a peculiar structure in the centre of a cell differing in shape from the others forming the epidermic covering of the skin. I have examined this point very carefully, and it appears to me that this gentleman has erred in supposing that the triangular opening is disposed between three epidermic cells; had he examined the most superficial layer of the epidermis detached from the rest, he would easily have detected the peculiar circular cell with the opening in its centre. It may here be remarked that, if the epidermis in connection with the cutis vera, be placed under the field of the microscope, it is exceedingly difficult to distinguish the superficial layer, and next to impossible to detect the aperture in the central cell. The observer would do well, therefore, in his examination of these structures to follow the plan given above.

If the most superficial layer of the cutis vera of the frog be examined with a low power, it is seen to contain, like the epidermis, a number of perforations, which, by transmitted light, resemble so many windows in a dark ground (Pl. VI, fig. 5). Some of the windows appear as if partly closed by a curtain, while in others the occlusion is complete. The curtain, I presume, is nothing more than a portion of the lining membrane of the passage, accidentally detached in tearing away the epidermis, &c. The passage just spoken of is narrower at its mouth than at its base. It leads a short way into the corium, and then abruptly ends in a blind sac.

Dr. Ascherson, in the paper already cited, says that, on making a transverse section of the skin, he failed to detect any duct leading from the cavity in the cutis vera to the triangular aperture on the surface of the epidermis, although

* Müller's 'Archiv,' 1840, p. 15.

† Article "Tegumentary Organs," Todd and Bowman's 'Cyclopædia of Anatomy and Physiology,' p. 500.

he had little doubt that some channel of communication existed between them. Mr. Huxley, in his able article just quoted, has given a diagram in which the canal leading from the triangular mouth to the cutaneous gland is represented as a very small tube, with a diameter not greater than that of the trifid opening. In the specimens of skin which I have examined, the canal was very wide, in fact it seemed to possess the same diameter as the large opening, seen on the surface of the epidermis, covered with epithelium. The minute triangular aperture appeared to me to be only a small door opening into a wide passage, which passage conducted directly into the cavity beneath. I imagine it possible that Dr. Ascherson failed to detect the canal, in consequence of his searching for a fine duct having a diameter equal to the trifid aperture, instead of one equal to the large perforation in the epidermis.

I have carefully searched for a fine tube as represented by Mr. Huxley, but have not yet been able to detect the slightest trace of one.* At first sight, the size of the duct appears to be a matter of secondary importance; but when it is remembered that we are at present attempting to deduce a knowledge of the function from the peculiar structure of the organ, it is at once observed to be a point of considerable moment. A small tube, although answering admirably for the transpiration of liquids, would greatly retard the free interchange of gaseous fluids. When we have minutely considered the peculiar structure of the cutaneous follicles in the skin of the frog, we shall next attempt to show in what manner they differ from the ordinary forms of sudoriferous glands, and how they would seem to be constructed for performing the function of cutaneous lungs.

The outline, as well as the relations of this passage and terminal cavity, can be tolerably easily studied in a transverse section of a portion of skin which has been preserved during a few days in a solution of chromic acid. Such a section is represented at Pl. VI, fig. 6. The size of the cavities varies very considerably; some are nearly twice as large as others. They are lined with a layer of tesselated epithelium, the nuclei of which, on the addition of acetic acid, come distinctly into view. Some of the cavities appear empty, or contain, as previous observers have said, only a clear fluid; while others are full of a matter somewhat resembling mucus.† The wide

* Since this paper was in type I have found that Dr. Hensche noticed that the duct was wider than the orifice. 'Zeit. f. Wiss. Zool.' vol. vii, p. 276.

† Hensche states that they contain 30—40 or more polyhedral cells. These cells were probably those of the epithelial layer lining the cavity.

spherical portion of these bottle-shaped organs, which lies in the cutis vera immediately under the pigment layer, is surrounded by a number of blood-vessels. When the blood-vessels are injected, they are seen to be congregated in the immediate vicinity of the cavities, and sparingly distributed throughout the intervening spaces. In this respect their arrangement bears a striking resemblance to the distribution of vessels round the gland-follicles in the skin of the toad, so beautifully delineated by Mr. Rainey,* and by Eckhard. The bottle-shaped cavities in the frog's skin are not, however, to be confounded with the large gland-follicles of the toad. They have little analogy to each other, and Mr. Rainey has even gone so far as to say that "no organs like those which I have described as the cutaneous follicles of the toad, exist in the integument of the frog or water-newt." On the other hand, however, the organs which it is the purport of this communication to describe, are to be found in the skin of the water-newt. Some even exist in the corium of the toad, but they are much less numerous, and are situated between the true gland-follicles spoken of by Mr. Rainey. Immediately beneath and partly around the blind sacs exists a layer of parallel bands, which compose the greater part of the true skin of the frog. These bands have been described by previous writers, and consists of two sets,—one running parallel to the skin, another perpendicular to it. In consequence of the latter constricting, or, more properly speaking, binding together the longitudinal bands, a transverse section of the skin presents a wavy appearance (Pl. VI, fig. 6).†

The perpendicular bands are described by Ascherson as dividing the cutis vera into small quadrilateral fields, which he at first imagined to be cavities, until, on adding iodine, he found them full of solid matter. He does not appear, however, to have noticed the existence of the parallel fibres. Czermak,‡ on the other hand, observed not only the perpendicular, but also the longitudinal bands. He speaks of the former as being a set of tubes or canals leading from the under to the upper surface of the skin, and of the latter as consisting of bundles of areolar tissue. With neither of these views am I inclined to coincide, for it appears to me that the structure of the perpendicular, as well as of the parallel bands, in some respects resembles that of smooth muscular fibre, although

* "On the Structure of the Cutaneous Follicles of the Toad," 'Quarterly Journal of Microscopical Science,' vol. iii, p. 257.

† Müller's 'Archiv,' 1841.

‡ "Ueber die Hautnerven des Froches," Müller's 'Archiv,' 1849, p. 252.

it differs from it in the absence of nuclei, and the very slight tendency to split up into spindleform bodies. The bands cannot be said to consist of fibrous tissue, for they are very broad, and not separable into fibrils. Neither are they made up of the ordinary areolar tissue, for they swell but very slightly on the addition of acetic acid. They greatly resemble the elastic fibres in cartilage, and behave towards reagents in a somewhat similar manner. That they are elastic one cannot doubt; for the skin, of which they compose the greater part, is very elastic. If Professor Ellis's views regarding the structure of non-striated muscles be correct, namely, that they are not made out of nucleated cells, as Kölliker supposed, but are formed of bundles of fibrils or threads, with nuclei distributed here and there on their surface, I should incline to the opinion that these bands are a peculiar form of non-striated muscular fibre; and I should consider their not splitting into cells, each containing a separate nucleus, additional evidence in favour of Professor Ellis's opinion. Without wishing to enter into the discussion lately raised by Professors Ellis and Thomson, and Mr. Lister, regarding the structure of non-striated muscular fibre, I may say that the whole subject appears to me to resolve itself into the single question, "Are the bodies described by Professor Kölliker and his followers as cells, cells in the ordinary acceptation of the word?" That is to say, do they consist of a cell-wall and distinct contents, with a nucleus in the centre? or, are they, as Professor Ellis thinks, fibres made up of a number of threads or fibrillæ? As it happens that the smooth muscles occurring in the different organs of the body, although they bear a general resemblance to each other, yet differ as to structure in several particulars, it must be borne in mind that the following remarks are only applicable to the muscle described. In the intestine of the cat, kept a day or two in a weak solution of nitric acid, the "cells" very often present a corkscrew appearance throughout their whole extent, but more particularly at their ends. When pressed, they take on the wavy outline spoken of by Kölliker. Other "cells," more stretched, have a remarkable jointed appearance, like a bamboo cane, and when examined with a good lens of high power, the spaces between the joints are seen to have a linear arrangement, which Mr. Ellis thinks is produced by the fibrillæ. Be that as it may, one thing appears to me certain, that the spindle-shaped bodies, described by Kölliker as cells, *are solid,* for they may be cut across or torn longitudinally without any contents protruding or flowing out. The torn ends and sides very often present a ragged appearance. If, on the other hand, these bodies are made up of minute fibrillæ, surrounded by a membrane, to which they are attached, the fibrils are so intimately connected with each other, that they cannot be separated except by tearing.

The integument of the frog, besides containing a great number of blood-vessels, is freely supplied with nerves. These have been very ably described by Czermak, and for the most part my observations confirm his. In one point, however, we differ; he says that many of the subdivisions of the nerves pass from the under to the upper surface of the skin through the perpendicular fibres, which, as was before mentioned, he regards as canals. The special purpose of these tubes or canals being to form a protecting sheath for the nerves, which, on reaching the upper part of the cutis vera, are reduced to merely the axis cylinder. As I regard these canals as a peculiar form of smooth muscular fibre, I cannot suppose that the nerves penetrate into, but only pass along the side of them.

There is yet a structure in the superficial layer of the cutis vera of the frog, which, as far as I am aware, has been described by no previous observer. It consists of a number of oval bodies, not at all unlike very small Pacinian corpuscles. These bodies are exceedingly numerous, and are distributed among the pigment-cells of the rete mucosum. I frequently attempted to trace the axis-cylinders of the nerves into these peculiar bodies, but without success. They are best seen when a weak solution of caustic potash is added to the skin, freed of its epidermis, in order to make it more transparent, and are roughly represented at Pl. VI, fig. 5, *b*.

The frog is not the only animal which has cavities in the skin, the mouths of which are covered over with a layer of tesselated epithelium. I found a similar kind of arrangement to exist in the skins of the newt and common water-lizard. In these animals, however, the cavities are of a somewhat different form, and less numerous than in the frog. The aperture in the middle of the tesselated epithelial covering of the lizard's skin is not of a triangular, but of an oblong shape; it sometimes measures as much as $\frac{1}{40}$ mm., and consequently may be said to have a still closer similarity to the ordinary form of vegetable stomates. The following description of the stomates of plants is given by Professor Lindley, in his 'Elements of Botany:' "Stomates are oval spaces lying between the sides of the cells, invariably opening into intercellular cavities in the subjacent tissue." This description of the stomates of plants cannot fail to strike the reader as having a remarkable parallelism with that already given of the cavities in the skin of the frog. In the leaf the cavity is situated in the parenchyma (which is analogous to the cutis vera of animals), is covered over by the cuticle (which is equal to the animal epidermis), and has an opening in its centre. The shape of the aperture varies in different plants, but it is for the most part oval, as in the skin of the lizard. Some botanists adhere to the opinion that the stomates of plants are secreting organs, and not mere passages for the transmission of gaseous fluids; but by far the greater number are agreed in regarding them as respiratory organs. I am very much disposed to ascribe a similar function to the organs in the frog's skin, which resemble so closely the stomates in structure. They are exceedingly numerous, amounting to many thousands in a square inch of skin (I counted about sixty in the field of the microscope with a magnifying power of 70 diameters), and are found distributed over all parts of the body, being most numerous, however, on the back and on the dorsum of the limbs; exactly in those positions where the sudoriferous glands in other animals are most sparingly distributed. If a comparison be instituted between the cutaneous follicles of the frog and the true sweat-glands of other animals, a very marked difference will be found both as regards their position and their structure. Let us for a moment contrast the sudoriferous follicles of the human skin, as they are most generally known, with the organs which have just been described as existing in the integuments of the frog. In the palms of the hands and soles of the feet, as well as in the axillæ and groins of man, the greatest number of perspiratory glands are aggregated; and if the cutaneous follicles of the frog have a similar function to perform, we might not unnaturally expect to find them most numerous in the same positions. Such, however, is not found to be the case; for while, in the frog, the back and dorsum of the limbs and other exposed positions are thickly studded over with the mouths of the cutaneous follicles, the axillæ, palms of the hands, and soles of the feet, are almost entirely devoid of these organs. On the other hand, if we examine into the position occupied in the cutis vera by the tegumentary glands of the human subject and by those of the frog, we shall find, that while the former lie in the deepest, the latter are confined to the most superficial layer of the derma. The mode, too, in which the glands communicate with the exterior of the body, is in each case dissimilar; for while, in the skin of man, the channel of communication is a long, tortuous, and narrow duct, in that of the frog it is a short, straight, and wide passage. In the human being there is no special covering to the mouth of the duct; in the frog, the passage is carefully closed over with a delicate layer of epithelium. Again, in the blood-vessels supplying the sweat-glands of man, we can detect nothing peculiar, while in those aggregated in the neighbourhood of the cutaneous follicles of the frog the usual function is found to be reversed; the arteries carrying forwards venous blood, the veins returning that which has undergone the arterializing process. It is thus seen that very little analogy can be traced between the sudoriferous glands of man and the cutaneous follicles of the frog, either as regards their structure or position. How different is the case when we attempt to compare the organs described in these pages with the respiratory apparatus of some of the lower animals. In the pulmonate gasteropods, for example, we have the lungs reduced to a simple sac, which, in many respects, resembles the little cavities in the frog's skin. In this simple form of lung, as well as in the stomates of the frog, we find the cavity lined by an involution of the epidermis, and its basement membrane surrounded by a network of fine capillaries. The contractility of both cavities presents us with still another point of resemblance. Dr. Ascherson has pointed out that the cutaneous follicles of the frog contract when a stimulus is applied to their nerves. He supposed that this property was dependent upon a layer of elastic fibres assisting to form the wall of the cavity, for at that time he was unacquainted with the true structure of the corium. I have not been able to detect any contractile fibres in the walls of the follicles, which appear to me to consist simply of a basement membrane and a layer of epithelium; but I have distinctly traced the widened-out ends of the perpendicular fibres already spoken of, ramifying on the exterior of the capsules.* The contraction of the cavities, I imagine, therefore, is produced by the shortening of the parallel and perpendicular bands of smooth muscular fibre composing the greater part of the true skin. I must now hasten to bring some evidence of the functional importance of the tegumentary respiration.

It was before mentioned that all animals respire more or less by their skin. In 1844, M. Fourcault † drew the attention of the French Academy to the interesting fact, that a

* Hensche also describes the smooth muscular fibres as composing part of the walls of the follicles; but, as has just been said, they do not, properly speaking, belong to the walls of the cavities, for they are only the spread-out terminations of the perpendicular fibres.

† Carpenter's 'Physiology,' p. 702.

complete suspension of the functions of the skin by means of a coating of varnish, gave rise to a state which he has described by the name of cutaneous asphyxia. In his experiments he observed that this condition was accompanied by an imperfect arterialization of the blood, upon which rapidly followed a marked decrease of the animal heat. This showed that the application of the varnish to the skin had not only prevented the insensible perspiration, but also the exhalation of carbonic acid and the absorption of oxygen. Had the perspiration alone been interrupted, the temperature of the animal's body would have increased, since it is to the evaporation of the sweat that the reduction of the animal heat is principally due. The constant evolution of heat from the cutaneous surface is replaced by the warmth developed during the combustion of the oxygen introduced through the skin and lungs, with the carbon and hydrogen of the tissues. The frog's skin is so perfect a respiratory organ, that in the absence of the lungs, it can carry on the diffusion of gases efficiently enough to support the life of the animal during several hours. Professor Moleschott has recently communicated to the French Academy some interesting experiments upon the effect of light upon the cutaneous respiration of the frog, showing that the function is much more rapidly performed in the sun's rays than during the absence of light. In the daytime more oxygen was absorbed, and more carbonic acid exhaled by the skins of the animals than during the night. From the peculiar organization and mode of life of this animal, as well as from the wide distribution and singular construction of the organs which it has been the purpose of this communication to describe, it appears not improbable that the follicles in the skin are more employed in the function of respiration than of perspiration; and I think we may therefore regard them rather as animal stomates than sudoriferous glands.

Description *of an* Object-compressor *for* Preparing *and* Mounting Objects. By W. Hislop, Esq.

(Read June 25th, 1856.)

This little instrument I have found extremely useful in the preparation and mounting of various substances as microscopic objects. It is so contrived as to afford a graduated pressure without the risk of breaking the glass cover. Any who have tried their hands at mounting objects permanently will at once see its applicability for all cases where a constant pressure has to be maintained for any time. For instance, if a section or other preparation is required to be mounted in balsam, it is necessary to keep the cover down until the balsam is cold, or the section will frequently curl, and lift it so as to admit the air; and this will sometimes occur even then. My plan is to have several of these compressors at hand, and as soon as the object is properly placed in the balsam, and the cover put on, the slide is at once placed beneath one of them, the trigger is let gently down, and the adjusting screw turned upwards, till all the superfluous balsam is expressed. The slide, still under the compressor, is then put aside in a drawer, until the balsam is hard enough to be safe. In like manner I apply it to the mounting of objects in fluid, being able to lay a coat of cement around the cover while it is under pressure. Previous to mounting, I also find it useful for flattening substances of all kinds, especially when being dried for mounting in balsam.

The figures show two forms of the compressor. Fig. 1

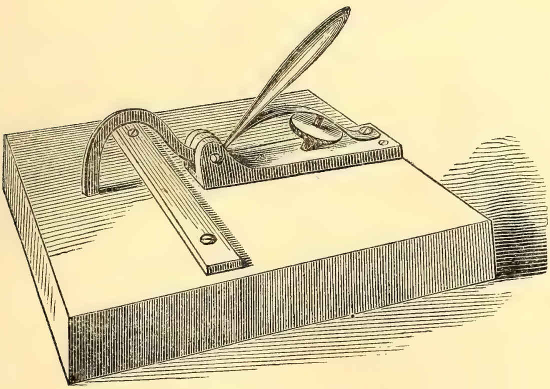


Fig. 1.

consists of a square block of mahogany, about three inches by four, across which a strip of brass is screwed, at a distance of one inch from one end, as a ledge, against which the glass slide is to be placed. A light trigger is jointed to the block in such a position that the end presses exactly in the centre of the slide. A steel or brass spring is fixed below the tail of the trigger, and beneath this a screw with a milled head is placed in such a manner as to increase the force of compression when it is unscrewed, by forcing the spring upwards, and *vice versâ.*

If preferred, a disc may be jointed to the trigger, so as to touch over an extended surface, or better still, a thin metal disc may be simply laid upon the cover, and the pressure be borne upon that. Care, however, must be taken that the balsam, or other cement, does not touch it, or inconvenience may result.

The second form, fig. 2, is identical in principle, but is made

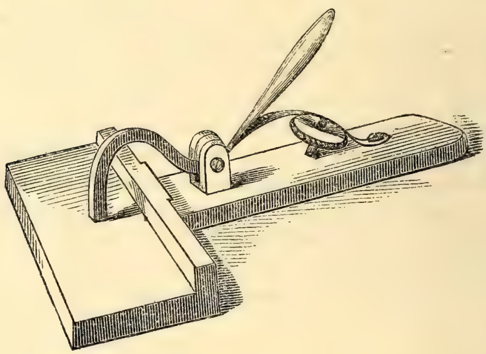


Fig. 2.

entirely of metal, and is useful when it is desired to apply heat at the same time as pressure, as it may be held over a lamp by grasping the prolonged end by the forceps, or it may even be fastened in a wooden handle.

On a Fungus parasitic *in the* Human Ear. By Jno. Grove, Esq., M.R.C.S., &c. Communicated by Henry Deane, Esq.

(Read April 15th, 1857.)

Having taken a lively interest for some years in the subject of parasitic growths of all kinds, whether occurring on animals or plants, I have lost no opportunity of seeking for them when occasions have presented offering any probability of success to my research.

In the month of September last (1856) I met with a beautiful specimen of a fungoid growth which was removed from the ear of a gentleman who had been suffering from inflammation of the left external meatus auditorius.

The ailment commenced with uneasiness and irritation of the ear, diminution of the sense of hearing, and some slight discharge. In a few days there was pain and greater urgency of the other symptoms. As the patient was in the prime of life, of unimpaired constitution, and apparently in vigorous health, I ordered simply poppy fomentations by means of spongio-piline, the ear to be carefully syringed with warm water, and a drop of glycerine to be applied night and morning—the syringing because there appeared to be some flocculent-looking matter deep in the meatus. After a day or two some of this flocculent matter came away in little masses, which was preserved according to order for my inspection.

The fungi to be presently described being detected, it occurred to me that the best method of preventing their further development would be to use some injection which was likely to be inimical to their existence. Alum was selected, and it seemed to answer perfectly. But soon the other ear began to take on the same symptoms as its fellow, and now the alum injection succeeded in checking altogether the progress of the affection, and the patient was speedily out of my hands.

The only instance of a growth of this kind in a like situation, that I am acquainted with, is in Robin's work; he quotes, however, from a paper by Mayer, in Müller's 'Archives.' He speaks of a fungoid vegetation which was found in some cysts removed from the ear of a child eight years old, who was suffering with a scrofulous discharge from the external meatus, and had been treated both locally and generally with a variety of medicaments.

The differences between the description given by Robin and that which I have to offer are such as to lead to the belief that the objects are not similar.

1st. I detected no cysts, but flocculent membranous-looking masses.

2d. He describes the stipe as long, and containing within it small granules (or having a granular interior). Now although the accompanying has a rather long stipe, it does not contain spherules or granules.

3d. The pileus is said by Robin to be small and of a greenish colour, whereas that here shown is comparatively large and of a reddish-brown colour.

4th. The position and character of the spores are distinctly different. Robin speaks of them as granules, single or double, spread over the surface of the upper swollen extremity of the stipe; but those here exhibited are closely packed oval spores, completely enveloping the upper extremity of the stipe, forming a compact pileus.

Further, there is a difference in the cases furnishing the growth, the contrast between a scrofulous child, eight years of age, and a healthy man in the prime of life, is as great as could be, and tends to show that the scrofulous habit has no special influence in favouring the growth of the parasite. (Pl. VII, figs. 1—7.)

Description *of an* Early Human Embryo *of about the fourth week of Utero-gestation.* By Arthur Farre, M.D., F.R.S., Professor of Obstetric Medicine in King's College, London.

(Read May 13th, 1857.)

In the year 1850 I had the honour of reading to this Society an account of a very early human embryo, the description and figures of which will be found in vol. iii, part ii, of the 'Microscopical Transactions.'

Having in that paper briefly explained the circumstances which render it a matter of great difficulty to obtain perfect specimens of the human embryo at very early periods of development, such as the violent pressure which the ovum suffers in the act of expulsion from the uterus, and the rough handling which it usually undergoes before it reaches our hands, independent of the rarity of procuring aborted specimens which are quite normal in their development, I need not here again advert to this subject. But I may observe, that while the development of the mammalian ovum has been traced through all its stages in many species (by the indefatigable Bischoff for example), the embryo of man has not been so carefully examined, especially in its early stages, as might fairly be expected from the great interest of the subject, even allowing for the impediments to the pursuit of human embryology to which I have just adverted.

It appears to me that the best way of supplying this deficiency is for each individual, who may have the opportunity, to record his observations, though they may be only of isolated examples; so that in time a number of such instances may be collated, and so a series may be obtained, which it is obvious, from the very nature of the subject, could not be formed in any other way.

I make no apology, therefore, for again drawing the attention of the members to this very interesting department of human physiology, by offering a brief description of another early human embryo which I have recently had the opportunity of examining.

This specimen was passed by abortion, for which no very obvious cause could be assigned, the mother being at the time in perfect health. From circumstances antecedent to the occurrence, I am not able to fix the age of the embryo by reference to any of the ordinary modes of calculation. In this case two menstrual periods had passed by before the occurrence of abortion. But it is plain, from the condition of the embryo, that any calculation, having reference to this circumstance, would make its age far greater than the small amount of development which it has undergone would warrant. I have therefore no alternative but to estimate the period of development in this, as in the former instance, by comparing the embryo with others, the age of which could be more accurately ascertained. Judged by this test, I am inclined to fix the period of development of the present example at the early part of the fourth week of utero-gestation, and, as compared with the specimen which I formerly described, as probably three or four days younger than it.

The external characters of the ovum in this case were such as are commonly observed in the human ovum when expelled by abortion. It was loosely surrounded by the decidua vera and reflexa. The ovum having been freed from these, was found to be of nearly spherical form, the chorion being everywhere covered by dendritic villi, which were nearly equally distributed over its surface. The extremities of these villi were only slightly attached to the decidua, except in one situation where the two surfaces were united for a small extent. Taking the chorion as the boundary of the ovum proper, it measured one inch in diameter.

Upon carefully laying open the chorion with a pair of scissors under water, the embryo, the seat of which could be already discerned through the semi-opaque membrane, was at once brought into view. It was not enclosed in a separate amniotic sac, but the amnion appeared to be everywhere adherent to the inner surface of the chorion by the intervention of a loose connective tissue (magma reticule), so that the amnion, in this instance, was either not yet fully developed, or had not its usual distinct form.

The embryo itself, to which I will now confine my description, was attached to the parietes of this inner sac by a short peduncle springing from the posterior extremity of the trunk, just between the rudimentary buds which indicate the seat of the future lower limbs. This was, I presume, the root of the allantois, and in opening the semi-opaque sac through which I could see the situation of the head of the embryo, and in keeping as far as possible from this point, so as to avoid mutilating what I knew would be a very interesting part, I unfortunately cut across the pedicle of attachment, and so by trying to avoid Scylla I fell into Charybdis. I mention this, because it will explain why I am unable in this paper to give any account of the allantois, which in an embryo of this date might be expected to present a condition of great interest; while, on the other hand, I am able to describe some points of fully equal interest, which are beautifully shown in the present example.

The embryo, in this case, presents the elongated and almost snake-like form which is commonly observed in the mammalian embryo of almost all classes at the periods of development which correspond with this. It is slightly curved, in the form of a bow, the head being inclined towards the posterior extremity of the trunk. In this curved condition it measures four lines, but its length would be increased by about one fourth if it were extended.

That which strikes the observer most at this period of development is the circumstance that here the embryo consists of those structures which are to be afterwards developed into parts and organs devoted to the purposes of what is termed the animal life, or those organs which bring the body into relation with the external world, such as the great centres of the nerves which relate to sensation and motion, the structures by which these are sustained and protected, the rudiments of the organs of locomotion, and some even of those relating to special sense, as the eye; while of those structures which are appropriated to the maintenance of the vegetative or organic life, scarcely a trace is as yet discoverable, beyond the heart or regulating organ of the circulation, which, at this period of development, constitutes the almost sole representative of that most important series of structures. At this period there is neither a thoracic nor abdominal cavity, for, with the exception of the heart, as first stated, the parts which these cavities contain and protect are not yet formed. The entire embryo therefore consists of a trunk, with the rudiments of a head and limbs, and of a heart for the maintenance of the circulation in the structures already formed, as well as in the membranes in which the embryo is inclosed, and which serve for the supply of its nutriment and for the aëration of its fluids.

It will be perceived by the drawing which accompanies this paper (Pl. VII, fig. 8 and 9), and in which I have preserved the proportion of all the parts, although the entire size of the embryo is magnified about seven diameters, that the head or anterior extremity of the trunk may be readily distinguished by the incipient development of those great nervous ganglia, or centres of nervous matter, which are connected in the first place with the principal organs of sense.

These great nervous centres appear at first in the form of vesicles, arranged in a linear series, whose unequal distension of the thin textures by which they are at this period covered in and protected causes the bulgings or tuberosities, so conspicuous in the part representing the head of the embryo. Three of these swellings may be readily distinguished. The most anterior of these (B) indicates the seat of the double vesicle which is afterwards developed into the cerebral hemispheres, at this time known as the prosencephalon. Its small relative size at this early period of embryo life is an interesting circumstance, when we consider how closely the cerebral hemispheres are connected with the intellectual faculties, and how greatly these portions of the brain preponderate in the fully developed organ. As, however, these faculties are not called into play at an early period of life, while, on the other hand, the organs of sense and relation must be exercised immediately upon the act of birth, we are not surprised to find the relative amounts of development of the nervous centres corresponding with these requirements. Behind the seat of the prosencepalon is observed another and rather larger bulging (C), which marks the situation of the mesencephalon or single vesicle of the corpora quadrigemina. Within the same bulging, but a little more anteriorly, is also found the vesicle of the third ventricle and the optic thalami. The mesencephalon, it will be noticed, is here larger than the prosencephalon, and, considering this as the great ganglion of the optic nerves, its great proportionate size is illustrative of the large relative proportion which this part of the brain exhibits in the lowest vertebrata. The third swelling (D) indicates the seat of origin of the acoustic nerve. It is the epencephalon, and contains the vesicle from which are developed the cerebellum and medulla oblongata.

Beyond this point a slight bending outwards indicates the situation of the commencement of the spinal cord, while the trunk is continued flexuous, but of nearly uniform size, until it terminates, after an abrupt curve forwards, in a pointed prominence indicating the seat of the future os coccygis.

Already it may be seen that the vertebræ are marked out, and, by the aid of transmitted light, their little quadrate divisions may be very distinctly discerned in the semi-translucent substance of which the trunk is at this period composed.

If now the eye is carried along the anterior surface of the embryo, there will be perceived, immediately below the anterior bulging indicative of the seat of the future cerebral hemispheres, a series of four laminæ or leaflets, which, when viewed in profile, appear single, but which occur in pairs. These constitute no permanent parts or organs, but become transformed into various structures, such as the maxilla, mandible, &c. They are fœtal peculiarities of a most interesting class, forming here the visceral arches, or visceral-bogen of German physiologists, while the fissures or apertures between them are known as the branchial fissures or apertures. They are one stage less advanced in the present instance than they are in the embryo which I formerly described. Opposite to the lowermost pair of leaflets, a looped blood-vessel enters the trunk. This leads from the heart, at this period consisting of three chambers only, viz., a single auricle and ventricle, and a bulbus arteriosus. In my former paper having more particularly traced the development of the heart, and examined its composition, both at this stage of embryonic life and also at periods somewhat later, I refrain here from any further remarks upon this interesting portion of the subject.

Nearly on a level with the heart, though a little lower down, will be perceived a slender lamina projecting from the side of the trunk in the form of a small fin or paddle. This is the sole rudiment at this stage of an arm or anterior extremity. It constitutes the portion of blastema in which is subsequently laid down the chief portions of the structures forming the hand and arm, but which is not more developed at this stage of embryonic life than is the paddle of the whale or porpoise.

On the other hand, the rudiment of the lower limb or posterior extremity is more easily distinguished, in the form of a bud, projecting from either side of the trunk near its termination, but, like the anterior extremity, as yet in so rudimental a form that the last vertebræ of the spinal column still project beyond it.

Emerging from between these is the root of what I presume to have been the allantois, but which was unfortunately cut across in the manner already explained. By this channel the blood, after circulating through the body of the embryo, would be carried to the membranes by which it is encompassed, and at this point doubtless the connection between the parent and offspring, such as it is at this period, is established.

In front of the spinal column are distinguishable two or three structures, one of which only is sufficiently definite to admit of precise delineation. It is in the form of an elongated body, having apparently a duct running downwards towards the root of insertion of what I suppose to be the allantois. I have little doubt that this is a rudimental

Wolffian body, one of the earliest and most transient of embryonic structures.

As yet there is not only no indication of distinct sex, but the period of development is apparently anterior to that stage of embryonic life in which those organs are distinguishable, which, according to the views of Kobelt, may be subsequently converted into the essential parts of either sex indiscriminately. But upon this point I would not be understood as expressing a decided opinion, because the rudimental structures here distinguishable will require a more critical examination than I have been yet able to give to them.

[At the conclusion of this paper the author gave a brief exposition of his views regarding the signification and homologies of the principal structures here described.]

ORIGINAL COMMUNICATIONS.

On the Structure *of* Lecidea lugubris (Sommf.) By W. Lauder Lindsay, M.D., Perth.

While engaged in lichenological studies in the Braemar Highlands during the summer of 1856 (August), I met with a beautiful little lichen, which has not hitherto, I believe, been detected in Britain, and which appears also to be very rare on the continent of Europe. It was the *Lecidea lugubris* of Sommerfeldt ('Suppl. Lapp.,' 143, and Schærer's 'Enumeratio Critica Lichenum Europæorum,' Bern, 1850, p. 101); and the *Schæreria lugubris* of Körber ('Systema Lichenum Germaniæ,' Breslau, 1856, p. 232). I was further fortunate enough to find specimens bearing not only apothecia, but spermogones; the latter organs not having apparently been hitherto discovered or described. The structure of the apothecia is exceedingly beautiful; and the peculiar spores serve to distinguish this species from all other British Lecideæ. The facts that the structure of this lichen is probably, in great measure, unknown to British lichenologists; that the plant has not hitherto been found in Britain, while it is a rare alpine continental species; that its spermogones have not been heretofore, so far as I am aware, discovered or described; and that its spores serve to distinguish it from all other British Lecideæ—induce me to offer the following account of its external characters and minute anatomy, based on my examinations of specimens collected at Braemar.

The *Lecidea lugubris*, Sommf., is placed, and very properly I think, by Schærer ('Enum.,' l. c.) in the section *Psora* of the genus *Lecidea*,—this section being characterised by the possession of a squamulose thallus; and in the subsection thereof in which the squamules are often aggregated or crowded into a plicate or areolate crust. Its external characters place it in near affinity to the more familiar *Lecidea cœruleo-nigricans*, Sch. (Schær., 'Enum.,' 101, Lich. Helvet. exsicc., 168). It also bears a resemblance, in some particulars, to *L. decipiens*, Ach. (Schær., 'Enum.,' 95, L. H. E., 164, and plate v, fig. 2; *Biatora decipiens*, Ehrh., Hepp, 'Die Flechten Europas,' 1853, 120; Tulasne, Mém. pour servir à l'histoire organographique et physiologique des Lichens, 'Ann. des Sc. Naturelles,' 3d ser., v, 17, 1852, plate x, figs. 28—30), and to *L. lurida,* Ach. (Schær., 'Enum.,' 96, L. H. E., 157; *Biatora lurida,* Sw., Hepp, 121); but it differs from them in its squamules being comparatively simple and aggregated, and in the apothecia being black, flat, and margined throughout. The lichenological student may further compare it, in regard to its general external characters, with *Psora* (*Lecidea*) *scalaris,* Hook, of Smith's 'Engl. Bot.,' vol. xi, p. 2, plate 2113 (2d. ed., 1844); in regard to the relative position on the squamules of the spermogones and the apothecia, with *Endocarpon sinopicum,* Wahl. (Tulasne, Mém., pl. x, figs. 19, 20); and in regard to the characters of the thecæ and spores with *Sphærophoron coralloides,* Pers. (Tulasne, Mém., pl. xv, fig. 4), and *Calicium turbinatum,* Pers. (Tul., Mém., pl. xv, fig. 15). Fries places it between his *Lecidea atro-alba* and *L. panæola.*

While Schærer has classified it according to its thallus, Körber has arranged it according to its spores. The latter places it in his sub-family *Lecidinæ* of the family *Lecideæ,* the latter being divided by him into three sub-families, and no less than thirty-two genera, which were formerly chiefly included in the single, but comprehensive, genus *Lecidea!* His Lecidinæ are characterised by possessing a crustaceous uniform thallus and lecidinic apothecia—black, not coloured, and having a proper exciple, formed of a tissue differing in colour from the thallus. He arranges it between his genera Catillaria and Lecidella, and near the genus Lecidea. The differential diagnosis between these is founded on the fact that Catillaria has two-locular, hyaline spores; and that Lecidella and Lecidea have ovoid or ellipsoid spores in subclavate thecæ, the latter genus possessing also a simple, carbonaceous hypothecium. But Körber constitutes this lichen the type of a new genus, on which he bestows the honoured name of Schærer—the great Swiss lichenologist (*Schæreria lugubris,* 'Syst. Lich. Germ.,' l. c.) "Den Manen," he remarks, "des vortrefflichen um die Wissenschaft aüsserst verdienten Schweizer Lichenologen Schærer widme ich diese durch ihren Fruchtbau hervorragende Gattung, die in vieler Beziehung ein Uebergangsglied zwischen den psorinischen und lecidinischen Flechten darzustellen scheint." ('Syst. Lich. Germ.,' p. 232.) The essential characters of his genus Schæreria are the globose spores, contained in linear thecæ, and the simple, brownish hypothecium.

I have every wish that the illustrious name of Schærer should be honoured in the description of really new species, for I think it is at least as little objectionable to employ the names of celebrated botanists to distinguish species as to bestow many of the present absurd adjective terms, which imply no structural peculiarities or natural affinities, but merely some far-fetched, and perhaps invisible or unintelligible resemblance or analogy. But I cannot regard the characters of the spores as sufficient to constitute *Lecidea lugubris* the type of a new genus, by whatever name it may be called. If we classify on this principle, we shall infallibly, as Körber has done, split up or subdivide the Lecideæ—and lichens in general—into an endless and most confusing number of new genera and species. I regard the characters of the spore as an invaluable assistance in specific diagnosis; and I quite agree with Körber that, in regard to its spores, this lichen stands conspicuously by itself among the Lecideæ. I think it, however, in classification, sufficient to place it under a separate subdivision, headed "*Spores globose,*" without creating a new genus for its special accommodation. The lichen possesses no external characters to justify such an isolation and distinction. I, therefore, prefer retaining the plainer and less euphonious name originally bestowed on it by Sommerfeldt—*Lecidea lugubris.* I do so as a practical protest against the modern spirit of name-manufacture, and of the fastidiously elaborate subdivision of genera and species. This is probably the result of a mono-ideaism; I shall not say a morbid one, but one which is apt to lead to a repulsively minute and difficult classification. By seizing upon one particular structural feature, as a guiding principle of classification, we are too apt to lose sight of natural affinities, and so fall into all the evils of artificiality.

Before entering upon the details of minute anatomy, I shall give the amended specific characters of *L. lugubris,* Sommf.—founded on those of Schærer and Körber. Neither of these authors, however, makes any reference to the spermogones.

Lecidea lugubris, Sommf. emend.—*Sp. char.* *Thallus* cartilaginous; olive- or reddish-brown; sub-effigurate; consisting of a series of sub-lobulate squamules, aggregated into an areolate crust. *Hypothallus* black. *Apothecia* sessile; black, naked; thalamium flat; margin sub-prominent, and consisting of a black or brownish-black, waxy, cup-shaped, proper exciple. *Hypothecium* brownish, sub-grumous, simple. *Thecæ* eight-spored; sub-linear, long, delicate; tapering below into a narrow longish pedicle. *Paraphyses* lax, wavy, very slender; barely equalling in length the thecæ; tips deep indigo blue. *Spores* arranged in linear series in thecæ, sub-minute, simple, globose, margined; nucleus pale yellow. *Spermogones* scattered, punctiform, immersed, sub-spherical, simple. *Sterigmata* simple, sub-linear; somewhat irregular in form; generating from their apices straight, rod-like *spermatia*.

Syn. Lecidea, sp., *Sommf.,* Suppl. Lapp., 143.
Schær., Enum., 101.
Fries, Lichenographia Europæa reformata, 1831, 314.
Rabenhorst, Die Lichenen Deutschlands, 1845, 83.
Schæreria, Körb., Syst. Lich. Germ., 232.

Hab. On weathered gneissic boulders, moor immediately to the west of the village of Braemar, Aberdeenshire. Coll. August, 1856.

Körber mentions, as the habitat of this lichen, primitive rocks on high mountains (above 3000 feet of elevation); stating that it is very rare. He gives only two stations for it,—one in the Riesengebirge (Flotow), and the other on the Bavarian mountains (Krempelhuber). Schærer again gives, as its habitat, subalpine rocks in Sweden, and other parts of northern Europe (Sommf., Blytt, and Flotow). The station in which I found it could not be said to be alpine. It was the low ground—a moor—immediately to the west of the Free Church School-house of Braemar, within half a mile of the village, and to the south of the high road leading to the Linn of Dee.

It grew sparingly on some weather-worn gneissic boulders. The principal rocks in the neighbourhood are gneiss, granite, and mica slate. I did not meet with it at all on the neighbouring mountains, which include some of the highest in Scotland (Ben Mac Dhui, 4296 feet; Brae-riach, 4280; Cairntoul, 4230; and Cairngorm, 4050). It is, however, a small lichen; and, not expecting such a rarity, I did not specially look for it. I have not hitherto found it in other parts of Scotland, notwithstanding that I have visited most of its highest mountains in the pursuit of lichenological studies (the Cairngorm range, Ben Nevis, Ben Lawers, the Coolin Range, Skye, &c.) It should in future be carefully looked for in such localities as Braemar.

The thallus generally consists of small, simple, thick, fleshy, convex, squamules, with a sub-lobulate, ill-defined edge. The colour is some shade of brown; in some cases a green tint predominating, in others a reddish. Sometimes the squamules are so minute, thick, convex, and irregular, that they have more the characters of verrucles or thalline warts. The under surface of the thallus is usually intimately adherent to its basis of support,—which is generally some of the primitive or metamorphic rocks,—gneiss in the specimens examined by me. It is found, on examination, that the surface of the rock has been disintegrated by the lichen, and that a sort of union has been formed between them; a union so intimate that it is almost impossible to cleanse the under surface of the thallus from the adherent particles of fine sand—the result of disintegration—without destroying portions of the cortical and medullary tissues of the thallus. It thus becomes difficult to see the black hypothallus upon, and from which the brownish thallus is subsequently developed. The thallus consists of the ordinary triple division of tissues—cortical, gonidic, and medullary. The cortical tissue consists of small cellules of a brownish colour. Those arranged most externally are somewhat oblong from mutual pressure, closely aggregated, and of a deep brown colour; while those placed internally are more round, of a light colour, and more loosely aggregated. The gonidia are large and distinct, and possess the usual characters. The medullary tissue consists of very narrow, delicate, indistinct, branching tubes or filaments.

The apothecia vary in diameter from the $\frac{1}{30}$ to $\frac{1}{40}$ of an inch. They are those of a true Lecidea—being flat, margined, black, and naked; the thalamium enclosed by a peculiar or proper exciple, formed of a substance differing in colour from the thallus. The thalamium is open *ab initio*, and it remains flat and open throughout. I have not observed it intumescent, so as to become convex or sub-globose, and obscuring or covering the margin or exciple; neither does the margin swell or disappear, though it may present slight irregularities in form. The apothecia are generally round; but they sometimes become, from mutual pressure, when two or three are aggregated together, somewhat angular. Though sessile, they are not attached, in their mature state, by their whole lower surface; but only by the central portion thereof. Their base of adhesion is sometimes comparatively narrow, and may become substipitate, or at least may raise the lower surface of the apothecium slightly above the upper surface of the thallus. The apothecium is sometimes slightly roughened on its surface; but I have not been able to detect any of the scobiform dust, which occurs on the surface of the thalamium in Sphærophoron, and which is due chiefly to the accumulation of the ripe spores, along with the *débris* of the elements of the hymenium.

The *hypothecium* consists of small, roundish, or irregular cellules, of a brownish tint. From the *hypothecium* the *thecæ* arise as small oval vesicles, which gradually become, by elongation, linear-cylindrical cells, having a nearly uniform width throughout, except below, where they taper suddenly into narrow, kneed or irregularly bent and longish pedicles. The thecal cell is at first full of a pale yellowish, finely granular or grumous protoplasm. As the theca increases in size, larger granules and globules make their appearance: these become agglomerated into globular masses, which gradually assume the form of the future spores. Lastly, the cell-wall of the spore becomes visible, and is separated by a hyaline, distinct margin from the globular nucleus, which is of a pale yellow colour. For a considerable period the spores are glued together in a linear series, somewhat after the manner of the spores of Sphærophoron and some Calicia. Here, however, the spores appear to attain to perfect maturity before they escape from the theca. Here, also, the spore-sac may generally be seen with tolerable distinctness, closely lining the interior of the thecal cell, at almost every stage of the development of the theca. Nor is the thecal wall ever so delicate in *Lecidea lugubris* as to be invisible, as in certain Calicia (*e.g.*, *C. tympanellum*, Ach., Tulasne, Mém., pl. xv, fig. 18). Mature thecæ generally measure from $\frac{1}{200}$ to $\frac{1}{280}$ inch,—the average being $\frac{1}{250}$—in length, by about $\frac{1}{2000}$ in breadth. They generally come off from the hypothecium in groups or bundles, six or eight thecæ being closely aggregated, and the several groups of thecæ are separated by similar bundles of paraphyses. They usually equal in length the paraphyses, and frequently project beyond them. When full of mature spores, the theca is a very beautiful object under the microscope: it may be likened to a narrow, colourless glass tube, containing a string of yellowish beads, of nearly the same diameter as the tube. The theca, when mature, becomes ruptured at the apex, giving escape to the spores one by one: these do not accumulate on the surface of the thalamium as in Sphærophoron. Under the reaction of iodine, the theca assumes a pale blue colour; but this tint is not much better marked at the apex than below. This colour, struck by iodine, is indeed much darker and more distinct among the groups of paraphyses, which separate the bundles of thecæ,—the amylaceous substance producing the reaction being probably a gummy intercellular matter, which cements the elements of the hymenium. While the paraphyses are somewhat vividly, and the thecæ are slightly, tinged blue by iodine, the protoplasm and spores acquire a deep shade of yellow. Hence a section of the hymenium, to which iodine has been added, is, under the microscope, perhaps even a more beautiful object than a section of the same hymenium in its natural state. The thecæ, in the majority of cases, disappear after rupture and escape of their contents. But, in some cases, the spores become shrivelled and aborted, and then carry with them the thecæ as caudate appendages or tails. Sometimes, but rarely, the thecæ present bulgings opposite individual spores, as if the walls were very thin and easily distended by unusually large spores. Such bulgings may occur opposite every spore, or only opposite one or two in a theca; and such thecæ have more or less of a moniliform character. The thecæ appear to be developed with amazing rapidity, young ones shooting upwards from the hypothecium as old ones become ruptured and decay. May we not accept this fecundity of the hypothecium, this great number of thecæ, and consequently of spores, as a beautiful instance of design in an alpine species, to obviate the counteracting influences of extreme cold and atmospheric vicissitudes?

The *paraphyses*, I have already stated, are about equal in length to the thecæ, but they appear to vary somewhat in size. Hence one great reason, probably, of the fact that the apices of the paraphyses *en masse* are not so smooth or even as in the majority of lichens, but are irregular, appearing here and there between or above the apices of the thecæ. They also appear to be fewer in number, compared with the number of the thecæ, than in most lichens; they are collected in bundles, which are sparingly scattered between the groups of thecæ, and by which they look as if compressed. The apices are knobbed; that is, they terminate in irregular wart- or knob-like cells of a deep indigo-blue colour. This colour of the terminal cellules, or articulations of the paraphyses, is the cause or source of the deep tint of the upper surface of the hymenium. The filaments of the paraphyses are delicate and wavy, and form a somewhat lax network *en masse*.

The *spores* are about $\frac{1}{2300}$ inch in diameter. They are regularly globose, having a globular pale yellow nucleus, between which and the cell-wall there is an interspace forming a hyaline distinct margin. Körber says the spore altogether is hyaline and colourless: this I cannot corroborate. The nucleus and protoplasm have always appeared to me pale yellow. In the young state the spore is full of a finely granular or grumous protoplasm. The granules increase in size, and become aggregated into a distinctly circumscribed, globular, homogeneous nucleus, which leaves a hyaline margin, as above described, between itself and the spore-wall. In the old state of the spore the nucleus again resolves itself into a mass of granules and globules, filling the whole cavity of the spore, which may also lose its regularly globose form. The spores are generally in apposition and ranged, one immediately above the other, in linear series in each theca. Until they approach maturity, they are, as has been already mentioned, glued together, though not very tenaciously. Sometimes a smaller number than usual (eight) are developed at intervals in the thecal protoplasm, which appears as a ribbon-shaped mass stringing together the spores like so many beads. The spores never become coated with an indigo powder, or with dark granular débris, as in Sphærophoron, but remain smooth and pale yellow throughout. They bear a certain resemblance, however, to the spores of *Sphærophoron coralloides*, Pers. (Tulasne, Mém., pl. xv, figs. 4 and 8) and of *Calicium turbinatum*, Pers. (Tulasne, Mém., pl. xv, fig. 15); but the bluish-black epispore distinguishes those of the former, and the brown colour those of the latter, while in both the spores are much smaller.

The *spermogones* are visible, under a good lens, as minute, punctiform warts,—black to the naked eye, but deep brown under the microscope. They are sparingly scattered on the surface of the thallus in the neighbourhood of the apothecia, or more frequently on sterile squamules, there being seldom more than two or three on a single squamule, placed at a little distance apart. These warts are found, on examination, to be papillæ pierced by a pore, which is frequently invisible even with the aid of a good lens. This pore is generally simple and round, but it may be finely stellate. It leads into and forms the external opening of the cavity of the spermogone, the body of which is wholly plunged in the substance of the thallus. The spermogone is of a somewhat spherical form; its cavity is simple, and its envelope thickish, and formed of roundish or irregular, small, deep brown cellules, closely aggregated. It is surrounded by the thickish, white, medullary tissue of the thallus, in which it is originally developed as a small nucleiform, brownish mass. The ostiole or pore, instead of opening in a papilla, sometimes, in the old state, is surrounded by a slight depression of the thallus.

The *sterigmata* are about $\frac{1}{1000}$ inch long, but they vary greatly in length. They consist of very fine, sublinear cells, simple, or composed of two or three cylindrical cellules; they are generally kneed, or present irregular bulgings and bendings. They are not unlike the sterigmata of Abrothallus (Monograph of the genus Abrothallus, 'Journal of Microsc. Science,' Jan., 1857, p. 60, and Pl. V, figs. 1 and 2). They usually taper gradually into the spermatia, which are given off as buds from their apices. I could sometimes trace the sterigmata given off in groups of three or five, like fingers or digitate processes, laterally from irregular, ramose, articulated, thickish tubes, imbedded in or springing from the internal walls of the spermogone. The sterigmata are very closely appressed, and *en masse,* under a low power, they appear as mere striæ arranged convergently to the cavity of the spermogone.

The *spermatia* are about $\frac{1}{3000}$ to $\frac{1}{4500}$ inch long. They are straight, rod-shaped, hyaline bodies, with obtuse ends; having, indeed, the characters of the spermatia of the majority of lichens. In some spermogones I did not observe the spermatia floating free; they were attached to the sterigmata. But in such cases they appeared about double the size of those I found in myriads floating free in other spermogones. Tulasne, I think, has noticed a similar phenomenon in the spermogones of certain lichens; and he hazards the opinion, for the fact is by no means established, that such large spermatia, after being thrown off, divide fissiparously into two. In some spermogones, where the spermatia were extremely numerous, they were also so minute that they could with difficulty be distinctly seen (under power 380). (Pl. XI, figs. 1—16.

On Self-division *in* Noctiluca.

By Thomas Brightwell, F.L.S.

The observations we have to communicate on the subject of Noctiluca may properly have for their text or starting-point the following passages in vol. iii of this journal:

Dr. Busch, at p. 201, says—"In Pl. X, fig. 7, is represented an animal apparently referable to Noctiluca, and which might readily be imagined to represent a gemmule fully developed on a perfect Noctiluca, which had pullulated on the disc itself, and only required to be detached to become an independent individual. But the author is rather inclined to believe that it is only an abnormity, a double monster; for, if a germination of this kind really took place in this class of animals, it would be very remarkable that only a single instance of it should be presented among the innumerable multitudes of individuals brought under the author's observation."

Mr. Huxley says, at p. 54—"Quatrefages and Krohn consider that a process of fissiparous multiplication takes place in Noctilucæ; both of these observers having found double individuals, though very rarely. According to the latter writer, division of the body is preceded by that of the *nucleus*. I have not had the good fortune to meet with any of these forms, and the only indication of a possible reproductive apparatus which I have seen, consisted of a number of granular, vesicular bodies of about $\frac{1}{2000}$th inch in diameter, scattered over the surface of the anterior and inferior part of the body."

Dr. Webb, p. 105, remarks—"The mode of reproduction is at present far from being satisfactorily made out. I have never met with a double individual, but on one occasion witnessed the process of division, without, however, noting any proof of its connection with that of fissiparous multiplication."

The facts we have to adduce tend to show that the conclusion of Quatrefages and Krohn, "that a process of fissiparous division takes place in Noctiluca," is correct; but further investigation of the subject is called for, and though we trust these facts will be deemed of sufficient importance to deserve record, we would urge those who have opportunity to follow up the investigation of the subject. Lieutenant-Colonel Baddeley (now residing at Gorlestone, near Yarmouth) has devoted much time and attention to the investigation of a Noctiluca, and it is to his observations and drawings I am almost entirely indebted for the material of this communication.

The Colonel's observations commenced in October, 1856, when the animals were plentiful, and have been continued to the present time (June, 1857), the animals not entirely disappearing in the winter months. Several of the drawings are made from specimens taken in the month of December last; a season when these delicate little creatures would hardly have been looked for on our shores.

We have seen that other observers speak of double forms as of rare occurrence, as abnormities, and double monsters, and mere adhesions. Colonel Baddeley has met with double forms in considerable numbers. I have figures of twenty specimens of double forms, carefully drawn by him from living specimens, each figure being from two to four inches in diameter; and he states that he has never made a gathering of the Noctilucæ without detecting double forms among them, and in some they were abundant.

A general idea of the process of division will best be obtained by the figures we have given, showing the commencement and gradual formation of a double form, and the ultimate disruption into two separate individuals. See Pl. xii, figs. 5, 6, 7, 8, 9.

Colonel Baddeley's observations lead him to infer that this process begins by the gradual formation of a second *nucleus*, which, after its commencement, rapidly arrives at the size and appearance of the other. A second globular substance, also, (termed, by some previous writers on the subject, the *mouth*), is formed in addition and near to the nucleus, and a constriction, small at first, but gradually increasing, takes place, until the perfect Noctilucæ are developed, united at last by a thin band, which is speedily ruptured.

The whole process seems to be accomplished in a few days. In a gathering made the 7th of March last, numerous double specimens were observed. On the 13th of the same month, only two double specimens could be found, held together by a slight band; and from that time to the 27th no double specimens could be detected.*

It will be seen that Krohn, (admitted by Mr. Huxley to be a most excellent and accurate observer) states that *the division of the body is preceded by that of the nucleus;* and it is a strong confirmation of this statement, that Colonel Baddeley, from his own observations only, should have come to the same conclusion.

Colonel Baddeley's remarks on the general structure of these animals, the nucleus, mouth, tooth, cilium, and gastric pouches, agree with those of previous observers as detailed in Mr. Huxley's excellent paper, and they need not be repeated here. Colonel Baddeley observes that scarcely any two individuals are exactly alike, some having the vacuoles and small oil-like globules distributed through their substance, while others have nothing of the kind. He has seen portions of the oil-like globules mixed with fluid pass out below the oral opening, as if through an anal one. Many individuals are also found destitute of the remarkable organ called the tail.

The observations of Dr. Busch (see vol. iii, 'Micr. Journ.,' p. 203), and particularly those of Mr. Gosse (see his 'Rambles on the Devonshire Coast,' p. 257), clearly demonstrate that the Noctilucæ increase also by germs or gemmæ.

Colonel Baddeley's observations have not led to the detec-

* Colonel Baddeley has since satisfied himself that the whole process of division does not occupy more than twelve hours.

tion of any process of this kind; but in many individuals he has observed "the yellow, clear globules, with a central, well-defined nucleus, more or less developed, of a rich reddish hue;" described by the above authors, and deemed, if not proved, by the latter, to be germs of Noctilucæ. (See Gosse, pl. xvi, fig. 10.)

When irritated, the Noctilucæ give out a phosphorescent light, which under a high magnifying power presents points of light more intense than the general glow. In captivity they soon lose this power.

Little has hitherto been said as to the food of the Noctilucæ, and it will, we think, surprise some of our readers, to find that these animals, small as they are, are sustained by Diatomaceæ, and that, in these microphagists, we have the means of supplying our cabinets with specimens of some of our rarer diatoms.

Colonel Baddeley observes that he finds, when newly gathered, each Noctiluca has several diatoms in its interior, lying in the various chambers or gastric pouches distributed throughout the body of the animal. These diatoms all disappear in a few days, leaving nothing visible but the vacuoles, or alimentary sacs, filled with granular particles. A very careful pressure shows an orifice, near the tail of the animal, the opening of which may be detected by careful pressing, and from this is protruded, by continuous gentle pressure, a very thin hyaline sac, filling gradually with fluid and small globular particles, till it attains about one third the size of the animal, when it bursts and disappears. On a greater pressure being applied, the so-called mouth, together with the thread-like walls (the network of fibres and fibrils of Mr. Huxley), shoot out through the opening, and float away.

In a paper published by Mr. Huxley in the 'Annals Nat. Hist.' (vol. viii, new series, p. 433), on *Thalassicolla,* he states that its structure is essentially similar to that of *Noctiluca,* and that there is a perfect analogy between the structure of his *Thalassicolla nucleata* and *Actinophrys Sol.* He defines the latter, "a spherical gelatinous mass, consisting of an internal dark granular portion, and a clearer external zone, from which many radiating threads are given off. Vacuolæ are scattered through the substance, larger in the external zone, smaller and more irregular in the interior. If the animal is much compressed nuclei and nucleated cells are forced out from its interior." Mr. Huxley, in this paper, intimates his opinion that, in the case of *Actinophrys sol* and *Noctilucæ,* no spontaneous fission takes place, but that two individuals may fuse together and become one.

In 1848, I stated, from my own observations, that *Act. Sol* multiplied by self-division, two and sometimes three individuals adhering by the outer edge only. (See 'Fauna Infusoria,' p. 21.) Eichhorn is also stated to have seen self-division in *A. Sol;* and the question may, we think, be considered as put to rest by Mr. Weston, who has, from his own repeated observations, written down self-division in *A. Sol as a fact.* (See 'Micr. Journ.,' vol. iv, p. 120.)

The facts now brought to light relative to the Noctilucæ, tend, we apprehend, to show that they must take their place in the lower rank of organized beings, and that they have some affinity with *Actinophrys Sol,* though by no means congeners with it.

Before completing the plate illustrating this article, Mr. Tuffen West went down to Gorlestone to make some additional drawings from living specimens, and he has also furnished me with some notes, the result of his observations, which I have great pleasure in adding to this paper.

"Slight movements of the Noctilucæ cause them to vary so much in their apparent form, that it is difficult to obtain an exact idea of their true figure. By turning the live box in which specimens are contained upside down occasionally, and watching them as in their progress to the surface they roll over and over, a good idea of these changes of appearance may be obtained. A pyriform or balloon shape is thus frequently seen, at the smaller end of which is the fissure described by previous observers, and near to it the mouth with the root of the tail, &c. We term this '*the side-view*' (see fig. 2). The so-called 'tooth,' or rather '*prehensile organ,*' in some cases presents exactly the appearance figured by Mr. Webb; in others that given by Mr. Huxley ('Micr. Journ.,' vol. iii, Pl. V, fig. 34 *d*). It appears to be formed by a duplicature of the general integument, from which it differs little in density or appearance. I did not see it in independent motion, but repeatedly moved in connection with the movements of the tail.

"The 'cilium' once seen can hardly fail to be again instantly detected; its action is intermittent; periods of rest of a second or two being followed by rapid undulatory movements for eight or ten seconds. Its motion is probably subservient to respiration, and is to be classed with the 'trembling organs' so lucidly described by Professor Huxley in *Lacinularia* ('Trans. Micr. Soc.,' vol. i, n. s., p. 7), and subsequently in *Echinococcus.* The sarcode fibrils constantly, though slowly, change their form and position. I once saw two processes move rapidly out from near the nucleus, precisely like those of an Amæba; these were shortly afterwards withdrawn. The granules with which the fibrils are studded glide gently up and down the threads. The vacuoles may also be seen to change their form and position under the eye of the observer, and sometimes they entirely disappear in individuals that have fasted for some days Pl. XII, fig. 6). They appear to be temporary sacs or stomachs, formed in the sarcode mass as they are required for the reception of food, and ceasing to exist as such after the food is digested. The number and size of the vacuoles communicate a greater or less degree of buoyancy, and so enable the animal to rise or sink. The mouth of the Noctiluca is probably a mere slit. The form given in fig. 15 may perhaps be the œsophagus. The 'pinching off' a portion of the body of a Noctiluca, described by Dr. Webb, has been repeatedly seen by Colonel Baddeley, who showed me one example of it (fig. 10); it may, perhaps, be an abortive attempt at self-division, failing from the absence of a *nucleus.*

"The existence of striped muscular fibre in the Polyzoa, when first asserted by Mr. Busk, was received with much hesitation, though it is now an established fact. The tail of the Noctiluca appears also to me to contain *striped muscular fibre.* Late researches go far to prove that (whatever may be the true explanation of the appearance called striation) its presence has much to do with the power and rapidity of muscular action. The powerful motion of the tail in a Noctiluca is very remarkable in so small a creature."

An examination of the Diatomaceæ found in the Noctilucæ has brought to light facts of not less interest than those arising from an examination of the animals themselves.

Professor Smith (in vol. i of his 'Brit. Diat.') has described and figured (see 'B. D.,' p. 27, and pl. v, fig. 46) what he, at first, called *Triceratium striolatum,* and corrected to *T. undulatum* of Ehr. There appears a pseudo-nodule in the centre of the figure given of this species, but Professor Smith, in his observations on the genus, p. 26, observes—"The appearance of this pseudo-nodule is probably accidental in the single individual from which the figure was drawn."

I had never seen a recent specimen of *T. undulatum* till Colonel Baddeley's examination of the Noctilucæ brought many under observation. Those prepared in acid showed the pseudo-nodule as in Professor Smith's figure, but a careful examination of the material, subjected only to repeated washings in soft water, brought to light these Triceratia in a connected state, and has shown that the so-called pseudo-nodule was only the stump of a long cylindrical horn, standing straight out from the centre of the triangular end of the frustule. The edges of the end are fringed with a comb-like row of papillæ or setæ. In the same state of the gathering were also seen individuals having the end view in the form given by Professor Smith.

Triceratium striolatum, Roper, *T. alternans*, and *T. variable* were found in the same material, but the species which seems to constitute the principal food of the Noctilucæ is the *Actinocyclus undulatus*, Kutz. It has been found in very great numbers in every gathering, and it appears to constitute a large proportion of the diatomaceous contents of the Noctilucæ.

Living specimens of another form, which we deem to belong to the genus *Rhizosolenia* of Ehr., were detected in the Noctilucæ, and we have also received from Mr. Norton, of Hull, specimens of the same, or a nearly allied species, found in an Ascidian, in which Mr. Norton was fortunate enough to detect many specimens in a perfect state.

This species consists of a long transparent tube, having a delicate twisted or spiral appearance, running through its whole length, as in some of the fresh-water Algæ, and at either extremity a styliform testule, with bifid branches inserted in the tube. The entire forms, when subjected to acid, break up, and leave the siliceous Rhizosolenian frustules perfect; but fragments only of the tube are found, in the shape of imperfect rings. We propose, under the above definition, to give this species the name of *R. styliformis*.

We hope to be able to give further details of the remarkable forms of Diatomaceæ found in the Noctilucæ in a future number of this journal.

On the Microscopical Characters *of certain so-called* Cetacean Bones *associated with* Cetolites *in the* Detrital Bed *of the* Red Crag *at* Felixstow, Suffolk. By the Rev. J. B. P. Dennis, F.G.S.

In the detrital bed at the base of the Red Crag, especially at Felixstow, in the county of Suffolk, are found very singular fossils, and in such considerable quantities that they have been made available for economic purposes. But while the manufacturer of artificial manure is daily grinding down heaps of the relics of a former world to renovate the earth, in accordance with that law by which Nature, phœnix-like, arises with renewed beauty out of her own ashes, surely it would be ill becoming the scientific age we live in, not to derive at the same time intellectual advantage from these remarkable remains; and this has, in some measure, already been done—for amongst the fossilized fragments some were observed to be of regular form, and, though water-worn, still gave indications of their origin, and the credit is due to the Rev. Professor Henslow for the discovery of the tympanic bones of whales of which Professor Owen has determined several species. I am not aware, however, that any attempt has been made satisfactorily to determine by the aid of the microscope the nature of other associated bones which, from their irregular shapes, afforded no sure indications of the animals to which they once belonged, and I think it has been too prematurely concluded that they all belonged to huge whales, which have so plentifully left their ear-bones in the Crag; the microscope, and that alone, if judgment be employed in its use, must eventually settle this question. These irregular portions of bones evidently belonged to massive animals, and our study must be directed to other bones of such animals for a solution of the problem before us; and it would be certainly jumping too soon at a conclusion to assign all the rolled bones found in the Red Crag to cetacean origin, because the hard tympanic bones of many whales have escaped the wreck of ages, and still remain as monuments of those huge creatures that once sported in primæval seas. In fact, a slight examination of those osseous stones that have been rolled like the flints and other portions of rocks that form the present shingle on our coasts, must lead us to suspect the existence formerly of mighty mammifers which probably once trod on dry land and roamed over extensive regions; and who shall estimate the centuries during which those bones have rolled to and fro on some primæval beach, lashed by the surge of seas which have, like those ponderous animals, been swallowed up by all-devouring time. We may fancy their first entombment, when probably numbers fell a sacrifice to some geological vicissitude during the convulsions of Nature in her throes to give birth to the world we live in, while she travailed with child—the future parent of civilisation and of the arts and sciences. Then again we see the deposit in which they were inclosed—"the great mammoth burial-ground"—broken up, becoming the sport of ocean, the bones torn from their resting-place and dashed to fragments on the shore, the harder portions resisting the action of the waves, and fighting for the mastery inch by inch, until the waters, vanquished at last, have spent their fury, perhaps shutting themselves out by their own turbulence, or else the land has risen in its defence. Thus again the osseous fragments are found entombed—the diminished, but not totally destroyed, remains of noble forms. Ages again roll on, and the Red Crag protects them, but not for ever,—the sea returns to the attack, and man, more ruthless than the waves, seizes upon them, and carries them away from their resting-place to grind them fine as the dust, and scatter them over the fields, not like the sown dragons' teeth, to raise a crop of mail-clad warriors, but that they may reappear in the staff of life, and so fill the fields with joy and gladden the heart of man. To descend, however, from the regions of fancy, if a reality in some measure has not been fancied, let us engage ourselves with the facts before us.

I have before my view some of these queer-shaped fossils, as hard as stones, shining as if the waves had licked their surfaces for countless ages; yet still, in their roughly chiselled outlines, may be traced the characters of bone, the abraded cancellous texture in parts is visible, and if you break one with a hammer, the grain, so to speak, of bone, and that of some once powerful animal, becomes apparent, the eye at once assures you that these stones were bones ages ago, endowed with life and motion; and if a step further is gone, and a chip, shivered off by the stroke of the hammer, is placed upon a glass slide, and warmed with a little marine glue over a lamp, and then, when it is cool, ground to a fine section, the microscope will reveal the marvellous structure of bone; then will be seen Haversian tubes and numerous lacunæ, and very often with their canaliculi in perfection, and so they plainly speak to you, if you can interpret their characters, what their former life was, and to what animals they belonged; for no Assyrian cuneiform inscription, no Egyptian hieroglyphic, ever told a plainer story to the skilful interpreter than these bones will tell to him who takes the trouble to look into their legible characters; nor do I deem the inquiry a trifling one, for, indeed, it is a matter of deep interest to the geologist and naturalist to restore lost forms of life—and this is rendered practicable by the patient examination of fossil and recent bone. If a section of fossil or recent bone of any known and large Pachyderm is examined under the microscope, two very distinct kinds of lacunæ, each with characteristic canaliculi, are apparent—the one sort fusiform, with numerous fine and nearly straight canaliculi; the other oval or roundish, with thicker-stemmed, less numerous, and branched canaliculi. Nor are the fusiform intermixed with the others, but form separately bands or stripes parallel with the Haversian tubes, or surrounding them, as the section may happen to be made. Between these bands appear the other distinct and characteristic lacunæ, which for the sake of distinction I shall term free lacunæ, as the others, for the same reason, may be called Haversian lacunæ. These distinctions are not any peculiarity in the bones of Pachyderms, and are equally shown in those of Cetaceans. In an inquiry, then, of this sort, we have to consider, amidst a general resemblance, the nice and real points of difference. In the comparison of mammalian bone, the question is more one of degree than anything else; Cetaceans present a *coarser character of bone* than Pachyderms. At an early period of my investigations I was somewhat misled by engravings of whale's bone, from which I thought that the canaliculi of its bone were numerous and fine; actual observation teaches me that such is not the case. The canaliculi in all cetacean bone are, for mammalian bone, coarse, and easily distinguishable from those of the elephant, &c. I have now examined both the Greenland whale, sperm whale, dugong, manatee, dolphin, porpoise, walrus, and seal, and find this *characteristic of all*—the dolphin and seal approaching the nearest in respect of fineness to the elephant; for even the ivory-like rib-bone of the dugong exhibits canaliculi visibly coarse in comparison with those seen in Pachyderms.

In cetacean bone, especially in the Greenland whale, sperm whale, and porpoise, as also in others in a less degree, the canaliculi of the free lacunæ very often branch out in a long and straggling manner, as shown at Pl. XIII, fig. 10; and this appears to be a distinctive characteristic of the whale's bone, and more so in the Greenland than the sperm whale; it is also well seen in the porpoise, &c. The bones of both the elephant and whale which have been obtained from the Drift are generally very perfect as to their microscopical characters. In the fossil whale, the free lacunæ having coarse, few, and straggling canaliculi, give a very clear and distinctive character to its bone, while the greater number and greater fineness of them in the elephant sufficiently distinguish the bone of that animal from the whale. The greater general regularity of the free lacunæ in Pachyderms, both as regards form and direction, affords another test. The canaliculi of the Haversian lacunæ of both the Greenland and sperm-whales often run into one another, or dilate in portions of their course, especially at the ends, which is a marked distinction from the fine and delicate characters of those of the elephant. The Haversian tubes, when they are better understood, will also furnish other clear distinctions; but it is, perhaps, too premature, at present, to found any arguments upon them; yet in the case of figs. 1 and 6, it may be seen, especially in the latter, that there is no correspondence with the whale. Fig. 1 is taken from a flat fragment of bone which, if it belonged to the whale, must have been a rib. It differs from that of the whale's rib as well in its fine and close-grained structure, as in the character of its Haversian tubes. The whale's rib appears to be made up of cancellous structure, while in the rib of the sperm-whale the Haversian tubes expand into the same sort of cavities, but I can detect very little difference otherwise; perhaps the canaliculi in the sperm whale are a trifle finer and more numerous than those of the Greenland whale. Fig. 1 represents a section of rolled Crag bone just adverted to; and fig. 2, fossil elephant from the Drift; and on the right, figs. 8 and 9, the jaw of the whale, recent, and the vertebra of the same, fossil: they are accurately engraved, so as to show the relative thickness and number of the canaliculi. Fig. 1, in its Haversian lacunæ, shows the delicacy and distinctness characteristic of Pachyderms; and the free lacunæ compare in all essentials likewise. The marvellous distinctness often exhibited in the fossil bone of the Drift elephant I have not met with in any Crag specimen; the canaliculi more or less are obliterated, but in those parts of the section where they are less so the correspondence is visible. Fig. 3 gives, more highly magnified, the free lacunæ of a Crag fossil and Drift elephant, taken from different specimens, but exhibiting the same characters; and, in fig. 4, are seen the Haversian lacunæ of Crag and Drift fossils compared together; and on the opposite side of the plate (figs. 10 and 11) are shown the lacunæ, free and Haversian, of the recent and fossil whale, magnified in a similar degree; by which the relative coarseness and numerical proportion of the canaliculi may be judged of, as well as their blurred appearance and their thickening at the ends, so very apparent both in the Greenland and sperm whales. In figs. 3 *a*, 4 *a*, representing lacunæ of the Crag fossils, it will be seen that as much as they approach those of the fossil and recent elephant (figs. 3 *b*, 4 *b*, and 12 *a* and *b*), so in an equal degree do they differ from those of the whale (figs. 10 and 11). I cannot distinguish any difference in size between the canaliculi of fig. 4 *a* and fig. 4 *b*, though, from the more perfect condition of fig. 4 *b*, they appear more numerous. They appear finer and more numerous than those of fig. 14 *a*, which is elephant from the Gravel, as also they compared well with those of the recent elephant. Not having yet been able to procure the bone of the mastodon, I am ignorant at present of its correspondence with the elephant in this respect.

The very general similarity of cetacean bone is a great help in the matter, and nothing can be more striking than the comparison of recent with fossil bone. Their agreement is shown in figs. 8, 9, 10, 11, with which the other figures of Crag and elephant bone, &c., bear no likeness. There seems, then, to me to be fair evidence, as shown by microscopical comparison, that the bones of Pachyderms, or at least of land animals perhaps of more massive proportions, are discoverable in the rolled Red Crag fossils. But perhaps a step even further may be gained. Fig. 12 represents the lacunæ of the elephant; fig. 5 *a* those of the hippopotamus; and fig. 5 *b* those of the rhinoceros; by which it may be seen that the free lacunæ in each of these animals differ—those of the rhinoceros being more distinct and somewhat smaller than the elephant's, and those of the hippopotamus being larger; and from noticing these distinctions, I have been led to suspect that in the rolled bones of the Crag several different genera are represented. Fig. 13 very much compares with the bone of the hippopotamus by the intermixture of sets of larger lacunæ, as also by the twisted characters of the Haversian bands; unfortunately the canaliculi are destroyed. Fig. 6, in its more perfect lacunæ, agrees, perhaps, with the rhinoceros; it has nothing whatever cetacean in its character. The Haversian tubes, in fig. 6, indicate a land animal, and one that moved with some speed over the ground, and such a disposition I have not yet found in any cetacean bone. Taking fig. 6, both as regards the Haversian tubes, lacunæ, and canaliculi, it affords a most instructive instance of the existence of a land animal, of which we can obtain no further information than that which a small portion of its bone supplies us with; that information, however, is important; and we only wait for further knowledge concerning the disposition of the Haversian tubes to enable us, as it were, to replace the fragment in its proper position in the skeleton. At fig. 7 is a comparison of another Crag fossil with fossil elephant from the Himalayan mountains; fig. 7 *a* represents the ordinary characters of very many of the Crag rolled bones; fig. 7 *b* giving a portion of the vertebra of the fossil Himalayan elephant. Neither specimens of bones are very perfect in details, but are very similar in general characters, and appear to have experienced, before they became fossilized, a very similar partial decay. Fig. 14 *a* represents elephant bone from the Suffolk Gravel, much decomposed and hardly fossilized. This compares well with the recent elephant, and better with fig. 1 than with fig. 2;

but it is very probable that the different circumstances attending the fossilization of bones from different formations may have the effect of giving a somewhat different appearance to them, and which must be taken into account in deciding upon them. To show the extent to which even recent bone may be decomposed, if only exposed for some time to atmospheric agency, I have introduced, at fig. 16 *b*, a section of the spinous process of the vertebra of a porpoise picked up off the shore at Felixstow. In outward appearance the vertebra was unaltered, but the continued action of the elements has obliterated all internal *microscopical* organization in the bone. You may search in vain for lacunæ, canaliculi, or Haversian tubes. This same destruction of microscopical structure, more or less, I have observed in bones that have been buried in soil for a length of time, as grave-yard bones, or have been otherwise exposed to the action of decay; and it is not enough in inquiries of this sort to acquaint ourselves with the characters of recent or perfect bone, but we ought also to know the different appearances or stages of decomposed bone, and for this purpose I have examined half-decayed bone, such as may lie tossing about in the soil of a garden, or have been buried in loose material. However decomposed bone may be when even the Haversian tubes are obliterated, yet here and there possibly may be found a stray lacuna with pretty perfect canaliculi; and so distinctive appear to be the great classes in this respect, that one perfect lacuna, with its canaliculi, is enough to decide the class of vertebrata to which the bone belongs. But I fancy had I brought forward any fossil bone as much decomposed as the recent bone is that I have figured at fig. 14 *b*, and attempted to prove even in its decomposed state that it might have been mammalian, no one would have believed me. And this should teach us what great caution is required before we reject as not mammalian any fossil bone which has been more or less exposed to those destroying influences that appear to date the beginning of their operation even in primæval times. And it is a matter of great wonder that, in spite of these sinister influences, so much of their true characters are yet retained in bones that have fallen under their sway for ages; and we can only account for it by the presence of an antagonistic principle by which organic substances are changed to fossils, and thus decay becomes arrested when once the magic wand of petrifaction has touched their particles, which before were ready to take wing and fly away.

To sum up:—A very patient comparison of cetacean and pachydermal bone, both recent and fossil, with the Red Crag fossils, such as are shown in the plate, having established in my mind the leading distinctions that appear to exist between the elephant and the whale as respects the microscopical characters of their bone, though I cannot positively identify the Crag fossils with either the recent or fossil elephant, yet their much greater analogy with the elephant than with the whale, their agreement in all essential particulars with the pachydermal type,—(as indicated by the greater fineness and number of the canaliculi, by the greater uniformity of the lacunæ, and also, with great probability, by the characters of the Haversian tubes)—induce me to conclude that the animals to which such bones once belonged were not truly aquatic in their habits, but were land animals, or, if at all aquatic, that they had the means of terrestrial progression such as are enjoyed by large Pachyderms. The considerable thickness of the cortical portion of the bone in these Crag fossils appears also to afford another argument against their cetacean origin, for the apparently massive jaws of the whale have only a thin coating of cortical substance enclosing the cancellous structure. I do not know why we should disbelieve the evidence I have adduced of the existence of these Pachyderms, when portions of the teeth of the mastodon have been obtained from the Red Crag, of which there is a rolled fragment in the Museum of Bury St. Edmunds. If the rolled bones which I have examined are cetacean, they are microscopically distinct from all known Cetaceans which I have had the means of examining; but supposing I am mistaken, still the subject is of sufficient interest to justify an inquiry, nor am I aware that the attempt has been made before, either to draw a comparison between the microscopical characters of the bone of Cetaceans and Pachyderms, or to figure any of the rolled bones of the Suffolk Crag.

But the question arises, where and when did these animals live? Fresh disclosures are now daily coming to light in reference to the ancient mammalia of the earth. To say nothing of the Microlestes of the Trias of Wirtemberg, or of the rib-bone from the Lyme Regis bone-bed, and which the inimitable engraving of Mr. Tuffen West, as given in the 16th number of this journal, shows could have belonged to no other animal than a mammifer, nor to mention the four Stonesfield mammalian jaws,* one of which, the *Stereognathus ooliticus*, I discovered myself, we have now the announcement from Sir Charles Lyell, in his Supplement to

* That is, of four distinct animals, viz., *Amphitherium Prevostii*, *A. Broderipii*, *Pharcolotherium Bucklandi*, and my *Stereognathus Ooliticus*.

the fifth edition of his 'Manual of Elementary Geology,' of the discovery by Mr. Beckles, in the Middle Purbeck Oolite, of about fourteen different mammifers; and it is worthy of notice that all these animals were of small size, the largest not exceeding a rabbit. Are we to suppose that no large mammifers were cotemporary with these living creatures, and may it not *be just possible, that in the Red Crag of Suffolk, exist the mammalian relics of cotemporaries of* Stereognathus, *of* Spalacotherium, *and* Plagiaulax. The giving utterance to such an idea may, in the eyes of some, convict me of geological heresy; but if we look a little into the facts of the case, it will perhaps not appear so imaginary as at first sight. The first question to consider is, did they belong to the Red Crag or Pliocene period? or, in other words, were the animals living about the time of that formation? If so, supposing that inundations and rivers conveyed these once ponderous bones to the sea, and the sea then rolled them, they must have become fossilized after they were deposited in the Red Crag; but, on the contrary, they show evidence of having been fossilized anterior to their having been rolled—they have still the gloss upon them that they acquired when they formed the shingle on the beach. They were *veritable stones then;* if they had not been so, all trace of the structure of bone would have been obliterated, whereas this structure is often marvellously preserved. There must then have existed some deposit that once contained the fossils in a more perfect condition, and where they *became petrifactions*; the older Tertiary beds in this country, with the exception of a cetolite and several cetacean fragments found in the London Clay, affording no clue as to their primary sepulture; and supposing them to be the spoils of Eocene deposits, we have a right to expect to find them there in greater numbers and perfection. I cannot think, then, that the deposit to which they primarily belonged is anywhere developed in this country; and they might have lived, for aught we know to the contrary, when Oolitic forest trees grew in Portland, and have trodden down beneath their feet tropical cycadites. If a rolled flint is picked up, though time has altered its outward appearance, there is no difficulty in determining whence it came, though we may not be able to follow it through all the journeys it has made since it became a hard substance; and so the mineral characters of the Crag fossils seem to afford the best, perhaps the only clue to the time when they formed parts of living beings, and these characters appear to agree with those of fossilized bone belonging to a period anterior to the Tertiary strata of this country. Surely, if the bones of the iguanodon had found their way from the Wealden to the Red Crag, and had been rolled and tossed about *in transitu*, they would have presented to the eye very similar mineral characters; in fact, I have a small portion of rolled bone in Oolite, having the same gloss and fracture; but as this is not a microscopical question, I need not pursue it any further.

If the assumption of Sir Charles Lyell is worthy, as it seems to be, of our consideration, and that, to quote his striking language, "we may now with more confidence assume that the sea of the Coralline Crag was open to the south, so that shells of southern forms lived in it, until at length the bed of the sea having been upraised 650 or 700 feet, all communication with warmer latitudes was cut off, and the fauna of the Red Crag acquired its more boreal characters;" then, upon this hypothesis of a sea open to the north, and by the destruction of strata as well, fragments of fossil bone would have got into the Crag sea, as Drift fossils now are continually doing on the Norfolk coast, and were rolled along the beach perhaps for ages, and during which they might have travelled considerable distances. How little should we have known of the animals whose bones have been found in Kirkdale Cave, if Hyænas had not resorted there. So in reference to the rolled bones of the Red Crag, the accidental circumstance of their having been treasured up therein as relics of the ravenous sea, has given us a knowledge of them which otherwise we could not have obtained, whether they belonged to the Tertiary or Secondary epoch.

On "FINDERS" *for* MICROSCOPES.

By ARTHUR M. EDWARDS, of New York, U.S.A.

THE importance of having an instrument, simple, and at the same time accurate, for the purpose of registering objects mounted on microscope-slides, so that they can easily and with certainty be again found, has occupied the minds of microscopists at different times; and several pieces of apparatus, more or less complicated, have been the result.

Perhaps the best of these is that invented by the late Professor J. W. Bailey, whose recent loss cannot be felt more by his countrymen, than it will be by the lovers of science in Europe.*

In the report of the committee of the Microscopical Society, appointed to consider the subject of an efficient *finder* for the microscope, the following properties were considered essential:—"*First.* It should be applicable to any microscope, whether furnished with stage movements or not; and it should not preclude the use of those movements. *Second.* It should not require new labels to be placed on the slides, or any mark or index to be made upon them. *Third.* It should not be necessary to remove the slide or finder for the registering or finding of every separate object. *Fourth.* The divisions on the index should be easily read. *Fifth.* It should allow the microscope to be used in the inclined position; and—*Sixth.* It should be cheap, and simple enough to be constructed by any one possessing a moderate amount of mechanical skill."

The first of two instruments which I am about to describe fulfils all of these requirements, if we except, perhaps, that one which says it should be so simple that it might be made by the microscopist himself. It is true that mine could really be so made; but when we wish for exactness in graduation in an instrument of this kind, it is best to have it so graduated by a proper workman; and I have had mine engraved, so that I might have as many impressions as I should need, all alike in the essential point of correct graduation.

As the slides mostly in use are those of the dimensions recommended by the Microscopical Society (of three inches by one), I have had my indicator made to that size; though, of course, as will be seen from the description, it could be of any dimensions.

Before describing the indicator itself, I shall speak of the preparation of the microscope necessary for its use.

The stage is ruled with two lines across it, intersecting each other exactly in the centre of the field of vision; and in the case of those microscopes having mechanical stages, these lines are continued across a circular piece of glass, which is made to fit into the hole in the stage, and the point where they cut each other is always brought into the centre

* Professor Bailey has bequeathed to the Boston (U.S.) Society of Natural History his whole microscopical collection, contained in books, with an index-volume, his collection of Algæ, his rough material for microscope research, including his cabinet of minute fossil animal and vegetable forms together with his microscopic memoranda and unpublished papers, and his very valuable library of microscopic and botanical works.

of the field by the stage movements when the indicator is about to be used. This ruling of the stage and circular piece of glass can, however, be done away with, by using a card of the same dimensions as the stage on which the two lines are drawn with a fine pen, and a circular portion in the centre made removable by a hinge or otherwise.

The indicator itself is a slip of paper the same size as the slide, viz., three inches by one, as seen in fig. 1, and has two

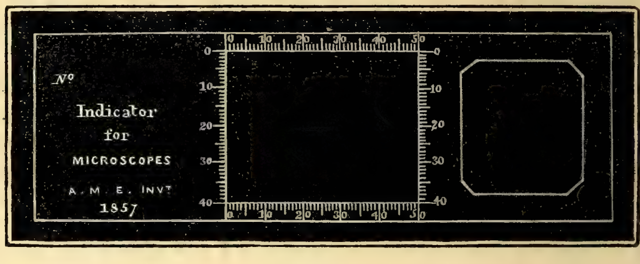


Fig. 1.

lines drawn across it, one inch from each end, which are graduated in fiftieths of an inch. At one tenth of an inch from each side, a line is drawn connecting the others, and these are also graduated in fiftieths of an inch.* By this arrangement the horizontal lines, which are numbered from left to right, bear the figures 0 to 50; and the perpendicular ones, in which they run from top to bottom, from 0 to 40.

On one end of the paper is a space for the number of the slide, and on the other, one for the description of the object mounted thereon. The blank space of paper between the scales is cut out, and after writing (in the parts assigned to them) the number and description of the object, the indicator is fastened to the glass slide with its face to the opposite side to which the object is; so that the graduations can be read through the glass, which serves to preserve both them and the label from being soiled.

When we wish to use the indicator, we have simply to place the slide on the stage; and when we find an object that we wish to register, we bring it to the centre of the field of vision, and then observe what numbers the two lines (as *a a′* and *b b′*, in fig. 2), ruled on the stage or card cut.

For instance, in the figure they cut 40 in the horizontal scale, and 15 in the perpendicular one; and, supposing the

* The United States inch is the same as the English.

object to be a *Pinnularia grandis*, we register it thus,—*Pinnularia grandis*, $\frac{40}{15}$, together with the number of the slide.

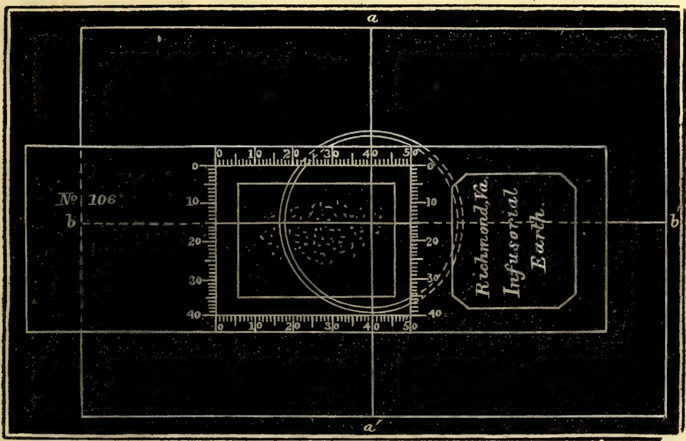


Fig. 2.

I have found it very often convenient to write them on the back of the indicator itself.

When the lines on the stage do not exactly correspond to one of the lines in the graduations, but fall between them, we can, with safety, guess at the distance (thus 25, 5, or 25, 2), as I have found that, though in this case the object may not always, when it is looked for again, be found exactly in the centre of the field of vision, it will generally be within its limits. Sometimes, however, the slide may be shifted, so as not to lie parallel with the registering lines, and, consequently they will not cut the same numbered graduations on opposite scales; thus, they may cut 30 in the upper horizontal line and 20 in the lower, 10 in the right hand perpendicular line and 20 in the left; in this case we register it thus $\overset{30}{\underset{20}{20\times10}}$, or else bring it so that they will coincide. In the example given it would be 25 in the horizontal and 15 in the perpendicular lines.

It will be noticed, that though there may be faults in the graduation of this indicator, it will not make any essential difference in its use, as the indicator is never removed from the slide which it registers, and therefore, as I before mentioned, it fulfils the sixth condition of the committee, and can be made by the microscopist himself.

I herewith send a few impressions of this indicator, with the hope that this little contrivance may prove of as much use to others as it has been to me, cheerfully submitting it to the consideration of microscopists.

My second instrument I desire to call a *registrar;* it is, in fact an indicator, adapted to the use of microscopes with mechanical stages only, and will be found represented in figs. 3 and 4.

In these illustrations (3 and 4) the stage is three inches by

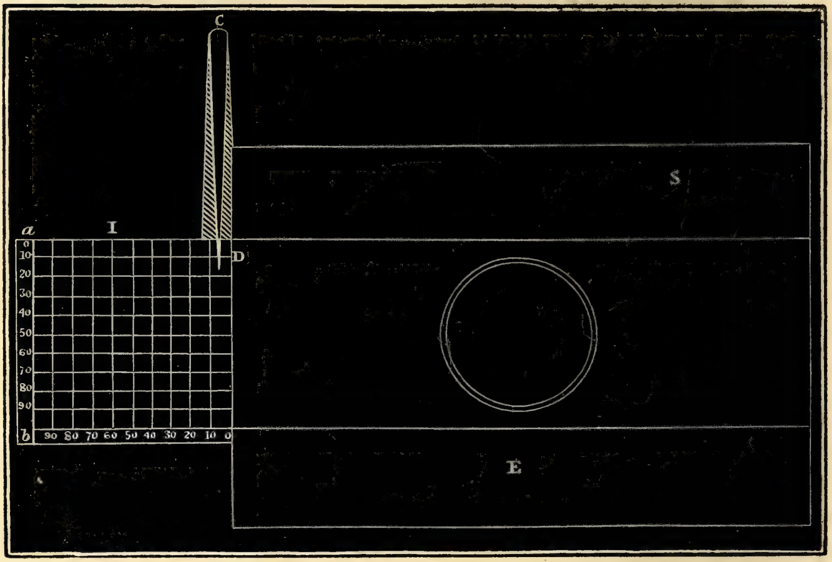


Fig. 3.

two, although, of course, this contrivance could be adapted to those of other dimensions. The stage, S, has a strip of brass, E, fastened to it, of the thickness and length of the glass slides. This strip is arranged, at one half an inch from a line drawn through the centre of the circular hole in the stage, so as to bring the centre of the slide into the middle of the field of vision.

On one side of the stage, at one and a half inch from the centre, is fixed a piece of ivory, I, measuring one and one tenth of an inch each way, and ruled with lines cutting each other across at one fiftieth of an inch apart;* the side strip (as *a*, in fig. 3) is reserved for the numbers, which run from

* In the figure, the lines are represented at only $\frac{1}{10}$th of an inch apart, to save the engraver trouble.

top to bottom, and the bottom strip (as *b* in the fig.) is also reserved for the same purpose, in which they run from right to left.

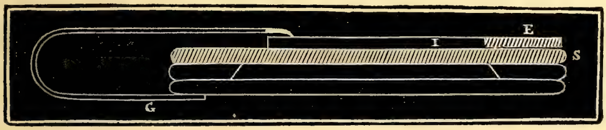


Fig. 4.

When the slide is placed on the stage it rests against this ivory scale and the brass guide-strip, so that it coincides exactly with that of the field of vision. A strip of brass is now bent into the form seen in the figure, c, and fastened at one end to the fixed stage on which the other moves, at G. The other end is brought to a fine point, and is blackened, so that it can be easily seen upon the ivory registrar. This strip or pointer is so arranged that when the moveable stage is brought perfectly square with the fixed one, its point rests at 50 in the upper zero line.

From an examination of the figures, it will be at once seen that, as the stage is moved in any direction, the registrar moves under the point, and when we find an object which we wish to register, we look at the pointer and observe the lines it points to, and write them down in the form of a vulgar fraction, *i. e.*, the numbers on the scale *a*, above the line, and those on *b* below.*

This registrar will be found to be of use on searching a slide for the first time, as we can begin at zero and travel across to 10; then, falling one or two graduations, we return across the scale, noticing the object by the way, and in this manner we traverse the whole portion of the slide upon which the objects are placed.

This instrument will not be of so extensive an application as the one first described, but still it would be found useful when attached to microscopes having mechanical stages.

* I should perhaps mention that I have found the best substance for attaching the paper indicator to glass slides to be the so-called "mucilage" sold at stationers' shops.

An Adjustable Index Point *for the* Scale *to be used as a* Marker. By W. K. Bridgman.

In carrying out the principles laid down by the committee appointed by the council of the Microscopical Society, I have succeeded in producing an arrangement capable of doing double duty—serving as a "marker," and, at the same time, being an index to the scale as a "finder"—so that either or both may be used upon the same object at any time without requiring a separate carrier, or interfering with any of the arrangements either of the slide or the object-glass.

Now, although a mark upon the label, or on the end of the slide itself, may be held to be inadmissible as a *permanent* record, abundant proof has already been afforded that, by the present contrivance, much time may be saved, and the ordinary use of the microscope greatly facilitated.

I look upon the objects we are seeking to attain as two-fold:

1st. To save one's own time; and

2d. To secure identity, either for oneself, or to enable other observers to find with certainty the particular specimens intended for their examination.

As securing both these important objects, I offer a plan which is almost instantaneous in action, both for "marking" and for "finding," and so easy of application, that it may readily be used by the veriest tyro in microscopic manipulation. It is also simple in construction, and capable of being applied to every form of instrument. But as very few microscopists are mechanics, no plan can be fully carried out unless our London makers take up the subject, and include finders in the purchasable furniture of the microscope.

The method of arranging the index, as described in the report given in your number for October last, p. 95, leaves the space between this and the centre of the field an arbitrary distance. In our own plan, this space is fixed at *one inch from the object, in a line parallel with the lower edge of the slide.* The reason for taking this standard of measurement is that, as the ordinary slides (three inches by one) contain three square inches, allowing the centre inch for the reception of the objects and their cover, a square inch will remain at each end, to be used either for the label as a marker, or to be covered by the scale as a finder; and any two points, one inch apart in the same horizontal line (measuring from any point in the middle inch to any position in the other inch at either end), will be represented, in exactly a corresponding position the counterpart of any spot in the one must of necessity fall within the area of the other. In our finder, this distance being first determined upon, a slide prepared for the purpose, is transferred to the instrument, which then becomes the medium for measuring a similar distance upon any other slide. The arm, A, fig. 1, carrying the index, is made a fixture to

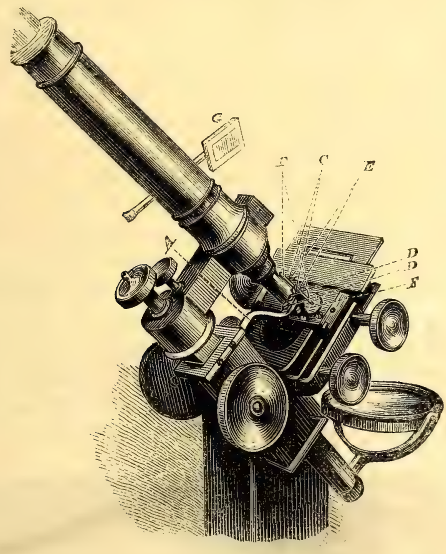


Fig. 1.

the instrument, and is brought to the right side of the object-glass as the most convenient position. The index itself, B, fig. 1, is a piece of steel wire, about one tenth of an inch in diameter, and an inch and a half long, sliding up and down in a brass tube, C, at right angles to the end of the arm, A, and vertical to the stage plate. It is also adjustable by the two screws, D, D, which unite them. This wire is filed to a point, notched at the bottom with two grooves crossing each other, and may be raised or lowered by the cross pin, E, working in guide slots at the upper end of the tube, which is also cut and sprung at the lower end to prevent lateral motion. The point is thus kept always in the same relative position, and may be easily adjusted by the following process:

Take a plain glass slide, and paste or gum a strip of paper upon it, about two inches and a half in length, as in fig. 2, A.

Draw a line parallel to, and half an inch from, the lower edge of the slide. On this line make a minute hole, an inch and a half from the right hand end, and, with a pair of compasses set correctly to an inch, place one of its points in the hole, and, inking the other point to render the spot conspicuous, mark the place on the right hand end of the slide. There will now be one mark—a minute hole, B, near the centre of the slide, and another—an ink spot, C, one inch to the right of it. Place this slide upon the stage, using the clip to keep it steady in its place, having first adjusted the stage plate perfectly square, and the body of the instrument, if moveable, well up to the stop. Bring the hole, B, into focus, and as near to the centre of the field as possible; then adjust the point of the index, B, fig. 1, accurately over the centre of the ink spot, and tighten the screws, D, D, to fix it in that position. The papered slide being removed, and any object mounted on a slide, with a plain paper label, F, fig. 1, previously fastened upon it, being now brought into the centre of the field, raise the style or index, B, fig. 1, and, with a common pen dipped in ink, touch its point, press it down gently till it touches the paper label for an instant, and a neat, little, round dot will be the immediate result. *At any future time, by merely placing this dot, as* 5, fig. 2, *again under the point by which it was pro-*

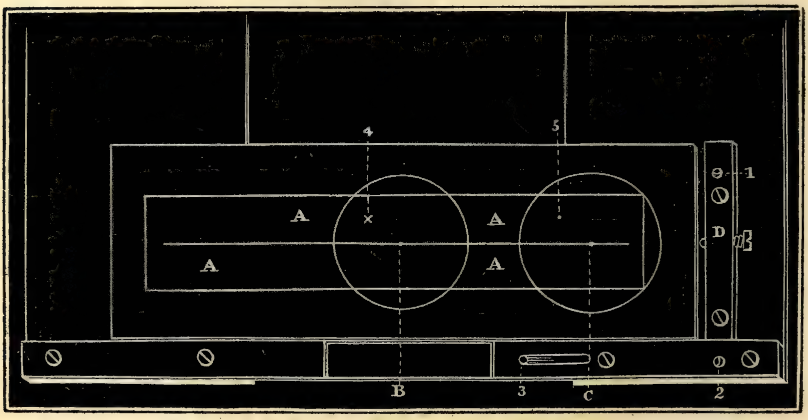


Fig. 2.

duced, and which may be done in a few seconds, the object 4, fig. 2, *will of course occupy its former position in the centre of the field.*

In arranging a cabinet of Desmidiæ, Diatomaceæ, or any other mixed objects, mounted dry or in any stiff medium, it is far better that every species should be represented by one or more slides, ignoring, as much as possible, everything else they may contain, and this plan affords by far the readiest and quickest means of accomplishing this end; and with reference to larger or even conspicuous objects, which, when placed upon the stage, are prevented from being seen by the setting of the object-glass, and are thus often troublesome to get into the field, it will be found an invaluable assistance.

The same label may contain both the name and the dots of registry, and different coloured inks may be used for different objects, as well as labels be put upon both ends of the slide, and no reference having to be made elsewhere, the object can be placed at once upon the stage in its proper position.

The label should be somewhat larger than the cover, and fixed upon the slide with its centre as near an inch from the centre of the cover as possible. This may readily be done by using another slide as a measure, holding it crosswise behind the one to be labelled, so that the two edges bisect the cover and the label equally.

To prevent the labels becoming detached, *the slides must be perfectly cleansed from grease and the paper thoroughly damped prior to using.* A few hours' confinement in a tin box with damp sand will render the ready-gummed labels well conditioned for adhering. The only objection that can be urged against using the label is the possibility of its being lost, but this can only arise from defective manipulation.

To complete it as a finder with a scale, the first step will be to provide a stop, D, fig. 2, on the right side of the stage plate. This should be so adjusted, that when the hole, B, in the papered slide is in the field, the movements of the stage shall be central, and the slide in the middle of the stage

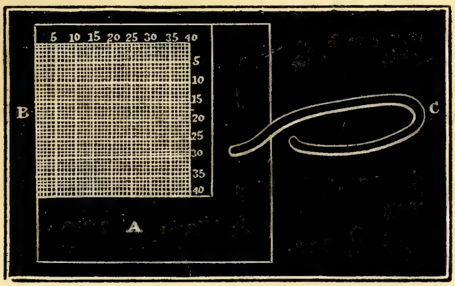


Fig. 3.

plate. A very thin plate of brass, A, fig. 3, about an inch and a quarter square (upon which the paper scale is afterwards to be fixed), is now made to rest over the right hand end of the slide, but without touching it, lying upon the stage-bar at the bottom, and the end bar or stop, D, at the side. Instead of being a fixture in this position, three steadying pins, soldered into the under side of the plate, A, fit into corresponding holes, 1, 2, and 3, fig. 2, in the stop and stage bar, and keep it perfectly steady and tight, and yet, by means of the handle, C, fig. 3, allow it to be taken off or replaced in an instant. A channel or groove leading to the left-hand hole, 3, fig. 2, of the stage bar, serves as a guide for directing the pins to their proper places, and if a medium thickness of slide be used, the plate may be fitted so close upon it as not to be in the way of the object-glass. Upon the brass plate, A, fig. 3, fasten the paper scale, B, either with paste, gum, diamond cement, or shell-lac. The hole, B, in the papered slide, being in the field, and the slide close to the stop and the stage bar, put the centre of the scale carefully under the point of the index, and see that the horizontal lines are parallel with the lower edge of the slide, by passing the scale backwards and forwards under the index; or, in this way its place may be accurately ascertained and marked beforehand.

As covers are seldom required larger than three quarters of an inch in diameter, the scale, B, need be only nine tenths of an inch square; eight tenths being used for the divisions, and one tenth at the bottom and right hand side being occupied by the numbers. The divisions being fiftieths of an inch, there will thus be only 40 each way, and the centre will read 20, 20, the first number referring to the top of the scale, and the right-hand number to the right-hand side of the scale.

As a finder, in its application to an instrument devoid of stage movements, an additional loose stage plate, similar to fig. 2, will be required to carry the scale and the stop, but used merely as a marker, the usual sliding stage-bar will suffice.

A piece of common looking-glass, about an inch square, G, fig. 1, attached to the body of the instrument on the left side, by a split ring, may be made to throw light from the lamp upon the label or scale, and render the marks legible without interfering with the object-glass.

Although where this instrument has been already applied, the same form and position have been retained, it by no means follows that other arrangements may not be found equally if not more convenient; as, for instance, the adjusting screws, D, D, fig. 1, may be made to work with milled nuts, and the arm, A, fig. 1, may be attached either to the base of the stage, the side of the swinging frame of the bar, or even to the bar carrying the body and slow motion. In the latter case it will require the style to be longer, and to have a greater range of vertical movement, or a separate adjustment may be required to meet the extreme variation in the different lengths of object-glasses. In every case, whether used as a marker or finder, changing the object-glass will necessitate the papered slide, fig. 2, being first applied to test the relative positions, and if the object be in any part of the field, it will be easier to allow for this than to alter for every occasion, but as most observers work principally with the quarter, this will seldom be required.

By description, even with the assistance of figures and diagrams, it is generally extremely difficult to render the action of any mechanical contrivance so intelligible as to be readily comprehended. In the present case, however complex and tedious it may appear, simplicity is one of its greatest merits, and when seen in use has invariably won for it instant approval. All the minutiæ, so far as I can find, have been given for its construction, but should any further explanation be desired, I shall have much pleasure in replying to any communication on the subject.

On a former occasion, a slight but important omission led to an unfavorable conclusion. In his work on the microscope, Dr. Carpenter, in quoting from a previous number of the Journal, our contrivance for scratching circles upon the glass, objects to the use of a diamond, as liable to cut or star the cover. Omitting to state that the splinter of diamond should have its point rubbed once or twice on a piece of Turkey stone, to give it a *scratching* instead of a cutting edge, might reasonably lead to the above conclusion; but with this precaution no fracture has ever occurred, and we have marked test-objects under the thinnest covers as delicately and as perfectly as can be wished for.

TRANSLATIONS.

CONTRIBUTIONS *to the* HISTORY *of the* DEVELOPMENT *of the* SPONGILLÆ. By N. LIEBERKÜHN. (Müller's 'Archiv,' 1856, pp. 1—19, 319—414.)

OF the above long and valuable communication we have space to give only the following abstract.

The constituents of the *Spongillæ*, which have up to the present time attracted the attention of observers, are the following:

1. The skeleton, consisting of siliceous spicules of various forms.
2. The interstitial gelatinous substance.
3. The *gemmulæ*, as they are termed, furnished with a pore, and having either a smooth shell or surrounded by *amphidiscs*.
4. Motile corpuscles occurring at certain seasons, and which are supposed to effect the reproduction of the sponge, and which, according to Hogg, move in consequence of an endosmotic action, and, according to Laurent, by *cilia*.

As regards the marine sponges, Grant notices similar corpuscles, which are ciliated at the anterior end, but not posteriorly; Quekett, however, states that he is unable to confirm this observation, and gives a totally different exposition of the mode in which reproduction is effected. Spermatozoa have been described in *Tethyum* by Huxley, and by Carter in *Spongilla*.

Lieberkühn's observations were almost exclusively confined to *Spongilla fluviatilis*.

1. With respect to the skeleton, Lieberkühn observes that the spicules are not united at the base by a siliceous material, as stated by Meyen, but by a substance destructible by heat. The spicules are usually arranged in aggregate bundles, which meet point to point at an obtuse angle, and project slightly above the surface of the sponge.

Minute portions of the gelatinous substance exhibit under the microscope *amœba-like* movements, respecting which it is unknown whether they are vital phenomena, as supposed by Dujardin, or referable to a process of decomposition. Other portions presented on part of their surface a kind of long *cilia,* by means of which they moved rapidly from place to place, throwing out, at the same time, processes from the non-ciliated part of the surface, and again retracting them, exactly as do the *Amœbæ.* Lieberkühn never observed the ciliated particles in the winter, nor before the spring; in the former season he noticed only those exhibiting the amæba-like motion. But these portions, which are always to be obtained when a living *Spongilla* is spread out upon the object-glass, are by no means amorphous masses, as figured by Dujardin, but among them may frequently be recognised structures having the form of a cell; and this is the case more especially in the winter, at which time the granular substance is less abundant. When the amæba-like movement has ceased, these bodies are seen to contain a *nucleus* and *nucleolus.* The entire sponge is composed of this kind of substance. Though employing for convenience the term "cell," Lieberkühn states that he has never succeeded in discerning a "cell-membrane" around these particles. Among these "cells" he often observed bodies containing foreign substances, such as *Bacillariæ,* &c., but which, in other respects, fully resembled the sponge-cells, and were also furnished with a nucleus, though unprovided with a contractile vesicle. They protruded and retracted motile processes, and it is not impossible, he thinks, that they may really be *Amœbæ,* which are sometimes without a contractile vesicle. Actual *Amœbæ* with a contractile vesicle are by no means rarely contained in the sponge.

The *Spongillæ* in general, especially in winter, are the habitation of an abundant infusorial life; he has observed abundance of *Paramecium aurelia, P. colpoda, Chilodon cucullulus, Trachelius, Amphileptus, Prorodon, Loxodes,* &c.

The gemmules.

The living *Spongillæ* are often seated, not immediately upon the wood, stone, &c., upon which they may be growing, but separated from it by a peculiar, dark-brown substance often several inches thick. This mass is composed chiefly of the remains of the dead sponge, empty gemmule-cases with their amphidiscs, various forms of siliceous spicules, &c.; and occasionally there may be found in it gemmules still retaining their brown colour and contents capable of development.

Dead *Spongillæ* are sometimes so thickly studded with gemmules as to present in consequence a gray or greenish colour. In the lowermost layers of the living sponge, contiguous to the dead portions, there occasionally occur large quantities of glittering white gemmules, but, except in colour, otherwise like the brown ones, and containing, like them, spherical bodies, composed of larger and smaller fat-like granules and an albuminous substance. These bodies are about the size of the largest sponge-cells, and are readily broken up by pressure. Others, again, may be seen with a very delicate case, though furnished with very transparent amphidiscs, and in these gemmules the contained spherical bodies are less readily broken up. When a portion of sponge containing gemmules of this kind is torn asunder with a fine needle under water, some whitish, ill-defined, spherical portions, of about the same dimensions as the gemmules, will be noticed. They present the following characters:

They are constituted of two distinct substances, one external, having a low refractive power, something like the common sponge-cells, and an interior spherical mass, with strong refractive power, almost like collections of fatty particles. When one of these bodies is crushed, it breaks up into cellæform structures of two kinds, and both about the same size as the sponge-cells. Those of which the interior highly refracting part of the corpuscles was composed, cohere together, and are constituted of a motile sarcode substance. The outer layer appears to be composed of firmly agglutinated cellæform globules, some very closely resembling the sponge-cells in the disposition of the nucleus and nucleolus, whilst others inclosed amphidiscs. Some of the amphidiscs thus contained in the cells were perfect in form, and others obviously only in process of formation. The amphidisc-cells did not present any nucleus, but were very distinctly defined.

Occasionally Lieberkühn noticed among the white gemmules, some which, together with free amphidiscs, supported on their transparent investing membrane others contained in vesicles or cells. From what he observed, he concludes that the above-described bodies represent immature gemmules. He is unacquainted with similar phenomena in the case of the smooth gemmules, remarking only that up to the present time he has never noticed, in one and the same portion of sponge, gemmules with amphidiscs together with smooth ones at the same time, although both forms occur at all seasons.

The usual contents of the gemmules have been described by Meyen (Müller's 'Archiv,' 1839, p. 83). In many instances Lieberkühn found that the globular arrangement no longer existed, the globules being replaced by granules exhibiting an active molecular motion.

That the gemmules are formed from agglomerations of sponge-cells may be readily proved in the branched sponge containing smooth gemmules. In a longitudinal section of a suitable portion we find—

1. Gemmules which are perfectly developed and consist of a smooth case and numerous globular bodies, first accurately investigated by Meyen; each of these globular bodies contains an albuminous fluid and numerous highly refractive vesicles; it is about the size of a sponge-cell, and is rapidly disintegrated in water.

2. Gemmules having a distinct case, and containing, besides the globular bodies of Meyen, corpuscles resembling these, but differing from them in the circumstance that they throw out protean processes as do the sponge-cells.

3. Gemmules with distinct case, and furnished with a pore, and containing only corpuscles of the nature of those last described. Some of these corpuscles contain a nucleus and nucleolus similar to those of a sponge-cell, from which they differ apparently only in the circumstance that they are filled completely with the vesicles above described.

4. Spherical masses of the same size as the gemmules, and composed of the motile corpuscles just noticed and of distinct sponge-cells. These sponge-cells have a distinct nucleus and nucleolus, and besides these, contain a very finely granular substance, dispersed either uniformly throughout the entire cell, or collected into minute spherical masses; these spherical masses have the same dimensions as the vesicles above referred to, and in many cells they are associated with several of these vesicles. On many of the spherical agglomerations of cells an excessively delicate structureless membrane may be already noticed.

It would appear, therefore, that the "globules" of Meyen are nothing more than altered sponge-cells.

The autumn is the most favorable season for observing the process of their formation.

With respect to the destination of the contents of these gemmules, Lieberkühn first quotes Mr. Carter's observations recorded in the 'Annals of Nat. History' (2d ser., vol. iv, p. 81, 1849), whose description of the mode of formation and composition of the gemmules pretty nearly accords with his own, and then proceeds to say that he has never succeeded in causing the expressed contents of the gemmules to become developed. He has never seen sponge-cells produced from them in the way described by Mr. Carter, and asserts that the process of development is entirely different from that stated by that observer. The first change in the gemmules was noticed in March. The cells no longer liquefied as before in the water when expressed from the gemmule, and exhibited amæba-like motions like the common sponge-cells. In many of the cells two nuclei with nucleoli might be observed, and, upon the whole, the larger vesicles did not contain so many cells, and presented a greater proportion of finer granules.

He placed a number of these gemmules in watch-glasses, and exposed them to the sun for some time every day. In a few days a fine white deposit might be seen surrounding some of the gemmules, which was found, under the microscope, to be composed of an agglomeration of coherent sponge-cells, which was still in connection with the contents of the gemmule through its pore. This substance was firmly adherent to the bottom of the glass. In other gemmules the extracted cellular substance was situated, not on the side next the glass, but upon the upper side,—in fact, wherever the pore was placed. The escape of the cellular substance was very slow, so that the case was not completely emptied under four days. The development of the sponge, therefore, would seem to take place by the escape of the contents of the gemmule through the pore. The external surface of the cellular mass thus protruded gradually becomes transparent, no longer exhibiting the large vesicular structure it before possessed, and presenting instead the minute granules characteristic of the common sponge-cells. Conical perforated eminences afterwards make their appearance upon this nascent sponge-substance. The same process takes place in the gemmules which have been retained within the horny skeleton of the sponge; but in this case the cellular substance produced from each gemmule coalesces with that from the contiguous gemmules, and the whole forms a continuous mass, which necessarily assumes very much the form of the original sponge, owing to the circumstance that it is deposited upon the old skeleton.

The commencement of the formation of spicules was observed by Lieberkühn about the sixth day after the expulsion of the contents of the gemmules. On breaking up the cellular substance, extremely delicate needles might be observed, some of which were smooth, whilst others presented a rounded swelling in the middle. The further development of these spicules will be noticed below.

Lieberkühn notices four kinds of gemmules characterised respectively by their cases or shells :

1. Those with smooth cases.
2. Those with stellate amphidiscs.
3. Those with amphidiscs, in which the discoid extremities are entire and not stellate.
4. Gemmules, whose case, instead of amphidiscs, is furnished with minute, usually slightly curved, siliceous spicules.

MOTILE SPORES.

[Besides the gemmules above described, other reproductive bodies are met with in *Spongilla* : 1. Some, which from their resemblance to the motile spores or zoospores of many plants, have also been termed "schwärm-sporen," or "motile spores;" and 2 others, which, from their resemblance to the spermatic filaments elsewhere met with, are, as it would appear, properly denominated "zoosperms," or "spermatozoids."]

These bodies are thus described by the author, who states that he first discovered the "motile spores" after having left some recently collected *Spongilla* for a few hours in a vessel filled with river water. They are recognisable by the naked eye, having a longitudinal diameter of pretty nearly two thirds of a millimeter, and of one fourth in the greatest transverse diameter. They vary, however, considerably in size, and are of an ovoid form. In most of them, without the aid of glasses, a transparent hemispherical space may be perceived in the anterior, and a brilliant white space in the hinder part of the body. These terms are applied, because in swimming the weakly refractive part precedes, and the other follows. The spores move actively about in all directions. After existing about two days in this motile condition, the spores become quiescent and subside to the bottom, where most of them perish altogether. They rarely become developed.

On the twentieth day, in a successful observation, the author noticed that the spot formed by the subsided spore was increased in size, and upon examining this, it was found to exhibit the constituents of the young *Spongilla,* that is to say, protean cells, smaller and larger spicules, and a few germ-granules.

The movements of the spores were effected by means of cilia, uniformly distributed over the surface, and in length about the same as those of the Turbellaria, though perhaps still finer. But what distinguishes them essentially from the ciliated coverings of all Infusoria as yet known, and that of the Turbellaria, is a kind of epithelial layer upon which they are seated. This epithelium is composed of a single layer of spherical cells, about $\frac{1}{300}$ mm. in diameter, and which, though touching each other, are not in such close contact as to lose their rounded figure. Sometimes portions of this ciliated epithelium may be seen detached, and such detached fragments are often apparent in portions of the sponge which have been torn to pieces. They must not be confounded with the spermatozoids which sometimes adhere to detached amæba-like fragments of the sponge under the same circumstances. Beneath the ciliated epithelium is a layer of sarcode, within which is contained what the author terms the medullary substance, which is of a spheroidal form, and occupies the whole interior of the spore. Its appearance differs greatly in different spores. The whole spheroid, which is whiter and more opaque at the hinder part, lodges extremely delicate siliceous needles, many of which, even at this time, exhibit the perfect form of the mature spicule. These siliceous needles are not disposed with any regularity in the spore.

The main differences in the contents of the "motile spores" arise from the greater or less abundance in them of "germ-granules." The fully formed "germ-granules" are usually spherical, more rarely lenticular. They attain a size of about $\frac{1}{75}$ mm., but some much smaller are met with. They exhibit a strongly refractive envelope and contents, which appear, when distinct, to resemble an ill-defined gelatinous globule. The number of these "granules" varies extremely in different spores. They are sometimes also assembled into little rounded masses, composed of three or more together. These conglomerated germ-granules may sometimes be seen, together with the siliceous spicules, escaped from the spore, and inclosed in a mucous, structureless case. Conglomerated granules of this kind are found in vast numbers in various parts of the *Spongilla*, but especially towards its base. But in all these instances the author has invariably also observed the ciliated spores. They appear, according to Lieberkühn, to correspond with the isolated groups of germs, which, according to Carter, pass into the protean cells; but an essential discrepancy arises with respect to this, from the circumstance that this observer states that the groups of germs are produced immediately from the gemmules. This is at present unexplained.

THE ZOOSPERMS.

Besides the ciliated bodies above described as being the agents of motion of the "motile spores," Lieberkühn observed not unfrequently great numbers of moving corpusclse in sponges which had been torn up, which could be readily distinguished from them. They had, for instance, a far longer and thicker filament, and a much smaller head. They "swarm" usually in numbers together, with the heads in contact, and in their motions closely resemble the well-known spermatozoa. They arise from spherical receptacles, surrounded with a structureless transparent tunic, around which are disposed the sponge-cells. These receptacles are about $\frac{1}{12}$ mm. in diameter. The author was unable to prove their nature to be that of spermatozoa, and all his endeavours to witness their penetration into the pore of the gemmule, as a kind of micropyle, were bestowed in vain.

The peculiar bodies described by Carter, under the same name, are considered by the author to bear no resemblance to those noticed by himself, inasmuch as they are much larger and have a contractile head. He has noticed bodies in the course of the winter, corresponding with Mr. Carter's figures, but these he regarded as larger or smaller specimens of *Trachelius trichophorus*. But it is otherwise, he observes, with respect to the corpuscles described by Huxley, in Tethyum, as spermatozoids; these, he says, strikingly resemble those of the *Spongillæ*.

Abstract of "OBSERVATIONS *on the* REPRODUCTION *of the* RHIZOPODA." By Prof. MAX. SCHULTZE. (Müller's 'Archiv,' 1856, p. 165.)

IN the author's work on the 'Organization of the Polythalamia,' he was in a condition merely to throw out surmises with respect to the mode of reproduction of these animals; but a supply of living Gromiæ—Rotalidæ and Miliolidæ—having afforded him an opportunity of making numerous observations on this subject, he now publishes the results at which he has arrived.

Remarking that an individual belonging to the genus *Triloculina* (D'Orbigny) had become stationary for several days, and enveloped, as is not unusual, in a thin layer of brownish slime, he paid particular attention to it. At the end of a few days after it had become quiescent, the author noticed that minute spherical, sharply defined granules were detached from the brownish slimy envelope, and in the course of a few hours the animal was surrounded with about forty of these corpuscles, which gradually became more and more widely separated from it. Microscopic examination of these bodies proved that they were young *Miliolidæ*. When viewed by transmitted light, they presented a pale yellowish-brown calcareous shell, consisting of a central, globular portion, partly surrounded by a closely applied tubular part, and having no septum in the interior. In a short time the young animals protruded their contractile processes from the anterior opening of the shell, and crawled about upon the object-glass. The parts of the body enclosed in the transparent shell could be examined with great accuracy under the highest magnifying powers, and were seen to consist of a transparent, very finely granular, colourless material, of which the protruded filaments were an immediate continuation, and in which were imbedded minute, sharply defined granules, protein- and fat-molecules, some of considerable size, and angular, like the vitelline plates in the ovum of fishes.

He was unable to perceive in the young *Miliolidæ*, either vesicular particles, as cells, or a contractile vesicle, nor could he recognise any distinctly defined nucleus. Nor did the application of different chemical reagents, especially of a dilute solution of chromic acid—by the aid of which it is easy to demonstrate that the body of the *Hydra* is composed of cells, as shown by Leydig (Müll. 'Archiv,' 1854, p. 270)—enable him to discern any other elementary parts in the body of the Polythalamia than those previously pointed out by him in his former work.

The latter half of the tubular volution of the shell is not completely occupied by the animal substance, whilst the central portion is densely filled. In this situation, also, the oil-drops are accumulated to such an extent as materially to interfere with the transparency of the substance, in consequence of which it is necessary, in making a more particular examination of the contents, to break up the shell and express the contents. Even under these circumstances, no nucleus could be perceived, such as may always be so readily demonstrated in *Amœba, Difflugia, Gromia,* &c., as is known to be present in many, if not most, others of the Protozoa.

But of nuclei of this kind the author has hitherto never been able to perceive any trace, not only in the young *Miliolidæ,* but also in other Polythalamia.

From the circumstances under which the young *Miliolidæ* made their appearance, it might be concluded that they must necessarily quit the parent in a tolerably perfect condition, and that it was probable they acquire the calcareous shell whilst still within the mother.

Professor Schultze was next led to inquire further into the mode in which the young originated. When the calcareous shell of the parent animal was carefully broken up, it was found to contain only trifling remains of a fine granular organic substance, which, after patient and prolonged observation, exhibited no trace of motion in delicate sarcode-filaments, such as is often, under other circumstances, presented in separated particles of the animal substance. Nor could he perceive any vestige of a body which could be regarded as a young one in process of development. The almost complete absence of any organic contents in the shell of an individual which 8—14 days previously was creeping about, renders it probable that the whole, or, at any rate, the main part of its body, had been transformed into young ones, a supposition which other observations had led the author to propound in his former work (p. 26), where he describes polythalamian shells in which most of the chambers were densely filled with dark-coloured globules, which might fairly be supposed to represent germ-granules.

In his recent researches, however, recorded in the present paper, he appears to have met with only a single *Polythalamian* which was filled with similar globules. This belonged to the species formerly described by him under the name of *Polymorphina silicea,* from the circumstance that its shell was siliceous, although itself possessing the form of a *Nonionina.*

In this instance all the chambers in the ultimate volution were filled with strongly refracting globular bodies, 0·018‴ in diameter, and of which 6—8 were contained in the larger and 3—5 in the smaller chambers. These bodies exhibited a peculiarly brilliant envelope, which, upon further examination, by means of acid and the breaking of them up, was found to be solely composed of minute siliceous particles. There were no other animal contents in the chambers. These globular bodies, he sees reason to regard as embryos furnished with siliceous capsules, and which might be supposed to be formed out of the contents of the chambers in the same way that the *Navicellæ* are formed in a *Gregarina,* and to be destined, on their liberation from the parent, to become the central or primary chamber of the future Rhizopod.

Should this prove a correct interpretation of the nature of the globular bodies, it would appear, as regards the genesis of the siliceous shell of these Rhizopods, that it is not composed of a collection of siliceous fragments, but that the animal itself must be capable of secreting siliceous matter in the form of very minute granules.

In conclusion, he adverts to the observations of P. Gervais (published in the 'Comptes rendus,' ii, p. 467, 1847), respecting the reproduction of the Miliolidæ, and which are fully confirmed by his own observations now recorded. Gervais states that the sexes are distinct in these animals, and asserts that he has witnessed their conjunction in pairs previous to the act of parturition. How far these statements are correct, Professor Schultze leaves to be determined by future researches.

REVIEWS.

On a True Parthenogenesis in Moths and Bees, a contribution to the history of Reproduction in Animals. By Carl Theodor Ernst von Siebold. Translated by William S. Dallas, F.L.S. London, Van Voorst.

The whole theory of reproduction, as it occurs in plants and animals, has undergone curious and interesting changes, according as new observations have been made from time to time. Amongst the earlier naturalists sex was only recognised amongst the higher animals, and the lower animals and plants were supposed to be produced by a process of budding. Gradually, however, it became evident that amongst the lower animals sexes existed, and at length the discovery was made of the true relations of the pollen of plants to the ovules contained in the pistil. Then followed the sexual system of Linnæus. But Linnæus was not aware how far the antagonistic cells existed amongst the lower plants, and it has been the discovery of microscopists of recent times that sperm-cells and germ-cells exist in the Linnean Cryptogamia. So far have these discoveries been extended in both the animal and vegetable kingdom, that it would appear to be a general law that no true species of animal or plant is renewed without the union of sperm-cells and germ-cells. But whilst these observations were going on, many curious instances of anomalous production of individuals were observed. Steenstrup drew attention to the fact that many animals, whilst passing from their youngest to their adult forms, produced new individuals without any union of germ-cells and sperm-cells. Such animal forms he called "nurses." Professor Owen observed the phenomenon of "nursing" with great care in the well-known plantlouse (*Aphis*). In these creatures, the young, generated by the union of the sperm-cell and the germ-cell, produce young, resembling themselves, for eight or nine generations without any union of the two opposite cells. This Professor Owen calls Parthenogenesis.

In the work of Professor Von Siebold, translated by Mr. Dallas, we have an account of the production of bees and moths from eggs which have been produced independent of any contact of the sperm-cells with the germ-cells. To this process of genesis, in which eggs, capable of producing the perfect form of the parent, Von Siebold proposes to apply the term Parthenogenesis, and calls it "true Parthenogenesis." It is, we think, to be regretted that the German Professor has thus attempted to apply a term, invented by Professor Owen, to another and different set of cases, denying its applicability to the instances for which it was invented. We give Von Siebold's explanation of the facts as they occur amongst Aphides:

"Not to deviate too far from the object which I have set before me in these pages, I will only here give prominence to that in the history of insects which people have been induced to regard as a peculiarity of the alternation of generations—I mean the remarkable reproduction of the *Aphides;* this, after standing so long as something quite abnormal and inexplicable, has now found its complete explanation in the nature of the alternation of generations. It is well known that in the *Aphides,* a sexual generation, represented by separate males and females, is followed by a series of generations, only including a single form, which proceed from each other in manifold repetition without any previous copulation, until after about seven to eleven such generations, a generation of males and females again makes its appearance. Steenstrup regarded these forms of *Aphides,* which are capable of reproduction without the influence of the male generative organs, and which had previously been looked upon as virgin female *Aphides,* as nurses (*Ammen*), and consequently as those members of an animal species subjected to an alternation of generations, which are capable of producing young in the asexual (or larval) state. Those *Aphides* which bring forth living young without a preliminary copulation, are in reality quite different in their organization from the true female *Aphides,* which lay eggs capable of development after the act of copulation. In the viviparous *Aphides* those organs especially from which the living young are produced, have quite a different form and organization from the sexual organs of the oviparous female *Aphides,* so that, in opposition to the *ovaries* (*Eierstöcke*), the products of which (eggs) only become capable of development by the action of the male semen, we may with perfect justice indicate these organs as *germ-stocks* (*Keimstöcke*), which are capable of producing young of themselves, without the influence of male fertilizing organs. These nurse-like, viviparous *Aphides* therefore, which instead of ovaries bear germ-stocks in their interior, are also destitute of the seminal receptacle, which occurs universally in the females of insects and plays an important part in the act of fecundating the eggs. Before the alternation of generations had yet been introduced into science by Steenstrup, I had already called attention to the different conditions of organization in the oviparous and viviparous *Aphides,* and especially to the absence of the seminal receptacle in the latter. Subsequently the development of the *Aphides* without fecundation has been completely explained by V. Carus as a process of the alternation of generations. The representation which Carus has given of the development of germinal bodies in the germ-stocks of the viviparous *Aphides,* has certainly met with a refutation from Leydig, against which I have nothing to object; nevertheless, although, according to Leydig, the young are developed from the germ bodies of the viviparous *Aphides* exactly as from eggs, by cell-formation, I would retain the denominations "germ-body" and "germ-stock" for these reproductive organs of the viviparous *Aphides,* in order to distinguish them, on account of their different physiological import, with regard to the alternation of generations, from the eggs and ovaries of the oviparous female *Aphides.*

"Owen has regarded the asexual viviparous *Aphides* as virgin females capable of reproduction; but these viviparous *Aphides* indicated by Owen as virgin parents are certainly something very different from the oviparous *Aphides* in their virgin state before copulation. For the same reason also I cannot approve of Owen's expression *Parthenogenesis*, as applied by him to the alternation of generations, as under the term Parthenogenesis I do not understand reproduction by asexual nurse-like or larval creatures, but a reproduction by actual females, that is to say, by individuals furnished with perfectly developed, virgin female organs, which produce eggs capable of development without previous copulation and in an unfecundated condition."

Although the production of perfect insects from eggs deposited by unimpregnated females, had been suspected by previous observers, so large a number of observations has never been recorded before as those now presented by Professor Von Siebold. After showing that this phenomenon must certainly be regarded as true in a number of species of sac-bearing Lepidoptera, belonging especially to the genus *Psyche,* he proceeds to give a detailed account of its existence in the honey bee (*Apis mellifica*). That worker-bees (the unfecundated females) and unfecundated queen-bees lay eggs which are capable of being hatched into drones or male bees, has long been known or suspected to exist by those who keep bees, is proved by the statement of a bee-keeper (Dzierzon), who, in 1849, published an essay on the subject. In this essay, quoted by Siebold, he says—

"Therefore, and this must be well borne in mind, in the copulation of the queen, the ovary is not impregnated, but this vesicle or seminal receptacle is penetrated or filled by the male semen. By this, much, nay all of what was enigmatical is solved,—especially how the queen can lay fertile eggs in the early spring, when there are no males in the hives. The supply of semen received during copulation is sufficient for her whole life. The copulation takes place once for all. The queen then never flies out again, except when the whole colony removes. When she has begun to lay, we may, without scruple, cut off her wings; she will still remain fertile until her death. But in her youth, every queen must have flown out at least once, because the fertilization only takes place in the air; therefore no queen, which has been lame in her wings from birth, can ever be perfectly fertile: I say, perfectly fertile, or capable of producing both sexes. For, to lay drone-eggs, according to my experience, requires no fecundation at all. This is exactly the new and peculiar point in my theory, which I at first only ventured to put forward as a hypothesis, but which has since been completely confirmed. Three young queens with imperfect wings have occurred during the past summer, and these, although, from the imperfection of their wings, they could evidently never have taken the fertilizing flight, and also on dissection proved to be unfecundated, nevertheless laid drone-eggs.—By this, all the mysteries which we have hitherto vainly endeavoured to unriddle, are completely solved. In the first place the enigma: Why is it that many mothers—they may be either queens or workers in their form—are only capable of propagating the male sex or drones? Because the former are either unfecundated, or their fertility is exhausted; the latter, on the other hand, are incapable of fertilization."

The general facts of the case having been made out by the apiarians, both Leuckart and Von Siebold determined, if possible, to test these views by the aid of the microscope. Both observers were aware that in certain stages of the fecundated germ-cell, the filaments of the sperm-cell may be observed. If, therefore, the facts stated by Dzierzon and the other apiarians were true, the sperm-filaments ought to be detected in the eggs of the female or worker bees, whilst they would be absent from those of the male or drone bees. Leuckart was not successful in examining a large series of eggs, but he gives the following result of his investigation:

"On two occasions only I met with some undoubted seminal filaments upon the micropyle of bees' eggs; on one occasion a single filament, on the other several, four or five (and yet I have most carefully examined more than fifty bees' eggs!). On both occasions it was upon worker-eggs that I found the seminal filaments. In drone-eggs I have never been able to distinguish a seminal filament, although I probably examined more drone-eggs than worker-eggs, and amongst these such as had been laid at the utmost a quarter of an hour previously."

Von Siebold was more successful. He says—

"After various vain endeavours to render the interior of the bee's egg accessible to the inquiring eye, I came at last to the idea of employing an artifice, which I had soon acquired by practice, and which allowed me to survey at least a portion of the inner space of the bee's eggs with great clearness and tranquillity. I crushed a bee's egg quite gently with a very thin glass-plate, and so that it was ruptured at its *lower* pole, opposite to the micropylar apparatus, and the yelk gradually flowed out at this spot, by which a clear empty space was produced at the upper pole within the micropylar apparatus, between the egg-envelopes and the yelk which was retiring downwards. I directed my attention very particularly to this empty space, which I saw slowly produced under the microscope during the effusion of the yelk. The production of such a preparation of course was not always successful, for sometimes the yelk flowed out of the ruptured envelopes, without the production of this empty space; the yelk also remained diffused in the upper part, and allowed of no certain judgment as to the presence or absence of seminal filaments. An error in crushing the egg, a little too much pressure upon it, or perhaps also a peculiar, less tenacious consistency of the yelk, probably caused the contents of the yelk to retire in every direction from the pressure, and therefore also to press upwards against the micropylar apparatus."

Of the result of his examination of the female eggs he says—

"Amongst the fifty-two female bee-eggs examined by me with the greatest care and conscientiousness, thirty furnished a positive result; that is to say, in thirty, I could prove the existence of seminal filaments, in which movements could even be detected in three eggs. Of the other twenty-two eggs, twelve were unsuccessful in their preparation. At the same time I may also indicate particularly, that the observations with positive and negative results followed each other quite irregularly, but alternating at very short intervals, which probably was only dependent upon the favorable or unfavorable consequences of my preparation of the eggs employed for observation. If the question is to be raised, why Leuckart was not so fortunate as to see what I have succeeded in seeing, I can make no other answer, but that probably the different method followed by us in our investigations, is to be blamed for Leuckart's want of success. Berlepsch informed me, that Leuckart did not examine the contents of the eggs by the careful compression of the bee's egg, but that he confined himself to submitting the eggs in a perfectly uninjured state to an external examination."

He also obtained drone-eggs on the same occasion. Of the examination of these eggs he says—

"I examined these twenty-seven drone-eggs, which might have been about twelve hours old, and which agreed perfectly both in their appearance and organization with the female eggs, with the same care and by the same method with which I had treated the female eggs, and *did not find one seminal filament in any single egg, either externally or internally.* I must also add, that only the seventh, thirteenth, and twenty-third eggs were unsuccessfully prepared. In all the rest of these drone-eggs the yelk retreated slowly and completely from the upper pole of the egg-envelopes, after the bursting of the membranes; the desired empty clear space between the micropylar apparatus and the retreating yelk was produced in the interior of these eggs, so that if seminal filaments had been present in them, they certainly would not have escaped my searching and inquisitive eye. In order to be quite satisfied as to this remarkable negative result, and to obtain the full signification of it, several female eggs of the same queen which had furnished these drone-eggs, were examined for comparison; for the objection might certainly have been raised, that this queen might have laid nothing but barren eggs, as, being already weakened by age and near her death, she might have had no more spermatozoids in her seminal receptacle. Nevertheless, many of these eggs contained seminal filaments; they were the twenty-seven eggs already mentioned by me,—namely, the sixteenth to the forty-second eggs."

It may be thought by some that these investigations are not conclusive, and perhaps they are not. But it should be remembered that the evidence on the other side is not a whit more conclusive. A naturalist confining his attention to the phenomena of sex as presented in the vertebrate animals, might bring against Von Siebold a verdict of "not proven;" but one acquainted with the phenomena of parthenogenesis in plants and the lower animals will be disposed to receive this evidence as of more value than the mere inference of the necessity of the influence of both sexes, derived from observations upon the higher animals. In fact, Parthenogenesis, in all its integrity, has now been observed in a large number of cases in the vegetable kingdom. The occurrence of seeds, independent of stamens, was first observed in a Euphorbiaceous plant in the gardens at Kew. It has been subsequently observed in a large number of plants, a list of which, with the observer of the phenomenon, we subjoin:

CHARACEÆ.
Chara crinita, A. Braun.
CANNABINEÆ.
Cannabis sativa, Naudin.
CHENOPODIACEÆ.
Spinacea oleracea, Le Cocq.
EUPHORBIACEÆ.
Cœlebogyne ilicifolia, J. Smith.
Mercurialis, species, Naudin.
ANACARDIACEÆ.
Pistacia Narbonensis, Tenore.
Pistaciæ species, Bocconi.
CUCURBITACEÆ.
Bryonia dioica, Naudin.
DATISCEÆ.
Datisca cannabina, Fresenius.

Although this phenomenon looks, at first sight, so exceptional, a little reflection will show that it is in accordance with the general plan of the growth and reproduction of organized beings. In both the vegetable and animal kingdoms there are two plans of procedure,—one for the reproduction of the tissues of the same individual, in which single cells or parts resembling each other are produced. This is simply growth, and goes on whether the particular plant or animal forms one mass, or splits up into single cells or larger parts. This process we may call *Homogenesis*. In plants it produces buds (phytoids), bulbilli, bulbs, sporules, or any other parts like or unlike to the stock or part on which it is borne (isophytoids and allophytoids). In animals it produces buds or gemmæ (zooids), which, like the homologous parts in plants, are either like or unlike their parent-buds (isozooids and allozooids). Here will be found the "nurses" of Steenstrup, the "agamazooids" of Lubbock and Huxley, and the "virgin mothers" of Owen. The other plan may be called *Heterogenesis*. Here a new series of homogenetic actions is initiated. For this process two cells are required—a sperm-cell and a germ-cell. In the plant the phytoid changed in its form bears the sperm-cell and is called a stamen (androphytoid), or the germ-cell and is called a pistil (gynophytoid). These are combined, and we have a hermaphrodite flower (androgynophytoid). In the homologous parts in the animal kingdom we have separate male animals (androzooids) and female animals (gynozooids), and the two sexes combined in hermaphrodite animals (androgynozooids). By this mode of viewing the phenomena of Parthenogenesis, it will be seen they belong to the series of homogenetic actions, and that we are gradually prepared for the remarkable development of buds into seeds amongst plants by such forms as bulbilli and sporules, and of buds into eggs amongst animals by a variety of transitionary forms.—E. L.

Adulterations detected, or Plain Instructions for the Discovery of Frauds in Food and Medicine. By Arthur Hill Hassall, M.D. London, Longmans.

Dr. Hassall's name is inseparably associated with the subject of adulteration. Whether he was the first to apply the microscope to the discovery of adulteration, or whether he has in all cases done so judiciously, there can be no doubt that of all persons he has used this instrument most largely in examining the adulterations practised in the preparation of articles of food for sale. It is indeed a triumph for the microscope, that in so many cases where the chemist was utterly unable to detect adulteration, it has perfectly succeeded. And thus it must be. Wherever sight assists us to the knowledge of the true nature of a thing, then the application of the microscope must facilitate observation and increase our knowledge. Already practical results of importance have followed on the publication of Dr. Hassall's observations as analyst of the celebrated "Lancet Sanitary Commission," and he has done great service to the cause of purity of food in the publication of the present volume. Although Dr. Hassall advocates a system of Government inspection of food, the publication of his book will go a long way to render such public interference unnecessary. The microscope is no longer alone a toy in the house of the wealthy, or an instrument of research in the study of the philosopher, but a part of the household arrangements of every intelligent family. With the aid of Dr. Hassall's book and a compound microscope, persons of ordinary intelligence will be able to examine for themselves the quality of their daily food. In fact, we do not despair of seeing the time when it shall be deemed a necessary accomplishment of every good housewife to be enabled to test the quality of all articles of food by the aid of the microscope.

Dr. Hassall makes the following sensible remarks on the application of this instrument to the detection of adulterations:

"The microscope is specially suited to the detection of organized structures or substances, as the several parts of animals and plants: it is with the latter that we shall chiefly have to do in the course of the present work.

"When we survey with our unaided vision any animal or plant, we detect a variety of evidences of organization or structure; but there is in every part of every animal or vegetable production an extraordinary amount of organization, wholly invisible to the unarmed sight, and which is revealed only to the powers of the microscope. Now this minute and microscopical organization is different in different parts of the same animal or plant, and different in different animals and plants, so that by means of these differences, rightly understood, the experienced microscopical observer is enabled to identify in many cases infinitely minute portions of animal or vegetable tissues, and to refer them to the parts or species to which they belong.

"Thus, by means of the microscope, one kind of root, stem, or leaf may generally be distinguished from another, one kind of starch or flour from another, one seed from another, and so on. In this way, the microscope becomes an invaluable and indispensable aid in the discovery of adulteration.

"Applying the microscope to food, it appears that there is scarcely a vegetable article of consumption, not a liquid, which may not be distinguished by means of that instrument. Further, that all those adulterations of these articles which consist in the addition of other vegetable substances, and which constitute by far the majority of adulterations practised, may likewise be discovered and discriminated by the same means.

"The same remarks apply to all the vegetable drugs, whether roots, barks, seeds, or leaves. We are not acquainted with one such drug which may not be thus distinguished.

"The seeds even belonging to different species of the same genus may frequently be distinguished from each other by the microscope, a point in some cases of very great importance. A remarkable instance of this has fallen under our observation. The seeds of the different species of mustard, rape, &c., may all be distinguished under the microscope by differences in their organization. To show the importance of the discrimination in some cases, the following instance may be cited. Some cattle were fed with rape cake, and died with symptoms of inflammation of the stomach and bowels. Nothing of a poisonous nature could be detected on analysis; but it was suspected that the cake might be adulterated with mustard husk, although even this point could not be clearly established by chemical research. Under these circumstances the cake was sent to the author for examination, who had but little difficulty in ascertaining that it was adulterated with mustard seed, which, from the large quantity consumed, was doubtless the cause of the fatal inflammation. Not only can the seeds of different plants of the same genus be frequently discriminated by the microscope, but in some cases those belonging even to mere *varieties* of species.

"The microscope in some cases can even inform us of the processes or agents to which certain vegetable substances have been subjected. Illustrations of this are afforded by the starches of wheat and barley: it can be determined by the microscope whether these are *raw*, *baked*, or *boiled*, or whether *malted* or *unmalted*. Illustrative figures will be found in the articles on BREAD and BEER.

"Again, it is not only when the articles are in a separate state that they can be thus distinguished; but even when mixed together in different proportions. We have succeeded in detecting in certain vegetable powders no less than nine different vegetable productions.

"So great and manifest are the differences revealed by the microscope in different vegetable substances, that, with ordinany care and some amount of preliminary knowledge, the discrimination becomes a matter of the greatest ease and the most absolute certainty.

"Further, wonderful to relate, the grinding and pulverization, and even the charring, of many vegetable substances, does not so destroy their structure as to render their identification by the microscope impossible. Chicory and coffee may be thus roasted and pulverized, and yet each may be subsequently identified with the greatest ease, they being in fact but little changed, except in colour, and in the case of coffee by the dispersion of the droplets of oil visible in the cells of the unroasted berry.

"Again, substances may be discovered by means of the microscope, even when introduced into articles for the purpose of adulteration in extremely minute quantities: the case of some mustard forwarded by a manufacturer to the 'Lancet' some time since furnished a remarkable illustration in point.

"The mustard was stated to be genuine; but on examination with the microscope, it was found to contain a small quantity of turmeric. The manufacturer, when informed of the fact, very candidly and properly acknowledged that this was the case, and stated that he had added '*two ounces of turmeric to fifty-six pounds* of seeds, not for the purpose of gain or adulteration, but simply to enliven the colour and make its appearance more acceptable;' that is, the quantity of turmeric present, and discovered by the microscope, consisted of only *one part in* 448 of the quantity examined.

"The last illustration—and a very striking and beautiful one it is, although not immediately connected with the subject of adulteration—which we shall adduce in order to show the extraordinary character of the information furnished in some cases by the microscope is supplied by honey.

"Honey is the saccharine exudation from the nectaries of flowers: the bees in collecting it carry away some of the pollen of the flowers visited by them. Now this pollen consists of cells or vesicles, differing in size, form, and structure, according to the plants from which it is derived, certain plants being characterised by pollen granules of a certain configuration and organization. By the pollen present in honey, therefore, the scientific microscopist acquainted with the characteristics of the pollen of different plants is enabled to decide in many instances upon the nature of the plants from which the honey has been procured, and whether it has been collected from the flowers of the field, the garden, the heath, or the mountain. See article Honey for figure in illustration.

"There is still another use to which the microscope may be applied in the detection of adulteration; it may frequently be made to serve as an auxiliary to chemical researches: thus, for example, when we want to ascertain whether any substance contains starch, carbonates, phosphates, &c., it is often the quickest and most certain way to apply the reagents to a small quantity of the substance while this is under the field of vision of the microscope."

In this work, however, Dr. Hassall does not confine himself to the microscopical examination of objects, but wherever chemistry is capable of assisting he indicates the processes to be pursued. Nor is the book confined to food alone. In addition to all the ordinary eatables and drinkables, we have detailed accounts of the methods of investigating tobacco, snuff, opium, scammony, jalap, ipecacuanha, colocynth, liquorice, and other drugs. It makes us indignant to read of the vile compounds that are employed to adulterate our food, but the iniquity becomes more atrocious still when we find that the remedies to which we fly for relief for the pains produced by the bad food are themselves all likewise adulterated.

Dr. Hassall's book is illustrated with upwards of two hundred engravings on wood, executed from original drawings by Mr. Henry Miller, Mr. Tuffen West, and Mr. Searson. These engravings are most efficiently executed, and comprise a series of very valuable microscopic illustrations. They are quite worthy the attentive study of those engaged in microscopic investigations, and as they are all devoted to the structure of very familiar objects, they may be very successfully used as a means of educating the eye in a variety of organic structures. We can recommend this volume to all who are engaged in microscopic inquiries, and especially to those who wish to turn their microscopy to practical advantage.

NOTES AND CORRESPONDENCE.

Nobert's Tests.—Most of those who take an interest in the microscope are, doubtless, well acquainted with Mr. De la Rue's calculations of the intervals which separate the lines in

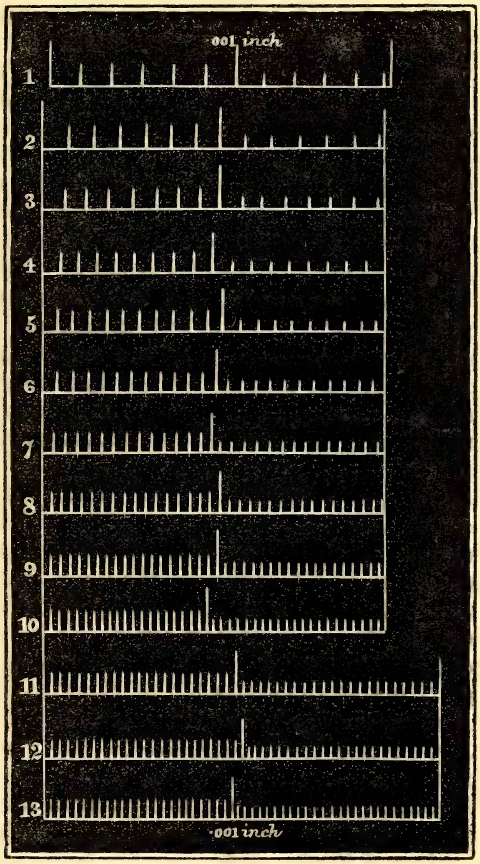


Diagram.

M. Nobert's marvellous productions, as given in Quekett's

'Treatise on the Microscope,' and Lardner's 'Museum of Science and Art,' vol. vi, p. 69, and, most probably, elsewhere. I believe, however, that many, to whom the subject is new, look upon these calculations with "the doubts of imperfect faith," or, "if they accept these measures at all" (to use the language of the Astronomer Royal, when speaking of very *different* measures, in his most instructive work, the 'Ipswich Lectures on Astronomy'), "they adopt them only upon loose personal credit." Under this impression, it has often occurred to the writer, that it would be both interesting and instructive to endeavour to draw the several groups of lines by the aid of the camera lucida, at the same time taking the $\frac{1}{1000}$th of an inch from the micrometer. This would afford, as it were, an *ocular* and *graphic* confirmation of Mr. De la Rue's calculations, sufficient to enable any one to satisfy himself of their general truth by mere inspection. This the writer has endeavoured to do, as shown in the accompanying diagram; and, though the method can only be considered rather rough and approximative, yet he apprehends that the risk of any serious error creeping in is only very small, and the table below shows that it is sufficiently exact to give very close approximations to Mr. De la Rue's results. The test-plate, which was used on this occasion, contains fifteen series of lines, and appears to be similar to the one mentioned by Quekett in his work on the 'Microscope,' p. 477, ed. 2. I have, however, only been able to transfer the first thirteen series, and in each series, in the drawing from which this was taken, the lines are represented as actually drawn with the camera, and, in order to present to the *eye* its relation to $\frac{1}{1000}$th of an inch, each series is most carefully continued by means of scale and compasses, so as to fill up the interval of 0·001 inch, such continuation being drawn in lines only *half* the length of those which represent the lines as dotted down from the test-plate. By this means, the approximate interval, which separates the lines of any series, can be obtained by mere inspection, the fraction of a division being taken by estimation. Thus, in the series No. 7, there are 28 intervals and about half an interval, or 28·5 intervals in 0·001 inch; consequently, in one inch, there are 28,500 such intervals, and the lines are distant from one another $\frac{1}{28500}$th of an inch. The results thus obtained are given in this table, side by side with Mr. De la Rues' calculations, and show as close an agreement as, I think, could possibly be expected by this method. The magnifying power in the first ten series is rather more than 1700 diameters, and in the last three above 2000, both estimated by the usual standard, ten inches.

TABLE.

	Number of lines in each band.		Distance of the lines in parts of an English inch.	
	De la Rue.	G. H.	De la Rue.	G. H.
1	7	7	$\frac{1}{11261}$	$\frac{1}{11250}$
2	8	8	$\frac{1}{13056}$	$\frac{1}{13330}$
3	9	9	$\frac{1}{15426}$	$\frac{1}{15500}$
4	10	10	$\frac{1}{18163}$	$\frac{1}{18000}$
5	11	12	$\frac{1}{20475}$	$\frac{1}{20500}$
6	13	13	$\frac{1}{23461}$	$\frac{1}{23750}$
7	15	15	$\frac{1}{28153}$	$\frac{1}{28500}$
8	17	18	$\frac{1}{32175}$	$\frac{1}{33000}$
9	19	20	$\frac{1}{37537}$	$\frac{1}{37500}$
10	21	21	$\frac{1}{40950}$	$\frac{1}{41500}$
11	23	23	$\frac{1}{45050}$	$\frac{1}{45000}$
12	24	25	$\frac{1}{47327}$	$\frac{1}{47660}$
13	26	25	$\frac{1}{50050}$	$\frac{1}{51000}$

I did not attempt the last two series, as I found it very trying to the eyes when the lines approximate so closely. The lines were viewed by a very fine $\frac{1}{12}$th of Powell and Lealand's, in my possession, mounted on one of Smith and Beck's stands, using their third eye-piece, the draw-tube being pulled out three inches in drawing the last three series; and I think it says much for the steadiness and perfection of Smith and Beck's stand (though only their smaller one, No. 2, on a single pillar), that under these high powers I was able to use the camera with ease and complete absence from tremor. The lines were illuminated by Messrs. Smith and Beck's achromatic condenser during the whole of the time that I made this drawing. I find that the smallest black stop, for cutting off the central rays in the revolving diaphragm of their condenser, when it is placed a very little on one side of the position concentric with the axis of the condenser, shows the finer lines with a sharpness and certainty which I have failed in producing by other methods of illumination which I have tried. In conclusion, I will add, there are several irregularities in the intervals in that part of the diagram which represents the lines as drawn by the camera, but whether these irregularities represent corresponding ones in the lines themselves, or are the result of imperfect drawing, I am not able to say; most probably the latter.—GEORGE HUNT, Handsworth, Birmingham.

The "Rio de Sangu."—At the meeting of the Academy of Sciences in Paris, held October 6th, 1856, M. J. Rossignon read a note on the "Rio de Sangu" (River of Blood), in the territory of Honduras. The account of this extraordinary phenomenon, which to us appears scarcely credible, is as follows:

"This singular spring is found near the village of La Virtud, near Choluteca, between the states of Salvador and Honduras.

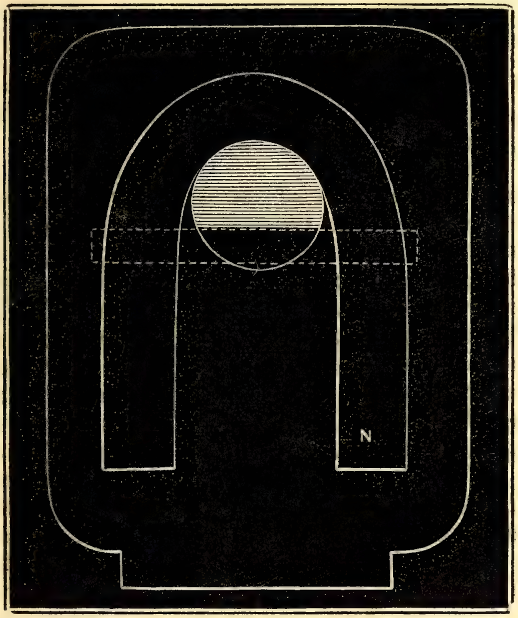
"The slender thread of water of which the spring is composed, flows constantly from a grotto formed of trachitic rocks. As it escapes from the source, the liquid presents the bright red hue of the blood of an animal recently killed. Its density is 2·75, and it has no sensible smell or taste. At a short distance, however, from the grotto it soon becomes changed, doubtless owing to the action of light, and above all to that of heat, which is very considerable in that country. It then acquires the smell of putrid flesh, which attracts the black vultures (zopilotls), the natural scavengers of those tropical regions, and who, when they have nothing better to devour, content themselves with this meagre diet.

"The liquid is coagulated by acids, and the coagulum is redissolved by alkalies. Evaporated in a capsule, it first coagulates at a temperature of 80° cent., and then throws down a deposit, which readily swells up and assumes a reddish-black colour. Distilled in a close vessel this residue affords all the products of the decomposition by heat of animal substances, leaving a porous and very friable, azotized charcoal. It affords at the same time an ammoniacal, yellowish oil of nauseous odour, but which differs widely from the animal 'oil of Dippel.'

"M. Rossignon detected in this fluid a great number of infusory animalcules, having an elongated form, and to which he attributes its colour and peculiar properties.

"M. Rossignon has also observed, in the small streams in Guatemala, vermiform animalcules, moving with excessive rapidity, and decomposing very speedily after the water had become stagnant. This water soon acquires a reddish-brown colour, exhales a very strong putrid odour, which also attracts the vultures and other carnivorous birds. The author of this memoir has detected, under several other circumstances, in stagnant waters more or less coloured, animalcules of an analogous kind, and which have not yet been studied."

A New Magnetic Stage.—In offering the following suggestions to your readers, I do not profess to have made any new discovery, forasmuch that all the best works descriptive of the microscope mention, at least, a magnetic stage, and Mr. Busk has afforded a detailed account of such an apparatus in the 'Microscopical Journal' for July, 1854 (No. VIII, pp. 280-1); but beg to suggest a far more simple, and I believe equally efficacious, form of instrument, which I have long employed with advantage, and which a single glance at the accompanying sketch will suffice to describe.*



The microscope employed is that known as "Warington's;" the brass object-plate is replaced by one of oak wood, into which one of the common horse-shoe magnets is imbedded, as shown in the drawing; the armature of the magnet thus becomes the object-holder, and provides completely for the universality of movement of the object with a readiness and equability of motion only attained by mechanical stages of superior construction.

* The sketch is the size of the original; the dotted lines represent the "armature" used as the object-holder.

It is not attempted to be inferred that so simple an instrument as I have described is intended to supersede the use of the mechanical stage when the microscope is furnished with one, but, in its absence, and then only, I offer it to every observer to whom economy is an object, as a substitute for the "sliding rest" usually supplied to "Warington's" and other cheap forms of microscope.

The advantages proposed by Mr. Busk are—1st, thinness of stage,—mine is exactly one-eighth of an inch; 2d, steadiness of motion,—mine has equal advantage; and 3d, its trifling cost,—mine cost me eighteen-pence, item, one shilling for the magnet and sixpence for the wooden stage. From inquiries I have made, I am led to believe that Mr. Salmon, of Fenchurch Street (who furnished the "Warington's"), could supply the magnetic stage in brass, instead of wood, at the same price as the present "sliding rest."

I shall be happy to show the instrument to any reader who may take an interest in the subject.—J. Newton Tomkins, F.R.C.S., Russell Place, London.

Facts on the Propagation of Actinia.—My aquarium affords at this moment a curious illustration of a mode of increase in a beautiful specimen of *A. dianthus,* which I do not remember to have seen noticed. Although special reproductive organs are well known to exist in the Actiniæ, it would appear that they are not actually necessary to the multiplication and continuation of the species, as this end can be as easily accomplished, and with as much certainty, by fissuration and self-multiplication. I have lately had an opportunity of witnessing both processes, in white specimens of *A. dianthus.*

In one, a fully formed offset was thrown out about half an inch from the foot; this continued to grow for some weeks, and was ultimately thrown off, having attained a considerable size. In another instance, the animal became so firmly adherent to the side of the glass, that, after having vainly endeavoured to detach itself, with an apparent degree of violence, it positively tore itself away, leaving behind six small pieces of the outer margin of the circular foot. Firmly glued to the side, these portions served for many days merely to mark the spot; at the end of a week I took a piece of stick, and was about to clean them off, when, much to my surprise, I saw that they retracted as soon as I touched them: in a few days more, I was still more surprised to see a row of tentacles round the head of each; and they have at this time considerably increased in size, so that my stock is richer by six perfectly formed Actiniæ. The parent certainly suffered at the time, for it remained motionless at the bottom of the tank several days, before it again made any attempt to fix itself. The wounded parts have since healed, the repair completed, and the animal is as lively as before. It is remarkable that I have had no increase of *A. dianthus* by any other mode; and in other specimens, after ejecting the young through the mouth, they have very soon after died.—JABEZ HOGG, London.

Microscopic Slide-dryer.—Several friends, who kindly mount for me microscopic slides, having stated that they had a difficulty in hardening the balsam, though they had tried the various means suggested, (1) such as hanging them over a gas-lamp, (2) placing them on a hot-water apparatus and (3) in the fender before the fire, it occurred to me that a modification of the common cheese-toaster or Dutch oven would facilitate the object.

I have had two made, and have been informed by the friends who have used them that the apparatus completely answers the purpose, and is a great convenience to them, as affording the means of stowing the slides away during the time they are in hand.

In hopes that it may be of use to others, I have sent a description of the apparatus for insertion in the 'Microscopical Journal.'

Those I have had made are one foot square and three inches deep, with a sloping top; the cavity being furnished with six movable shelves, resting on ledges rivetted to the sides at equidistant spaces. The shelves are cut out on the centre, so that both sides of the glass slides are exposed, and furnished all round with a narrow, turned-up ledge. These shelves will hold one dozen slides each, so that the bottom of the case and the slides will hold seven dozens of slides.

A classical friend has proposed the name of *Retino-klibanon* for this apparatus, which I have called a *slide-dryer*. J. E. GRAY, British Museum, March, 1857.

PROCEEDINGS OF SOCIETIES.

Microscopical Society, *January* 14*th*, 1857.

George Shadbolt, Esq., President, in the chair.

T. N. Tomkins, Esq., 8, Russell Place, Fitzroy Square; J. R. Steadman, Esq., Sharnbrook, Beds; J. A. Pigott, Esq., Albert Terrace, Bedford, were balloted for, and duly elected members of the Society.

A paper, by J. Quekett, Esq., "On the White Substance surrounding the Mealy Bug, an insect infesting the Vine," was read.

Another paper, by the same author, "On the presence of Fungi in living and decaying Wood," was read.

Mr. Ward announced the intention of the Master of the Apothecaries' Company to invite the Members of the Society to a Soirée at Apothecaries' Hall, on Tuesday, April 28th.

A Report from the Sub-Committee appointed to determine the best mode of constructing a uniform attachment for Object-Glasses was read.

February 11*th*, 1857.

(annual meeting.)

George Shadbolt, Esq., President, in the chair.

Reports from the Council on the Progress of the Society during the past year, and from the Auditors of the Treasurer's accounts, were read. ('Trans. Micr. Soc.,' p. 131.)

The President then delivered an Address, which was ordered to be printed with the preceding Reports.

It was resolved that George E. Blenkins, Esq., be elected Joint Honorary Secretary with Mr. Quekett.

The election of officers and new members of Council took place, when the following were declared duly elected:

President.—George Shadbolt, Esq. *Treasurer.*—N. B. Ward, Esq. *Secretaries.*—John Quekett, Esq.; George E. Blenkins, Esq.

Four Members of Council.—T. H. Huxley, Esq.; E. G. Lobb, Esq.; W. Peters, Esq.; J. H. Roberts, Esq.

The Rev. T. Wiltshire, Rectory, Bread Street Hill; Dr. Cobbold, 27, Upper Seymour Street; James Wyatt, Esq., Coldstream Guards; James Macgregor, Esq., 55, York Terrace, Regent's Park; J. Moore, Esq., Grasmere Lodge, Lower Tulse Hill, were balloted for, and duly elected members of the Society.

The Society then adjourned to a soirée, at which about 350 persons were present.

March 4th, 1857.

George Shadbolt, Esq., President, in the chair.

H. Morley, Esq., 4, Frederick Villas, East Brixton; W. A. Lloyd, Esq., 19 and 20, Portland Road, Regent's Park, were balloted for, and duly elected members of the Society.

Dr. Harley read a paper "On the Skin of the Frog." ('Trans.,' p. 148.)

Mr. Busk gave an abstract of a paper by Mr. Beardsley, "On a Deposit from a Lake in Cumberland." ('Trans.,' p. 146.)

April 15th, 1857.

George Shadbolt, Esq., President, in the chair.

Dr. E. H. Vinen, 6, Chepstow Villas West; W. J. Sargenson, Esq., 5, Pall Mall, were balloted for, and duly elected members of the Society.

A paper, by H. Dean, Esq., "On a Parasitic Fungus," was read. ('Trans.,' p. 160.)

Mr. Ward made some observations on Mosses, and exhibited and described a large collection of those plants.

May 13th, 1857.

George Shadbolt, Esq., President, in the chair.

R. Wilson, Esq., 80, Old Broad Street; J. E. Elliott, Esq., 4, Martin's Lane, Cannon Street; D. Scannell, Esq., Chapel Street, Grosvenor Place; John Miller, Esq., 36, Jermyn Street; Dr. M'Kinlay, Paisley, were balloted for, and duly elected members of the Society.

Dr. Farre read a paper on the early state of the Human Embryo. ('Trans.,' p. 161.)

Mr. Jackson exhibited and described a new form of Microscope.

June 10th, 1857.

George Shadbolt, Esq., President, in the chair.

R. Farmer, Esq., 6, Manor Road, Upper Holloway, was balloted for, and duly elected a member of the Society.

A paper, by George Blenkins, Esq., "On a Human Ovum," was read.

A paper, by Dr. Donkin, "On a new species of Filamentous Diatom new to Britain," was read.

A Report from the Sub-Committee "On the best form of Universal Attachment of the Object-Glass," was read.

The meetings were then adjourned until October.

ZOOPHYTOLOGY.

In the 'Transactions of the Tyneside Naturalists' Field Club' has been published a "Catalogue of the Zoophytes of Northumberland and Durham," drawn up by Mr. J. Alder, whose unwearied industry and well-known powers of minute observation we are glad to see thus devoted to the subject of Zoophytology. The work, as it may be termed, is not a mere catalogue of the Sertularian Zoophytes and Polyzoa found upon the coasts of Northumberland and Durham, but includes numerous and copious observations upon various species, and more especially the descriptions of several new genera and species. In the introductory observations the following list is given of species characteristic of the north-eastern shores:

1. Cœlenterata.

1. Actinozoa.

Actinia digitata.
Anthea Tuediæ.
Pennatula phosphorea.

2. Hydrozoa.

Eudendrium rameum.
confertum.
Tubularia Dumortierii.
Halecium muricatum.
Sertularia tricuspidata.
,, *fallax.*
,, *filicula.*
,, *fusca.*
Thuiaria thuja.
Plumularia Catherina.
,, *frutescens.*
Grammaria ramosa.

2. Molluscoida.

1. Polyzoa.

a. Cheilostomata.

Gemellaria loriculata.
Cellepora Skenei.
Bugula fastigiata.
murragana.
Flustra truncata.
Carbasea papyrea.
Eschara cribaria.
Retepora beaniana.

b. Ctenostomata.

Farrella pedicellata.
Avenella fusca.
Alcyonidium mamillatum.

Many of which, Mr. Alder observes, are generally rare or wanting in the south and west. Comparing the marine Fauna of the above region with that of the south coast, the most striking deficiency is found in the Asteroid and Helianthoid orders, many genera in which are entirely wanting; as are likewise all the calcareous and corticated corals. Of the more conspicuous south country zoophytes we may note the absence of—

Sertularia nigra.
pinnata.
Plumularia pennatula.
Campanularia gelatinosa.
Anthea cereus.
Adamsia palliata.
Caryophyllia Smithii.

And, among the Polyzoa, of—

Membranipora Lacroixii.
Flustra chartacea.
Caberea Boryi.
Valkeria pustulata.

The catalogue contains 164 species, of which seventeen at least are believed to be new. Mr. Alder arranges them in the following orders and families :

ANTHOZOA.		
1. Hydroida.		
Tubulariadæ	15	
Sertulariadæ	30	
Campanulariadæ	18	
Hydridæ	2—65	
2. Asteroida		3
Helianthoida		10—78
POLYZOA.		
Cyclostomata		11
Cheilostomata		54
Ctenostomata		14
Pedicellinea		1
Hippocrepia		6—86
		164

The more characteristic species of the different bathymetric zones are stated to be the following:

1. Littoral zone.

Sertularia pumila.
Actinia mesembryanthemum.
coriacea.

Lepralia verrucosa.
punctata.
Membranipora pilosa.
Flustrella hispida.
Alcyonidium hirsutum.

2. Laminarian zone.

Sertularia operculata.
Laomedea geniculata.
Campanularia Johnstoni.
Lepralia hyalina.
Membranipora membranacea.
pilosa.
Cellularia reptans.
Flustra foliacea.
truncata.
Alcyonidium hirsutum.

3. Coralline zone.

Tubularia gracilis.
Halecium halecinum.
Sertularia fallax.
filicula.
Antennularia antennina.
Plumularia falcata.
Campanularia Johnstoni.
dumosa.
Reticularia serpens.
Coppinia arcta.
Pennatula phosphorea.
Actinia crassicornis.
Cellepora pumicosa.
Gemellaria loriculata.
Membranipora Flemingii.
unicornis.
Flustra foliacea.
truncata.
Carbasea papyrea.

4. Deep water.

Eudendrium rameum.
Tubularia Dumortierii.
Sertularia tricuspidata.
abietina.
fusca.
Plumularia falcata.
Catherina.
Campanularia volubilis.
dumosa.
Grammaria ramosa.
Actinia digitata.
Diastopora obelia.
Cellepora ramulosa.
Skenei.
Lepralia reticulata.
linearis.

Cellularia ternata.
Peachii.
Bugula Murrayana.
Alcyonidium parasiticum.

The new genera and species described in Mr. Alder's 'Catalogue' are—

1. ANTHOZOA.

Fam. TUBULARIADÆ.

1. *Vorticlava.* Alder (p. 10).

Polype linear-cylindrical or clavate, soft, naked, affixed at the base, solitary (?). Head terminal; tentacles in two rows, stout, dissimilar, the upper row capitate.

1. *V. humilis*, n. sp. Alder (p. 10, Pl. I, figs. 1, 3).

Body white, semi-transparent, nearly of equal thickness throughout; upper tentacles 5, short and stout; lower tentacles 10, about three times the length of the upper. Length of body, $\frac{2}{10}$ inch.

Hab. On *Corallina officinalis*, between tide-marks. Cullercoats, also at Felixstow.

2. *Eudendrium*, Ehrenb.

1. *E. confertum*, n. sp. Alder (p. 13, Pl. I, figs. 5—8).

Polype white or pale flesh-coloured, with a longish ovate head, surrounded by a single row of tentacles. Polypary tubular, yellowish, horn-coloured, strongly wrinkled across, but not annulated, slightly branched and expanding a little towards the apertures; base, a densely reticulated and closely adhering crust. Height, $\frac{1}{4}$ to $\frac{1}{2}$ inch.

Hab. On old shells of *Buccinum undatum* and *Fusus antiquus* from deep water. Cullercoats.

2. *E. capillare*, n. sp. Alder (p. 15, Pl. I, figs. 9, 12).

Polypary minute, very slender, thread-like, a little branched, transparent, pale horn-coloured, smooth, excepting two or three faint rings near the origin of each branch. Polypes terminal on the upper branches, vase- or pear-shaped, with a single row of eighteen or twenty, long, slender tentacles; reproductive capsules on separate short branches near the lower part of the stem, or clustered on verticillate pedicles; two or three capsules in linear series on each pedicle. Height, $\frac{1}{2}$ inch.

Hab. Parasitic on *Antennularia ramosa.* Embleton Bay.

3. *Tubularia.*

1. *T. implexa*, n. sp. Alder (p. 18, Pl. VII, figs. 3—6).

Tubes small, very slender, generally more or less contorted below, smooth, wrinkled, or regularly annulated beneath a smooth, transparent epidermis; slightly and sub-unilaterally branched; the branches going off nearly at right angles to the stem, and a little constricted at their base. Gregarious, forming a densely tangled mass of $\frac{1}{2}$ to $\frac{3}{4}$ inch in height.

Hab. Deep water, thirty miles east of Holy Island.

Fam. SERTULARIADÆ.

1. *Sertularia*, Linn.

1. *S. tricuspidata*, n. sp. Alder (p. 21, Pl. II, figs. 1, 2).

Stem slender, alternately branched, twisted at intervals, and jointed above each cell; cells alternate, rather distant, smooth, exactly cylindrical; a little bent outwards, with a three-toothed rim; ovicapsules strongly ribbed across, with a narrow funnel-shaped aperture. Height, 1 to 2 inches.

Hab. Deep water.

2. *S. tenella*, n. sp. Alder (p. 23, Pl. II, figs. 3, 6).

Minute, creeping, throwing up short unbranched or slightly branched stems, which are slender, zigzagged, and jointed above each cell; cells alternate, rather distant, elongate, barrel-shaped, finely wrinkled across; aperture erect, patent, squared, and four-toothed. Length, $\frac{1}{2}$ to 1 inch.

Sertul. rugosa, var., Johnst.

Hab. Plum. falcata, and other zoophytes. Not common.

Fam. CAMPANULARIADÆ, Johnst.

Laomedea, Lamx.

1. *L. neglecta,* n. sp. Alder, p. 33, Pl. III, figs. 1, 2.

Polypary minute; stem filiform, sub-flexuose, with two or three alternate simple branches, each bearing a cell; the stem annulated, with from four to seven rings above the origin of each branch, and sometimes slightly ringed below; the branches ringed throughout, cells narrow and deep, with alternate deep and shallow crenations, forming about eight bimucronated denticles round the margin. Polype with fifteen or sixteen slender tentacles. Height, $\frac{1}{8}$ inch.

Hab. Between tide-marks, on under side of stones.

2. *L. acuminata,* n. sp. Alder (p. 34, Pl. III, figs. 5, 8).

Polypary minute, scarcely branched, with a slender annulated stem; the annulations strongest at the base, and becoming fainter or disappearing towards the cell. Cells thin, membranous, finely striated longitudinally, elongate pod-shaped, squared below, and tapering to a fine point above; margin slightly crenulated. Polype, when extended, two or three times as long as the cell; tentacles 20, muricate, united by a web at the base. Height, $\frac{1}{10}$ inch.

Hab. Old shell of *Fusus antiquus* from deep water. Cullercoats.

2. *Campanularia.*

1. *C. Johnstoni*, n. sp. Alder (p. 36, Pl. II, fig. 8).

Stem creeping, plain; pedicles long, with numerous close-set rings at the base, and more or less ringed at the top; middle portion usually plain, sometimes ringed; cells deep and rather large, with ten to twelve strong denticles round the rim; ovicapsules nearly sessile on the creeping stem, ovate-oblong, strongly plicated transversely and truncated at the top. Length, one and a half to two tenths of an inch.

Hab. On seaweeds, zoophytes, shells, &c. Common.

2. *C. Hincksii*, n. sp. Alder (p. 37, Pl. II, fig. 9).

Stem creeping, plain; pedicles long, nearly smooth, with two or three slight spiral twists at the base and two or three spherical rings at the top, one of which is within the cup: cells rather long, with parallel sides, wrinkled or lineated longitudinally; marginal denticles 10, of a squared or castellated form, a little indented at the top. Height, about $\frac{1}{8}$ inch.

Camp. volubilis, var., Hincks, in 'Ann. Nat. Hist.,' 2d ser., vol. ii, p. 180.

Hab. On shells and zoophytes from deep water.

3. *C. gracillima*, n. sp. Alder (p. 39, Pl. IV, figs. 5, 6).

Stem erect, compound, sub-unilaterally branched; cells very slender, long, tubular, thin, set on loosely twisted pedicles of about two whorls; aperture entire. Height, 1 inch.

Hab. On shells and zoophytes from deep water.

A very similar if not identical species occurs in Bass Strait (Busk).

3. *Grammaria*, Stimpson.

"Polypidom rectilinear, elongated, cylindrical, composed of aggregated tubes, generally without branches, which, when they occur, are of the same character as that from which they spring. Cells arranged on all sides, in more or less regular and equidistant longitudinal rows, giving a section of the stem a star-like appearance."

G. ramosa, n. sp. Alder (p. 40, Pl. IV, figs. 1—4).

Polypary stout, horn-coloured, irregularly branched; branches arising from a constricted base; cells cylindrical, bending outwards to a distance nearly equal to the width of the stem, with an even margin, behind which they are frequently annulated with one or two lines of growth; they are set in about four longitudinal rows, the adjoining cells alternating and the opposite cells nearly in a line with each other. Height, 1—2 inches.

Hab. Deep water; rather rare.

II. Polyzoa.

Fam. Membraniporidæ.

1. *Membranipora*, Blainville.

As considerable confusion and obscurity involve the various British species of *Membranipora*, a genus to which Mr. Alder appears to have paid considerable attention, and which he has in great measure now cleared up, it will be advantageous to notice his arrangement of the several species belonging to it which have occurred to his observation. These are—

1. *M. membranacea*, Linn. *Flustra membranacea*, Johnst. *M. membranacea*, Busk. Cat., p. 56, pl. lxviii, fig. 2.
2. *M. pilosa*, Linn., Johnst., Busk.
3. *M. lineata*, Linn. Alder (p. 53, Pl. VIII, figs. 1, 1*a*).

Cells oval; the margin with four or five spines on each side, bending inwards, generally rather slender and not flattened on the sides. Ovicapsule large, galeate, slightly frosted, with an arched rib near the top. Avicularia subsessile, or a little elevated, situated on one or both sides of the ovicapsule, more rarely at the top, and sometimes at the bottom of the cell.

Flustra lineata, Linn., Johnston.

Membranipora lineata, Busk. Cat., p. 58.

4. *M. spinifera*, Johnst. Alder (p. 53, Pl. VIII, figs. 2, 2*a*).

Cells oblong-oval; the margin with numerous stout, linear, or subclavate spines, about seven on each side, erect or leaning inwards. Ovicapsule shallow, smooth, with two or more spines (?). Avicularia, on the top of club-shaped spines, developed sparingly on any part of the margin of the cell.

Flustra spinifera, Johnst. 'Transact. of Newcastle N. H. Soc.,' vol. ii, p. 266, pl. ix, fig. 6.

Flustra (?) *lineata*, Johnst., 'Brit. Zooph.'

5. *M. craticula*, n. sp. Alder (p. 54, Pl. VIII, figs. 3, 3 *a*).

Cells in linear series, small, oval; margin with five to seven spines on each side, which are shining, flattish at the edges, and lie closely over the aperture; one or two of the uppermost spines are erect, long, and cylindrical. Ovicapsule rather small, smooth, and cylindrico-globose, with a rib across the middle. An avicularium generally at the top of the ovicapsule, sometimes at its side.

Hab. Deep water.

6. *M. Flemingii*, Busk. Cat., p. 58, pl. lxi, fig. 2; pl. lxxxiv, figs. 4, 5, 6; pl. civ, figs. 2, 3, 4. Alder, p. 55, Pl. VIII, fig. 4.

7. *M. Pouilletii*, Audouin.

Cells ovate, broadish below, rather larger than in *M. Flemingii*, and without the inner expansion; margin granulated with a thin rim; spines four or six, round the top of the cell, short; one only, on each side, visible below the ovicapsule. Ovicapsule large, globose, or elongated, strongly granulated and occasionally perforated. Avicularia dispersed; sometimes a small one on each side of the ovicapsule.

M. membranacea, Johnst.
M. Pouilletii, Audouin, 'Expl.' I, p. 240; Savigny, 'Egypt,' pl. ix, fig. 12.

8. *M. unicornis*, Fleming, (p. 56, Pl. VIII, fig. 6).

Cells stout, oval; margin granulated, with two spines on each side near the top, one of which is usually covered by the ovicapsule. Ovicapsule sub-cylindrical, smooth, with a strong rib above the margin and surmounted by a conical avicularium.

Flustra unicornis, Fleming.
Mem. membranacea, Johnst. (pars).
Lepralia squama, Dalyell.

2. Fam. Cellulariadæ.

1. *Bugula*, Oken.

B. fastigiata, Fab. Alder, p. 59.

Polyzoary one to four inches high, stout, bushy, irregularly branched; becoming purplish or rusty-red when dry; cells biserial, cylindrical, elongate, attenuated below; aperture wide above, elliptical below, with a stout cylindrical jointed spine at the upper and outer angles, and a denticle in front of it; no spine at the inner angle. Avicularium large, with a longish beak. Ovicapsules very shallow.

Sertularia fastigiata, Fab.
Cellularia fastigiata, Fleming, Dalyell.
Cellularia plumosa, Johnst., 'Brit. Zooph.,' p. 341, pl. lxi.

Hab. Laminarian zone. Very common.

3. Fam. Salicornariadæ.

1. *Salicornaria*, Cuvier.

1. *S. sinuosa*, Hassall.

Doubts having been previously entertained with respect to the distinction of this form from *S. farciminoides*, Mr. Alder "found it necessary to subject both kinds to a careful re-examination." The result of which has confirmed him in the belief that they are really distinct species. The best character, he says, is found in the avicularium. This organ in *S. farciminoides* is semicircular and arched upwards; that of *S. sinuosa* is triangular and points downwards, always sloping a little to one side. In addition to this the form of the under lip of the cell differs in the two species: in *S. farciminoides* it is slightly arched in the centre; whilst in *S. sinuosa* it is quite straight, and rather projecting, with a sinus at each end.

We now quite agree with Mr. Alder in regarding the two species as distinct.

Sub-order. CTENOSTOMATA.

Fam. ALCYONIDIADÆ, Johnston.

1. *Alcyonidium.* Lamx.

1. *A. mamillatum*, n. sp. Alder (p. 64, Pl. V, figs. 3, 4).

Encrusting, semitransparent, brownish; covered with rather long, stout, and strongly wrinkled papillæ, from which the polypides issue; tentacles 16—18.

Hab. On old shells, deep water.

2. *A. albidum*, n. sp. Alder (p. 64, Pl. V, figs. 5, 6).

Encrusting, semitransparent, yellowish-white; general envelope inconspicuous; polypides prominent, ventricose, flask-shaped, sub-recumbent, becoming erect towards the aperture, which is truncated when contracted; tentacles 18.

Hab. The stem of *Plum. falcata.*

2. *Farrella*, Ehr.

1. *F. pedicellata*, n. sp. Alder (p. 68, Pl. VI).

Body (of cell) ovate-oblong, yellowish, transparent, with long and very slender pedicles, uniform in thickness throughout, arising from a creeping fibre; tentacles 12. Length of cell, $\frac{1}{30}$ inch.

Hab. Old shells of *Buccinum undatum* and *Fusus antiquus*, in deep water.

On some NEW BRITISH POLYZOA. By the Rev. T. HINCKS.

(*Concluded from* No. XIX, p. 176.)

THE following is the conclusion (accidentally omitted) of a paper which appeared in the last number of the 'Journal.' It completes the description of the *Alcyonidium hexagonum* (Hincks)—the *A. Mytili* of Dalyell.

The surface of the fleshy crust is thickly covered with small prominences, marking the point at which the polypide issues from its cell. The normal shape of the cells is hexagonal, but they are subject to many irregularities. The *septa* are well marked, and show distinctly on the surface. The polypides are laid lengthwise in the cells, and the orifice is at one extremity, and not central. Sir John Dalyell says that they have about fifteen tentacula. The ovaries occur as somewhat circular *papillæ,* scattered irregularly over the *cœnœcium,* within which the *ova* are distinctly visible. At the top of each ovarium, when the embryos are about to escape, an opening appears, and a small tube is gradually pushed forth to some distance. Through this tubular orifice they work their way by means of their *cilia,* and as soon as they have effected their escape begin to move with great activity through the water. I have seen seven pass from a single ovary in the course of a few seconds. The embryo is circular in form, white, opaque, and bears a striking resemblance to a *low-crowned hat.* The margin is fringed with *cilia.**

The figure of *Sarcochitum polyoum* in Gosse's 'Marine Zoology' should, I think, be referred to this species. It bears no resemblance to the *Sarcochitum* of Hassall.

Hab. Salcombe, Devon; encrusting sea-weed, between tide-marks.

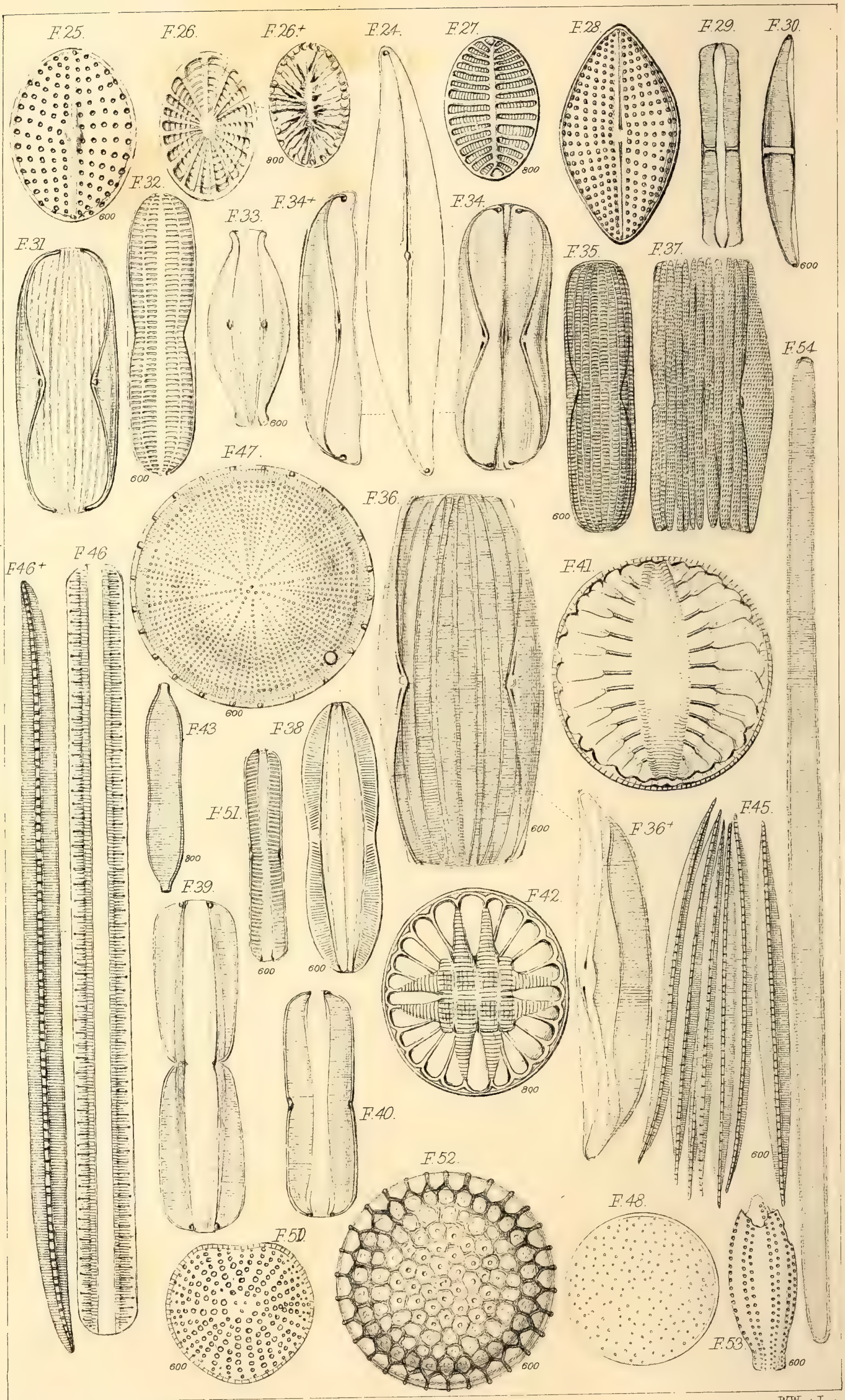
FARRELLA ELONGATA. [*Laguncula elongata,* Van Beneden.]

This species I have obtained in great abundance on the Lancashire coast, in the neighbourhood of Fleetwood and Lytham.

The pedicle is of very variable length, and the cells are *very slightly* attached to the creeping fibre. In this latter respect the species differs markedly from the *F. pedicellata*—a kindred form lately described by Mr. Alder. The tentacles of *F. elongata* vary in number from ten to fourteen. The former number is very common amongst the younger polypides; fourteen occur rarely, and twelve is the ordinary complement.

I recorded the occurrence of *F. elongata* in Britain some years ago, but the notice seems to have been overlooked (*vide* 'Micr. Journ.,' vol. iv, p. 95).

* In the 'Annals of Nat. Hist.' for November, 1851, I have described these embryos, referring them wrongly to the *Cycloum papillosum* of Hassall.



Dr. Greville del. Tuffen West sculp.

W. West Imp.

DESCRIPTION OF PLATE I,

Illustrating Professor Gregory's paper on the *Diatomaceæ* of the Glenshira Sand.

Fig.
24.—*Pleurosigma*, not named, sp. ?
25.—*Cocconeis distans*, n. sp. × 600.
26.—*Cocconeis radiata*, n. sp. × 800.
26*.— „ „ „ Abnormal form of the same.
27.—*Cocconeis costata*, n. sp. × 800. This is a small specimen.
28.—*Cocconeis lamprosticta*, n. sp.
29.—*Amphora rectangularis*, n. sp.
30.—*Amphora elegans*, n. sp. A detached valve. × 600.
31.—*Amphora plicata*, n. sp.
32.—*Amphora biseriata*, n. sp. × 600.
33.—*Amphora lineata* ? n. sp. ? × 600.
34.—*Amphora obtusa*, n. sp.
34*.— „ „ A detached valve.
35.—*Amphora crassa*, n. sp. × 600.
36.—*Amphora Grevilliana*, n. sp. × 600.
36*.— „ „ A detached segment.
37.—*Amphora Arcus*, n. sp., showing many segments in apposition. The detached segments are figured in my first paper on the Glenshira Sand. See 'Quarterly Journal of Microscopical Science,' vol. iv, Pl. IV, fig. 4.
38.—*Amphiprora minor*, n. sp. × 600.
39.—*Amphiprora lepidoptera*, n. sp. The front view. (The side view is figured in the plate above referred to (under fig. 37) as *Amphiprora vitrea*, *β* ?) This specimen is from ⅓ to ½ shorter than what I now find to be the average length of this fine species.
40.—*Amphiprora* ? *recta*, n. sp. The second figure, mentioned in the text, is omitted for want of room.
41.—*Campylodiscus simulans*, n. sp.
42.—*Campylodiscus bicruciatus*, n. sp. × 800.
43.—*Tryblionella apiculata*, n. sp. ? × 800.
45.—*Nitzschia* ? *socialis*, n. sp. × 600.
46.—*Nitzschia insignis*, F. V., n. sp.
46*.— „ „ S. V., „
47.—*Eupodiscus sparsus*, n. sp. ? × 600.
48.—Disc, not named, n. sp. ?
50.—Disc, not named, n. sp. × 600.
51.—*Amphiprora* ? not named, n. sp. ? × 600.
52.—Disc, probably one of the *Polycystineæ*. × 600.
53.—Oval form. Diatomaceous ? or one of the *Polycystineæ* ? × 600.
54.—*Synedra Baculus*, n. sp.

Figs. 44, *Nitzschia distans*, and 49, a disc, not named, have been omitted for want of space, but will be given on a future occasion.

Although many of the above figures are magnified to 600, and some to 800 diameters, yet they all vary in size to such an extent that specimens might have been selected which, magnified 400 diameters, would have been of the same length as the figures.—W. G.

The figures to which no mark of the magnifying power is attached are drawn to a scale of 400 diameters.

DESCRIPTION OF PLATE II,

Illustrating Mr. Dobson's paper on Lerp.

Fig.

1.—Ova of *Psylla* ?

2.—Larvæ constructing the conical crusts of lerp.

3.—The scaled form of lerp.

4.—The *Psylla* which affords the white lerp.

5.—Different forms of yellow lerp.

6.—The species of *Psylla* which produces the yellow lerp.

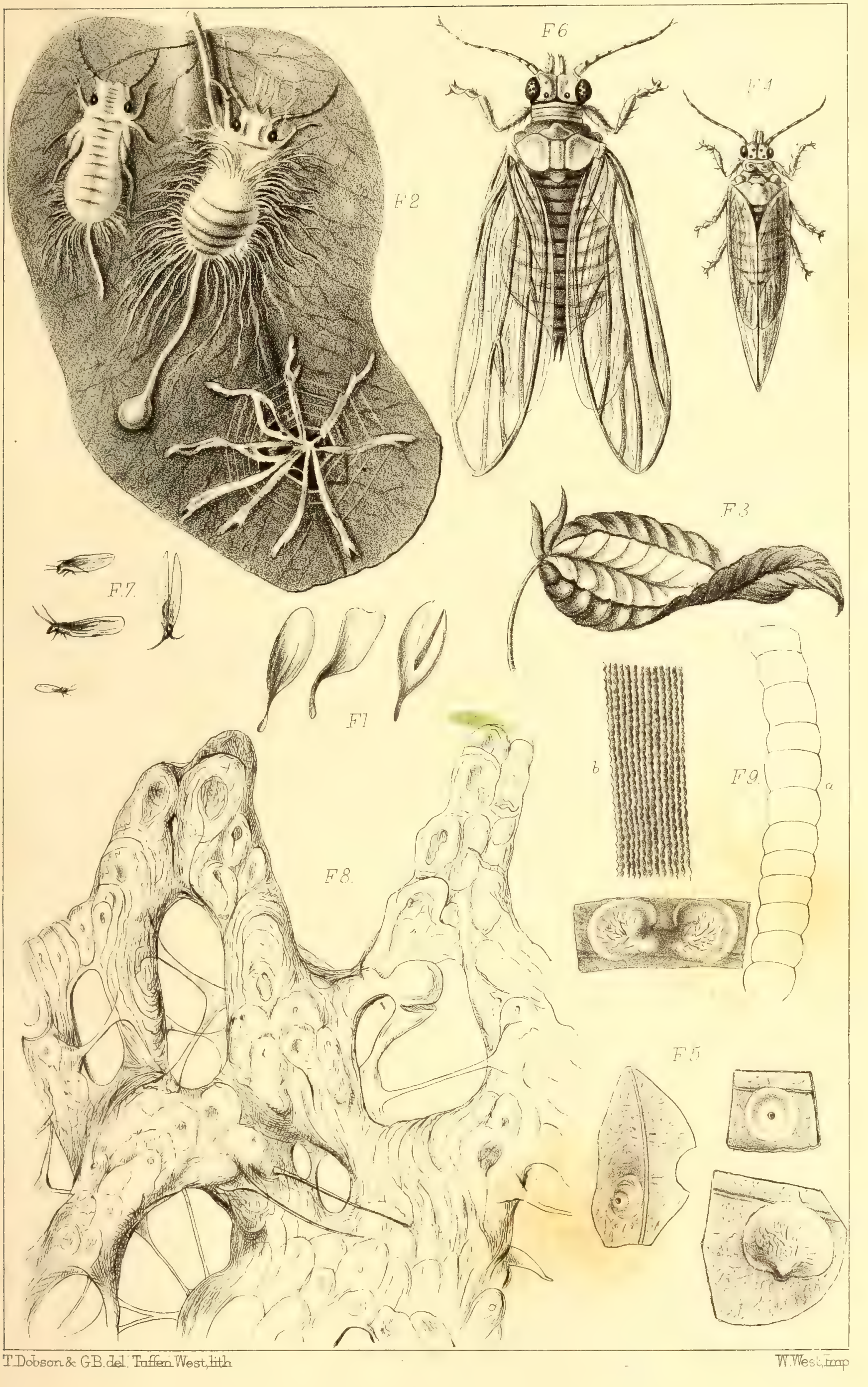
7.—The various species of *Psylla* affording lerp. Nat. size.

8.—Portion of the edge of a crust of yellow lerp. Magnified 30 diameters.

9.—Hairs on the crusts.

a. Towards the apex.

b. Towards the base.



T. Dobson & G.B. del. Tuffen West, lith W. West, imp

DESCRIPTION OF PLATES III, IV, V,

Illustrating the Hon. and Rev. S. G. Osborne's paper on Vegetable Cell-formation, principally as shown in the Growth of Wheat.

PLATE III.

Fig.

1.—Seed of wheat germinating, slightly enlarged.

A. Green future blade, &c.

B. Seed, starch, gluten, &c.

C. Main root.

DD. Lateral roots.

EEE. Free cones of cells at the points of the roots.

F. Hard cellular matter, the base of growth of root and stem.

α. Cellular tissue, the original covering of embryo blade.

β. Ditto of root.

γ, *γ*. Rootlets.

δ, Course of bundle of dotted fibre.

ε, *ε*, *ε*. Suckers.

ζ. Course of spiral fibre.

2.—Section from junction of germ with seed.

2 *a*.—The sap-tube on a larger scale.

3.—Thick-walled cellular tissue, with dark granular matter and oil, connecting the bundles of fibre and their investing cells with the germinating point.

ab. Layers of cells in immediate connection with—

c. Thick-walled cells containing oil.

4.—Termination of rootlet slightly magnified, with its free capsule of cells, *d*, and suckers.

5.—Capsule enlarged.

6.—Centre of apex of young root.

7, 7*.—Stages of growth of suckers from side of root.

f. Suckers.

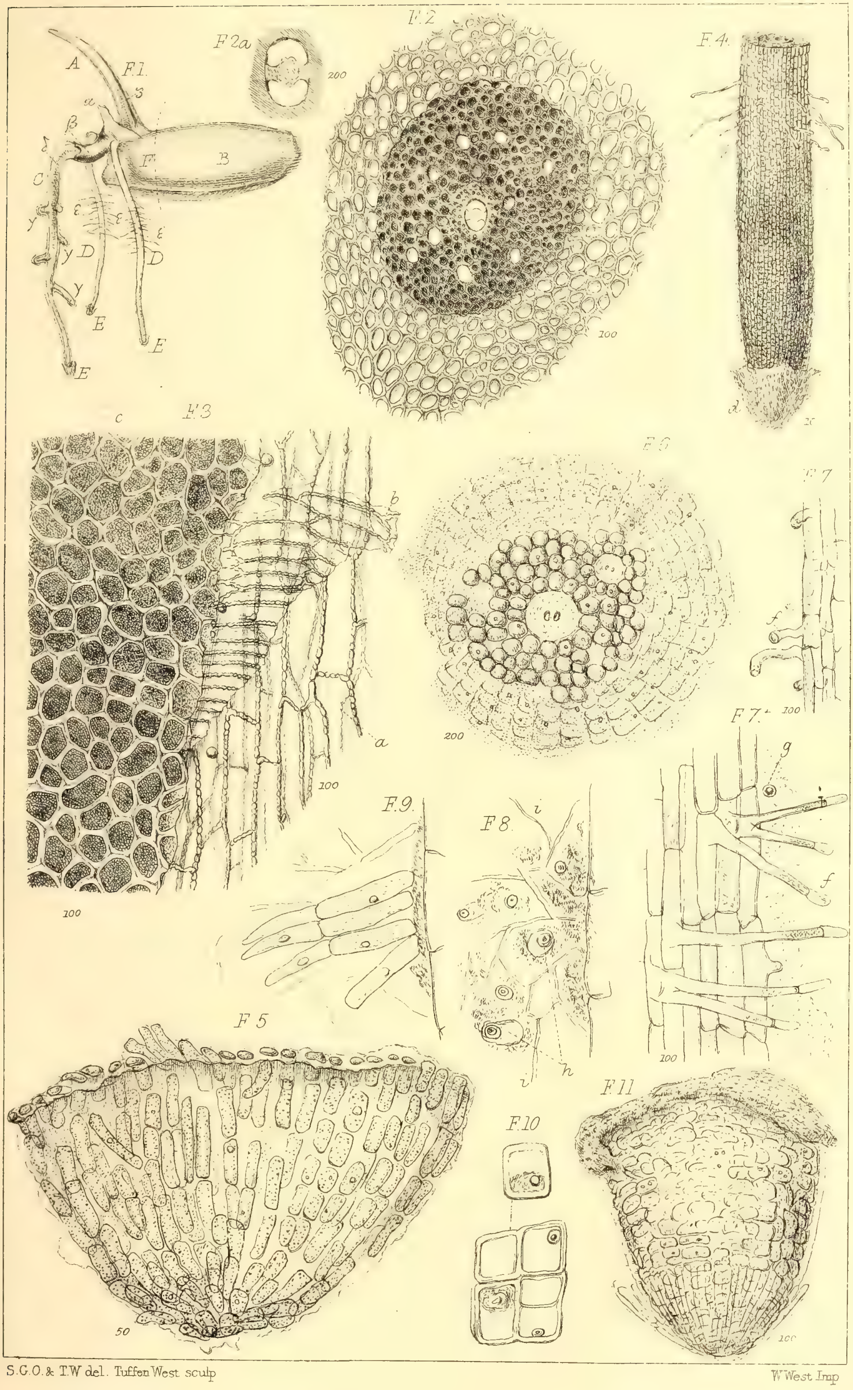
g. An escaped nucleus with its nucleolus.

8, 9.—Growth from side of root.

h. Nuclei in egg-shaped vesicles.

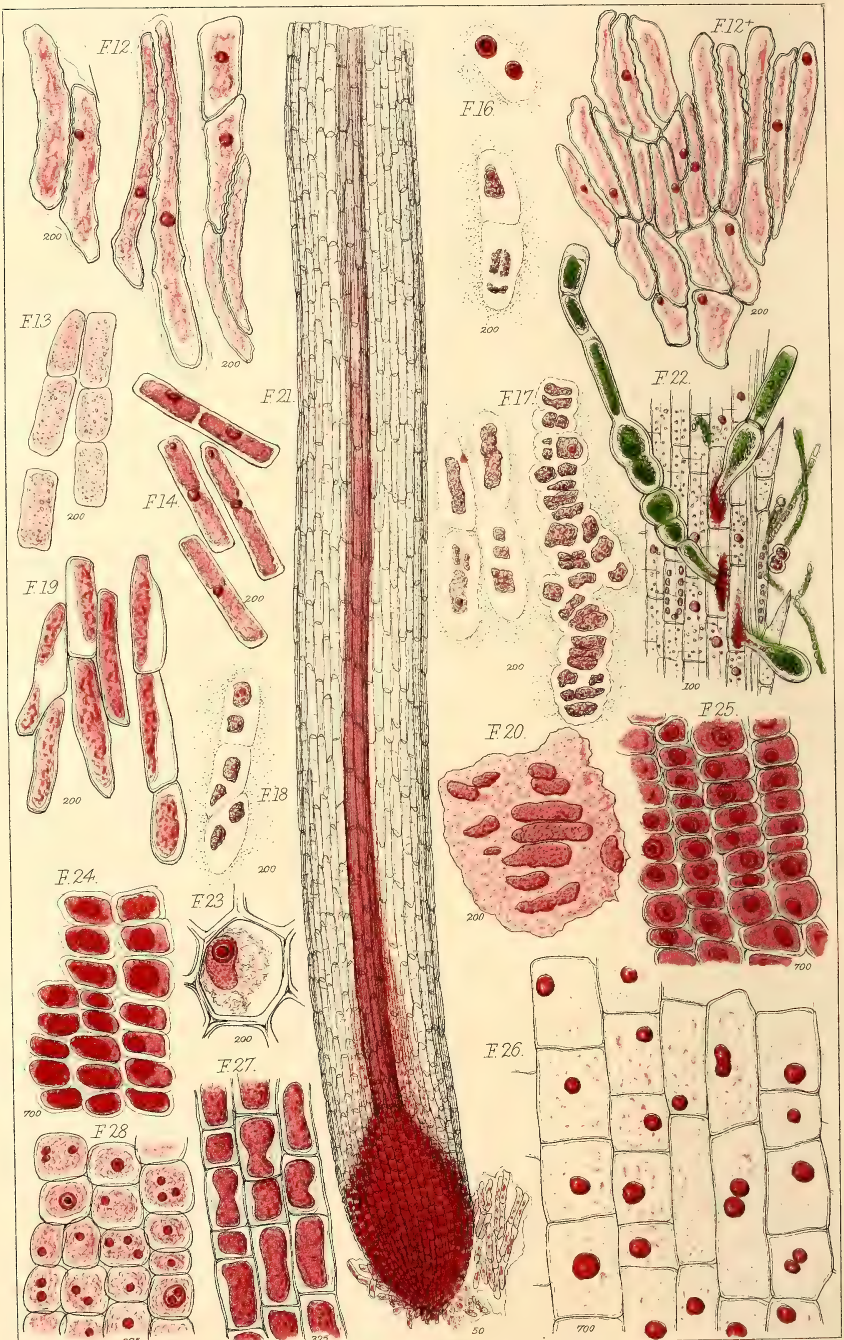
i. Hyaline thread-like processes.

10.—Cell-increase.



S.G.O. & T.W del. Tuffen West sculp

W West Imp



S.G.O. & T.W. del. Tuffen West sculp.

W West chromolith.r

PLATE IV.

Fig.
12, 12*.—Capsule cells.

13.—Capsule cells, without nuclei.

14.— „ „ nuclei formed; cell-increase proceeding by sub-division.

16, 17, 18.—Very earliest stages of cell-formation.

19.—Cell-increase by recession of granular contents to one side,—as displayed by colouring.

20.—Early cell-formation, coloured.

21.—Lower portion of a root of wheat coloured; the capsule-cells strongly painted; the pith-tube coloured; the colour decreased as growth proceeds; the parenchyma colourless.

22.—Absorption by a parasitic fungus, of coloured matter taken up by Anacharis.

23.—Shows well the nucleus with its nucleolus, in the "ovate vesicle;" from the large cell-structure surrounding the "sap-tube."

24.—Commencing formation of nuclei, and consequent increase in depth of colour, from base of a maize root.

25.—Nuclei perfectly formed, cell-contents reduced in quantity and depth of colouring.

26.—Taken from a little higher up the root. Nuclei alone left, the cell-contents having more or less disappeared.

27.—Cell-growth by the formation of a septum or septa, dividing individual cells into two or three; the walls frequently seem to be composed of several layers of plasma maize.

28.—Cells containing double and triple nuclei, sometimes two in one vesicle.

PLATE V.

Fig.

29.—Young leaf of wheat; it is seen to possess the free capsule of cells and epidermic plasm, closely identical with those of the root.

29*.—Portion of edge of the above much magnified.

30.—Some of the free cells from the above, detached.

31.—Transverse section of embryo leaf folded, with its straw-coloured envelope.

32.—Double ovate granules and molecules, showing a tendency to regular arrangement; from formative matter at an early age.

33.—Appearance of nuclei with nucleoli and vesicles, in formative matter at a stage more advanced than the last.

34.—Cells increasing by sub-division; from maize-leaf.

35.—Annular, spiral, scalariform, and pitted vessel, in juxtaposition; maize.

36.—Early formation of pitted vessel; maize.

37.—Dark spots indicating the commencement of actual perforation of the delicate membrane at the base of the pits in a "pitted" vessel; maize.

38.—Progress of absorption of basement membrane, spirally; maize.

39.—Transverse section, root of maize, showing the pentangular form assumed by scalariform tissue, through pressure of the surrounding cell-structure.

40.—Scalariform vessel from young cucumber, unrolling; its pentangular form is thus very distinctly brought out.

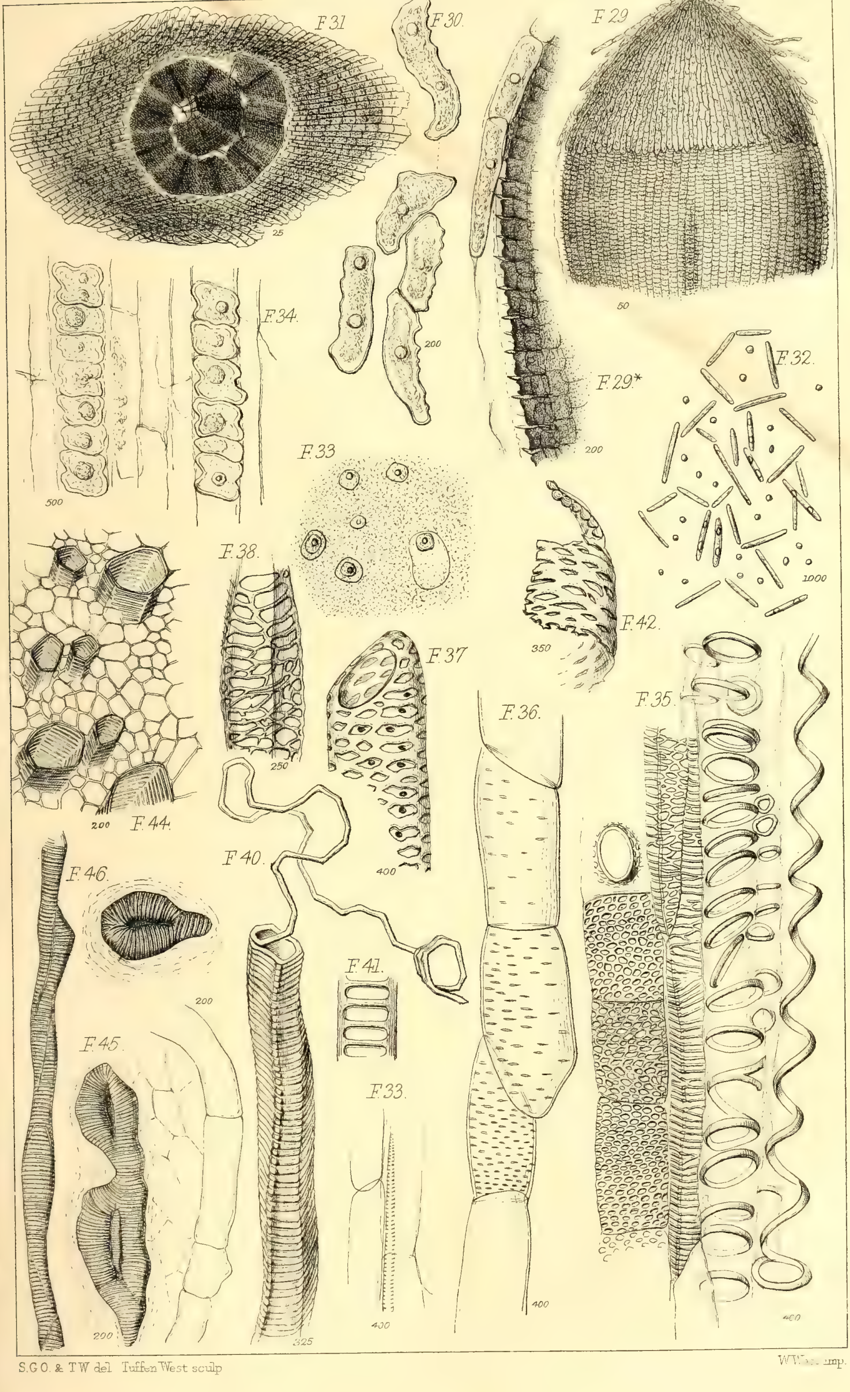
41.—Absorption of basement membrane in a linear direction, in the production of an annular vessel.

42.—Transverse section of a pitted vessel, a portion of the cut edge projects and shows well the production of the "pits," also lines indicating the layers of secondary deposit on the cell-wall.

43.—Rudimentary spiral fibre; plumule of wheat.

44, 45.—Early stage in formation of scalariform tissue; young vegetable marrow.

46.—The same, showing formation of a scalariform vessel, by the addition of cell to cell, and absorption of their walls at the points of contact.



S.G.O. & T.W del Tuffen West sculp W.W... imp.

DESCRIPTION OF PLATE VI,

Illustrating Dr. Harley's paper on Cutaneous Respiration.

Fig.

1.—The deep and superficial layers of the epidermis of the Frog's skin.

a. Epithelium covering the openings.

b. Central cell, with aperture.

2.—Deep layer of epidermis, showing the arrangement of the openings.

3.—Central cells, containing the triangular apertures in different stages of enlargement.

4.—Oval opening in the central cell of the Water-Lizard.

5.—Cutis vera of the Frog.

a. Lining membrane of the air-passage.

b. *Peculiar bodies*, resembling in some respects Pacinian corpuscles.

c. Pigment-cells.

d. Termination of the spread-out ends of the perpendicular fibres.

6.—Transverse section of the Frog's skin.

a. Epidermis.

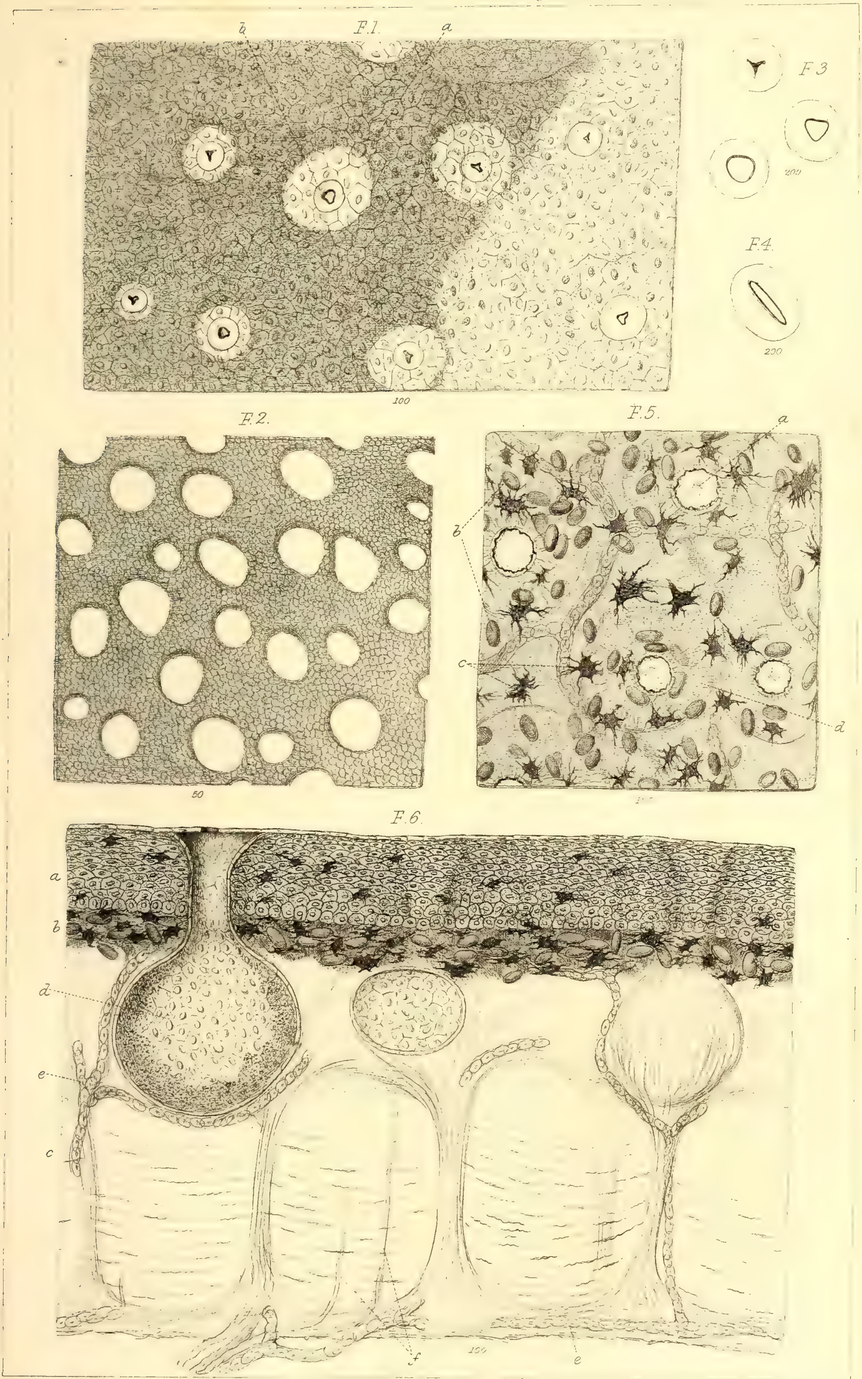
b. *Peculiar bodies* distributed among the pigment-cells.

c. Cutis vera.

d. The air-cavities, cut through in different parts.

e. Blood-vessels.

f. Nerves.



G. Harley & T. W. del.   Tuffen West. sc. ad nat.   W. West imp.

DESCRIPTION OF PLATE VII,

Illustrating Mr. Grove's paper on a Fungus parasitic in the Human Ear, and Dr. Farre's paper on the Human Embryo.*

Fig.

1.—Appearance of the fruit of the fungus on the floccose mycelium, under a low power.

2.—Portion magnified 400 diameters, the dark "head" in the centre probably more matured than the remainder; most of the heads are smaller and of a fawn colour—such is the one represented on the right; the three on the left are in an early stage. Some of the mycelium is also shown.

3.—One of the "heads" viewed from above.

4.—Sporules detached in mounting; here and there amongst the mycelium were patches of them, probably nature-sown.

5.—Threads of mycelium ramifying beneath the surface, amongst the delicate hexagonal pavement epithelium; when it reaches the surface many short branches arise, as shown towards the upper left corner.

6.—Mycelium in a vesicular condition, perhaps from abundance of moisture in such part; it may be worth inquiry whether a process of true conjugation may not take place in such circumstances. The idea has been mooted before, and I have seen other instances which appear to add to its probability. *A priori*, it does not seem unlikely that a fungus, growing in an excessively moist locality or in water, may, in such alga-like condition, conjugate like an Alga.

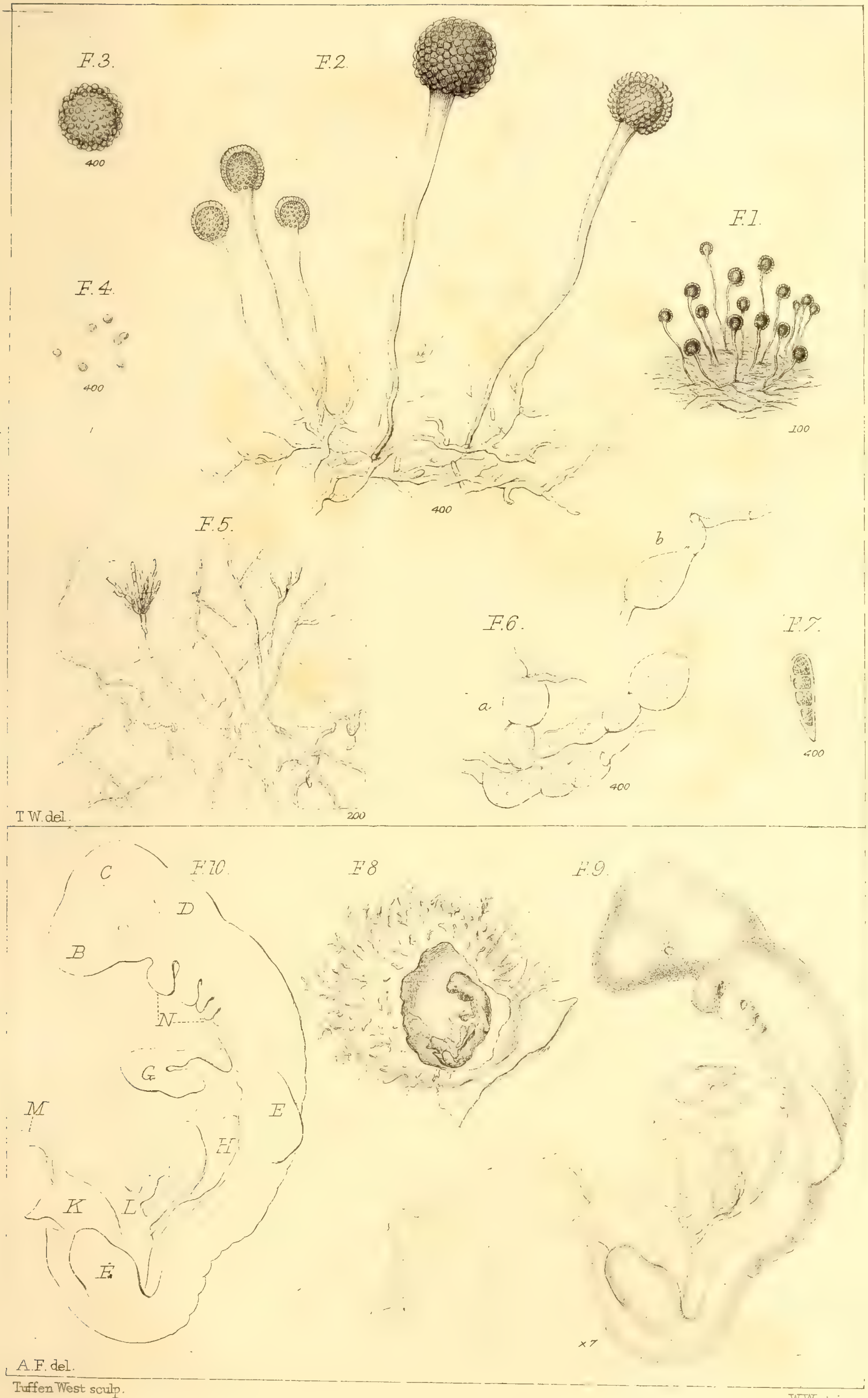
7.—An ascus, with four greenish sporidia, *on* a portion of the mycelium, whether accidentally or not, it may be difficult to say. No other example was seen; so that it may not have any connection with the other fungus.

8.—Embryo of the natural size contained in the fœtal membranes.

9.—The same embryo removed from the membranes, magnified 8 diameters.

- B. Prosencephalon.
- C. Mesencephalon.
- D. Epencephalon.
- E. Rudimentary upper extremity.
- F. Lower ditto.
- G. Heart, consisting of auricle, ventricle, and bulbus arteriosus.
- H. Probably Wolffian body.
- K. Root of allantois.
- L. Probably a portion of rudimentary intestine, into which appears to open the remains of a vitelline vesicle. Behind this is a body in which rudimentary cells are seen (hepatic?)
- N. Branchial laminæ (visceralbogen).

* Figs. 1—7 are multiplied 7 diameters.



Tuffen West sculp.

W West imp.

INDEX TO TRANSACTIONS.

VOLUME V.

LONDON: PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.

TRANSACTIONS

OF THE

MICROSCOPICAL SOCIETY

OF

LONDON.

NEW SERIES.

VOLUME VI.

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JOHN CHURCHILL, NEW BURLINGTON STREET.
1858.

TRANSACTIONS.

Observations *on the* Structure *of the* White Filamentous Substance *surrounding the so-called* Mealy Bug (*Coccus vitis*) *of the* Vine. By John Quekett.

(Read January 14th, 1857.)

About two years since I was requested by my friend, Mr. Daniel Hanbury, to examine the white waxy substance surrounding the bodies of certain female insects of a species of Coccus, from China, which was known under the various names of *insect white wax, Chinese insect wax, Japanese wax, tree wax, vegetable wax,* and *vegetable spermaceti.* This substance, up the year 1847, was introduced into this country in tolerable abundance, but since that time, according to Mr. Hanbury, the price at which it sold, viz., 1*s.* 3*d.* per lb., not being sufficiently remunerative, no further importation has taken place. The wax in question, as has lately been discovered by William Lockhart, Esq., of Shanghae, is formed by a species of Coccus hitherto undescribed, but which has recently been named by Mr. Westwood, *Coccus Sinensis.* The specimens described by Mr. Hanbury in an able paper, published in the 'Pharmaceutical Journal' for April, 1853, consisted of rounded masses of a semi-opaque substance, surrounding the dried full-grown bodies of the female insects. Some of the masses of wax had been scraped from the tree, others still remained attached to pieces of the wood. Besides the larger insects, there were others, probably young ones, also imbedded in the wax; these were of a light-brown colour. Mr. Hanbury having made a microscopic examination of the white substance, and finding that it differed in structure from anything that he had hitherto become acquainted with, kindly submitted his specimens to me for further examination, and the result of my investigations will be found in the following description, which formed an appendix to his paper.

"The wax was mostly in the form of rounded masses, varying from one quarter to one third of an inch in diameter; within these were inclosed small brown insects, which I find have been named by Mr. J. O. Westwood, *Coccus Sinensis.* When a small portion of the wax is examined with a power of not less than 250 diameters, it is found to consist of a series of short filaments or cylinders, some of which are straight, but others more or less curved; within each cylinder is a tubular cavity, extending throughout its whole length. That this is a tube may be well shown by the addition of water, which will readily enter both extremities of the tube, and render these parts more transparent than those containing air. The diameter of the cylinders is on an average $\frac{1}{4000}$th of an inch, whilst that of the tube within varies from $\frac{1}{7500}$th to $\frac{1}{8000}$th. The majority of the cylinders, when divided transversely, are found to be of circular figure, but I have occasionally seen them slightly flattened on one side.

"In fig. 1 (Pl. I), you have a representation of the cylinders as seen under a power of 500 diameters. If the wax be heated on glass it readily melts when the temperature rises to 184° Fahrenheit; and if examined in this state, the fluid mass is perfectly transparent and structureless. On cooling, however, it crystallizes precisely like spermaceti, as shown in fig. 2. I have also made a microscopical examination of the insects, but have not been able to discover as much of their internal organization as I could wish, in consequence of their dried and shrivelled condition. One of the most perfect specimens that I could select from upwards of a dozen which I took out of one of the rounded masses of wax before alluded to, is represented in fig. 4; this is its dorsal surface. Fig. 5 is a representation of the abdominal surface of the same insect. It will be seen that it has six legs, and the body is full of wax. In one of these insects, which appeared more transparent than the rest, the circular aperture or mouth was more plainly seen than in the specimen represented by fig. 5; but from the injury all the insects had sustained, I could not ascertain more of their intimate structure. Mr. Hanbury having, through the kindness of Sir W. Hooker, obtained some of the living cochineal from Kew Gardens, brought me a specimen of the white matter with which the insects are surrounded for comparison with that of the insect wax, and I find that it is composed of two distinct substances, one occurring in the form of filaments, and the other in minute oval bodies, which I shall term cocoons; these are about $\frac{1}{10}$th of an inch in the long, by $\frac{1}{25}$th in the short diameter. When these last were examined microscopically, they presented nearly the same structure as the insect wax, but the filaments were of two kinds; one which made up almost the entire bulk of the cocoon was of small size, averaging $\frac{1}{8000}$th to $\frac{1}{10000}$th of an inch in diameter; whilst the others, which are met with in fewer numbers, and on the outside of the cocoon, were nearly of the same nature as those of the insect wax, the principal difference being, that they were of greater length and rather larger diameter, being on an average $\frac{1}{3500}$th of an inch. The tube in the interior was also larger in proportion to the diameter of the filaments. A few examples of both kinds of filaments are represented in fig. 3, the smallest being those of which the great bulk of the cocoon was made up. I found it was a difficult matter at first to moisten these cocoons; neither water, glycerine, nor turpentine answered for the purpose; but I subsequently ascertained that alcohol did it completely, and from most of these oval bodies, which I have called cocoons, I have been able to extract a small insect; in one case the insect had wings, but all the others were without them. I concluded that this winged insect might probably be a young male Coccus. The apterous insects were of a brown colour; but upon carefully examining some parts of the white mass most free from cocoons, I discovered a number of red bodies about $\frac{1}{40}$th of an inch in diameter; these I concluded to be the young females, and their bodies were full of the beautiful and characteristic colouring matter. On submitting a cocoon to the action of heat, I found that a portion of it would melt and crystallize on cooling, precisely like the insect wax, but the temperature was much higher than 184°. In melting, all the tubular filaments disappear, but in the residuum there are numerous globules, probably of an oily nature. I should think, therefore, that the insect wax of China and the white matter of the cochineal insect would turn out to be as nearly alike in chemical composition as they are in their minute structure."

Since this time my attention has been directed to all the insect productions I could meet with that, as far as external appearances were concerned, at all resembled the insect wax, and, with this view, the cocoons of insects, and the white flocculent substance known as American blight, have been examined, but none of these presented the same character as the wax in question; it however happened, that about six weeks since I was spending an evening with Mr. Furze, one of our members, when a gentleman of the party, Mr. Evans, a surgeon, from Walthamstow, brought for examination some specimens of the mealy bug, which at that time he had discovered on one of his grape-vines. On seeing this for the first time, I was immediately struck with its resemblance to that of the *Coccus Sinensis,* and at once, with Mr. Evans's permission, proceeded to examine the white filamentous mass beneath the bodies of the creatures. It was at first seen by reflected light, and many of the filaments which appeared to be on the stretch were quite straight, whilst others in their neighbourhood were spirally twisted, somewhat like the fibres of the smaller spiral vessels of plants. In endeavouring to remove some filaments for examination as transparent objects, they were found to be very elastic, and, if torn forcibly away, they would coil themselves up into a small compass, and, unless moistened with some fluid, it was difficult to isolate any of the individual filaments. It was mentioned, in the description of the insect wax of China, that there was a repellent power for other fluids except alcohol, and such was found to be the case in this instance, the filaments not being readily moistened by any other fluid. On examining the filaments with a power of 250 diameters, two kinds were apparent, one rather less in size than the largest filaments of the Chinese insect wax, varying in diameter from the $\frac{1}{4500}$th to $\frac{1}{5000}$th of an inch, the other very much smaller, and agreeing with the smaller filaments of the cochineal wax; all on being broken were found to be more or less curved. On lifting up one of the Cocci, numerous ova of a pinkish colour were found imbedded in waxy substance. These are now visible in the wax beyond the body of the creature, the parent Cocci being now dead and much shrivelled up. On applying heat to the filaments they melt, but not so readily as those of the *Coccus Sinensis* and cochineal insect, neither is there such an evident attempt at crystallization. When we consider the tubular character of these filaments, it is evident that there must be some special organ, or set of organs, through which the waxy substance has been made to pass; in fact, it resembles macaroni on a very small scale.

As I have hitherto failed in making this out, I have thought the subject worthy of the attention of the Society, knowing that it numbers amongst its members several individuals who have both the skill and the opportunity to carry on investigations of this nature.

Note.—Since this paper was written, Mr. Busk, at one of the meetings in the last session, directed the attention of the Society to a peculiar fibrous, starchy material surrounding the ova. (See vol. v, Trans.) This was composed of solid cylindrical filaments which on analysis were found to consist of a rather unusual animal secretion, of which starch was a principal constituent.

On an Early Human Ovum. By G. E. Blenkins, F.R.C.S.E., Lecturer on Anatomy and Physiology.

(Read June 10th, 1857.)

The interesting and instructive communication submitted to the Society at our last meeting by Dr. Arthur Farre, descriptive of the appearance of an early human embryo, has suggested the following observations on another aborted human ovum, within the first month after conception, which I have lately had the opportunity of examining.

The most important points for our attention in such investigations seem to be clearly to comprehend the nature and import of the several parts, as well as their mutual relations, and to note carefully the degree of evolution each part or organ has undergone, in order that we may be in possession of accurate information to guide us in our researches into the laws which regulate their development.

Every one who has directed his attention to the subject will, I think, admit that our knowledge in this respect is still very obscure, and the opinions of observers are widely different and very conflicting, clearly dependent on the paucity of observations which have been made on really healthy and normal human ova. Descriptive accounts of monstrous and distorted embryos, it is true, are numerous, but good descriptions and accurate delineations of those which we can rely upon as being in a healthy condition are rare.

For the determination of the age of this ovum the usual data upon which we reckon for assistance in such inquiries, uncertain as these are, altogether fail me in this instance. I refer to the dates of the menstrual periods about the time when conception had occurred, or the periods when sexual intercourse had taken place. On these points I regret I am unable to obtain any satisfactory information; I have had, therefore, to resort to a comparison with the most trustworthy examples which have been recorded by various authors who have written on the subject. In Wagner's 'Physiology,' an embryo and its membranes is represented and described, which the author considers to be the type of its period—about three weeks old. It presents a very great similitude in size, general appearance, and relative dimensions of the several parts to the one, a brief account of which I have now to bring before you. An inspection of this specimen will convince you, I think, that it has the aspect of being in a healthy condition, and that its abortion was due to accidental causes, and not dependent on any abnormal state of its envelopes, nor on malformation or disease of the embryo itself. There is a slight amount of coagulum at opposite points of the chorion, but that, in all probability, was formed at the time of its separation and expulsion from the uterus. The ovum (fig. 1) when entire was of an oval shape, and its dimensions were half an inch in its long diameter and three eighths of an inch in its shortest. The external surface of its outer membrane or chorion was thickly beset with villi more closely aggregated in some parts than others. This membrane was laid open after the specimen had been macerated in tolerably strong alcohol, with the view of hardening it, so as to render its examination more easy—a proceeding which I am now convinced is a bad one, and should much prefer, if I met with another, to display the several parts under water in its recent state, as the action of the spirit has the effect of rendering the membranes opaque and causing them to collapse, and, in all probability, the first incision will divide or detach either the umbilical vesicle or the allantois; the former occurrence unfortunately happened in this instance, and though the relation of the vesicle to the embryo was clearly seen and traced, its division has somewhat injured the specimen. Between the chorion and amnion lay the umbilical vesicle or vitelline sac, relatively of large size, oval in shape, and measuring one eighth of an inch in its longest diameter; this presented a shrivelled or corrugated appearance, and its contents were coagulated by the action of the spirit. A most distinct attachment or prolongation from the vesicle into the abdomen of the embryo existed, and it seemed also to be adherent to the amnion at this point; there is no duct which can be properly so termed, but there is a slight constriction at the point of junction with the embryo. The vesicle did not occupy the whole of the space between the amnion and chorion, between them there was a considerable interval, intersected by slender, soft filaments, forming a very delicate reticular tissue, to which Velpeau has assigned the name of corps réticulé; this I detached in order to bring the exterior surface of the vesicle more distinctly into view, as this minute web of albuminous filaments, from the connection existing between it and the chorion, in some measure concealed it. Immediately investing the embryo, and closely applied to it everywhere, was a very delicate membrane, visible only when placed under the microscope, which seemed to be adherent to and be continuous with the sides of the abdominal cleft or laminæ abdominalis. Dr. Allen Thomson, in the admirable account of two human embryos of this period, mentions that he did not perceive the amnion in either. I can readily understand, from what I observed of its delicacy and transparency in this specimen, that it might easily be overlooked without the aid of a low magnifying power. Passing off from the fore part of the caudal end of the body is a delicate sac, containing an opaque cord-like substance, which can be distinctly seen through the membrane by transmitted light; this is evidently the allantois, and agrees precisely with the figure and description of the corresponding part in the ovum examined by Wagner, which has been before referred to. Müller found a similar structure attaching the embryo to the chorion, which he has described, and is of opinion that the cord was not composed of vessels, but appeared to be a simple structure. Coste and other observers have also given precise information regarding this structure. After very careful and frequent examination of this part in the specimen before me, I have come to the same conclusion, and I believe it is the remains of this structure which we recognise in the more advanced fœtus under the name of the urachus. By its lower and broader end the allantois joins the chorion, at which point this opaque tubular-like part is seen suddenly to terminate.

Velpeau, in his 'Ovology,' states that in all the embryos he examined at this period, they were invariably found to be attached by an umbilical cord to the chorion; as he clearly refers to the part which is now under consideration, it must be admitted to be an erroneous view to take of it, for the structures entering into the composition of the part which in the progress of development becomes the umbilical cord, consists, not only of the umbilical vessels and the remains of the allantoic duct or urachus, but contains as well the obliterated duct or pedicle of the vitelline sac, all bound together by a peculiar gelatinous areolar tissue, and surrounded externally or inclosed in a tubular sheath derived from the amnion, whereas, at this early period, the amnion has not begun to invest any of these parts, and they are quite distinct.

It is not my intention, on the present occasion, to enter into the question of the utility of the allantois at this stage of embryonic life when it is found to be most developed, or to inquire whether it has relation to the nutrition of the embryo, as supposed by Velpeau, or receives the urinary production as well as conducting the fœtal vessels to the chorion, according to most embryologists. We must first clearly establish which is the human embryonal structure that corresponds to the more highly developed allantois of animals, and this, I think, has been completely decided by the researches of Wagner, Müller, Coste, Bischoff, and other distinguished observers; and the result of my own examinations entirely accords with the conclusions they have arrived at; and I consider M. Velpeau in error in regarding the magma reticulare, contained in the endochorion, as the true analogue of the allantois of mammalian animals.

I pass now to the examination of the embryo itself. As before mentioned, I found it to be closely surrounded by the delicate amnion, and slightly exceeding the one sixth of an inch in length. The head is very distinctly recognised, with its three cerebral divisions or vesicles. The rudimentary eye is visible with some difficulty, from the absence of pigment, but when viewed with strong reflected light it may be discerned, and what is developed seems to consist of the posterior part of the sclerotic coat only. The eye of the opposite side may be seen when the specimen is turned, so far corroborating the opinion of Baer and Bischoff, that they are separate from their commencement; for, according to these authorities, the malformed embryo designated cyclops is the result of an arrested development of the first cerebral cell, in consequence of which the rudiments of the two eyes approach and are confounded together. Owing to the position of the head, which is bent forwards, I am unable to see distinctly the branchial fissures; I fancy two of them can be discovered, but owing to the specimen having been immersed in spirit, I am afraid that any attempt at separation now would only mutilate it. The heart is distinctly observed occupying the centre of the cleft, which is afterwards to be inclosed to form the thorax and abdomen; on either side are two masses which must be the liver, of large size even at this early period. The foundation of the alimentary canal seems to be laid, for by transmitting a strong light through the specimen a curved body can be seen connected both with the allantois and umbilical vesicle. The Wolffian body or primordial kidney cannot be detected; according to Bischoff, the commencement of their evolution precedes the liver. I have no doubt they are present but hidden by the allantois, and I am unwilling to disturb this latter part, about which there has been so much discussion and controversy, and which is so remarkably well seen in this ovum.

The cephalic extremities are very distinct under the form of fin-like processes, but the caudal members have not yet protruded; a slight prominence or fulness may, however, be noticed just above the coccyx on either side, denoting the points where they are about to spring from. Velpeau asserts that the rudimental limbs appear simultaneously; such certainly is not the case in this instance. The coccyx is large, turned forwards, and a little to the left side.

I would say a few words respecting the villi of the chorion at this period. Formerly much contrariety of opinion prevailed regarding these processes, some considering that they contained vessels, while others were of opinion that the villi themselves were vessels. This question has been since fully decided by the researches of Carus, Velpeau, Wagner, Bischoff, and others. In all animals and in man they are developed long prior to the vessels which afterwards pass into them from the embryo. I have carefully examined several of these little tufts, selecting the largest and most fully formed from the neighbourhood of the chorion, where the allantois joins it, and which is afterwards to become the seat of the placenta, but have failed to discover the trace of a vessel. One of these villous tufts I have mounted for your inspection (fig. 2), and it will be seen that they are hollow canals, their walls being composed of granular cells, and having numerous pouch-like projections from them, or rudimentary villi; one of the primary divisions of this tuft is partially broken across, and you will notice distinctly that it is empty.

In conclusion, I fear I must apologise to the non-professional portion of my audience for the introduction of such dry details, on a subject which they cannot be expected to be very familiar with, and to some of whom they may appear altogether unintelligible; but as we medical members of the Society have been remarked as not performing our share in its business, and as I personally feel the imputation to be a just one, I have ventured to lay before you these few remarks, which the examination of this ovum has afforded me the opportunity of making, in order to show that I am desirous of contributing my mite whenever I have the means of doing so.

TRANSACTIONS.

On a species of Filamentous Diatom *new to* Britain.

By Arthur S. Donkin, M.D., Morpeth.

(Read June 10th, 1857.)

In the 'Quarterly Journal of Microscopical Science,' vol. iv, p. 105, Mr. Brightwell, in a communication on the filamentous long-horned Diatomaceæ, describes two species of these singular Algæ as the first which have been, in a living state, discovered in this country: these are *Chætoceros Wighamii,* gathered by Mr. Wigham, at Breydon, near Yarmouth, in July, 1854; and *Goniothecium hispidum,* since found with the preceding, in the bay of the Isle of Roa, near Ulverstone. Since the date of Mr. Brightwell's communication, no other native member of the family has, I believe, been discovered.

Within the last few days, however, it has fallen to my lot to discover a third species in a recent condition, which, if I am not mistaken, has hitherto been found only in a fossil state in certain diatomaceous earths, and in the guano deposit on the coast of Peru; from which it appears to possess a very wide geographical range. This species is the *Syndendrium diadema* of Ehrenberg, easily recognised by the peculiar form of its frustule, with its numerous styles having branched extremities proceeding from its larger or more convex surface. This species was discovered in the following manner. A few days ago, I purchased a lobster taken off the Cresswell coast, nine miles to the east of Morpeth, not far from low-water mark, where the sea bottom is covered with flat rocks and the larger Algæ luxuriant. After subjecting the contents of this lobster's stomach to the action of boiling nitric acid for several minutes in a small retort, and after removing the acid from the remaining sediment by repeated ablutions with distilled water, I was not a little astonished to discover on all the slides—on which a portion of this sediment was placed—several specimens of *Syndendrium diadema;* its frustules being more numerous than those of any other diatom. From this fact it would appear, that this remarkable form is quite common on this part of the Northumbrian coast (but this I mean shortly to ascertain by future investigation); and if so, which I little doubt, it will materially assist, by the facility offered for the study of its living form and economy, in solving the question as to whether the group, to which it belongs, ought to be classed amongst the Diatomaceæ, from which it has been excluded by Professor Smith in his recent 'Synopsis,' and by others, as of a doubtful character. It will also assist in determining whether those various species of the same family, hitherto observed only in a fossil or semi-fossil condition, have in the living state their frustules aggregated into filaments, or whether these exist as separate and independent organisms.

That the different genera constituting the filamentous Algæ will, by future investigation, be ultimately classed amongst the diatoms, although perhaps as an aberrant sub-family, I am inclined to believe. They possess one essential characteristic of the Diatomaceæ, namely, an external siliceous envelope, rendering their minute forms indestructible, either by the lapse of time or by the action of decomposing agents, ordinary or extraordinary, by which all other organized structures are resolved into their ultimate elements. But future observation must determine their relative position to their congeners by a careful study of their mode of development, and of the reproduction of their species.

On the MARINE DIATOMACEÆ *of* NORTHUMBERLAND, *with a Description of* EIGHTEEN NEW SPECIES. By ARTHUR S. DONKIN, M.D. Morpeth, Northumberland.

(Read October 21st, 1857.)

HAVING in the course of the past summer had occasion to visit the shores of this county for relaxation and pleasure, I embraced the opportunity thus thrown in my way of examining to some extent her marine *Diatomaceous products*; a work for which I was in some measure prepared, by having for the last few years devoted a portion of my leisure time to this particular field of inquiry, more especially in studying the fresh-water species.

I must own, too, that I was in no small degree prompted to the undertaking by knowing that the Northumbrian waters, have hitherto been, to the microscopist, unexplored regions. For, however carefully certain branches of her natural history have been studied by the labours of her native naturalists—her ornithology by the immortal Bewick, and, more recently, by the accomplished Mr. Selby—her zoophytology by the late Dr. Johnston, and by Messrs. Alder and Hancock—no one yet had thought it worth his while to explore her springs, streams, lakes, subalpine tarns, and the waters of her extensive sea-board, in search of those microscopic beings, the Diatomaceæ; beings on whose surfaces, invisibly minute to the unaided vision of man, the omniscient hand of Creative Wisdom has found sufficient space to carve designs, so varied and elaborately beautiful, that their investigation has become a pleasurable pursuit even to some of the most philosophic spirits of the present age.

After some considerable investigation carried on amongst the fresh-water *forms,* which everywhere in this county abound, I became convinced of the accuracy of Professor Gregory's remark,* to the effect, that those in search of new species belonging to this already extensive group, must procure his materials from the boundless waters of the ocean. This accurate suggestion I have followed, and have now to lay the result of my labours before this society. But before entering *in medias res,* a few brief remarks on the physical characters of this coast, and the manner in which I procured the objects of my research, may be novel and interesting to some of our members.

The Northumbrian shore, extending from the Tyne to the Tweed, embraces a coast line of about seventy miles, washed by the waters of the German Ocean; it presents, in this wide range, attractions of the highest order to the tourist, the archeologist, and the naturalist. Here are the Farn Islands, the favourite resort of sea-fowl, and the scene of the heroic feat of Grace Darling. The Saxon monastery of St. Cuthbert, at *Lindisfarne,* fills the mind with poetical associations:

> "A solemn, huge, and dark-red pile,
> Placed on the margin of the isle;
> . . . . .
> Which could twelve hundred years withstand
> Wind, waves, and northern pirates' hand."

Here, too, are the lofty towers of Bambrough—

> "King Ida's castle, huge and square,—"

and the baronial castles of Dunstanborough and Warkworth, pointing, amidst their dismantled solitude, to bygone times

* 'Trans. Micr. Soc.,' vol. v, p. 86.

of feudalism, when the pursuits of war and rapine left science no votaries.

The natural features of this district are not less varied than its historical records are attractive. Here are rude precipitous promontories, some of sandstone, others of massive basaltic columns, rearing their heads majestically above the storm, and bidding bold defiance to the onward sweep of the incessant surge, which, in its futile efforts to upheave these cyclopean monsters from their primeval birthplace, is scattered back in clouds of white and sparkling spray, forming a picture sufficiently fascinating even to the most apathetic of nature's admirers. In such situations as these, flat reef-shaped rocks of sandstone, covered with a luxuriant growth of the larger Algæ, stretch far beneath the waves; at ebb tide these are laid bare for a considerable distance, and abound in *grallatorial* bipeds, and in all that would grace an aquarium. Beyond these "points" again, the eye rests on calm, sleepy bays, surrounded by a sandy beach, and by sand hills, the creation of the winds, and which the matting *sea-reed* (*Psamma arenaria*) prevents from being dissipated by the same element. Here also are the estuaries and mouths of several rivers discharging their waters into the ocean, and forming harbours for the extensive prosecution of the coal trade.

That a shore such as I have described should abound in diatoms might readily be supposed. The method I pursued in procuring these I shall now pass on to describe; I have found it superior to any other for obtaining marine forms. Professor Smith states,* that "the shallow pools left by the retiring tide at the mouths of our larger rivers" are the favourite habitat of marine species. But such localities I have found not to be half so prolific in species as the *sands of still bays, on the shore, where they are exposed by the reflux of the tide, at a distance corresponding with the half-tide margin.* In these places, where the sands are sloping towards the sea, and grooved out into small furrows, filled with salt water oozing out from behind, the abundance of diatoms aggregated into a living mass, imparts to the surface of the sand different hues of chestnut and olive; the difference of colour being due to the nature of the species present. These coloured patches, it is interesting to observe, are, during the sunshine, studded with numerous minute air-bubbles, undoubtedly given off by the diatoms themselves.

To separate the diatoms thus detected from the surface

* 'Synops.,' vol. i, Introd., p. i.

of the sand I found to be impossible. I therefore seized hold of the nearest bivalve shell which happened to lie in the way, and with this I carefully scooped up the surface of the coloured sand. This I emptied into a wide-mouthed, stoppered bottle, capable of holding eight ounces, until half full; the other half of the bottle I filled up with salt water. I then shook the whole briskly and allowed the bottle to stand for a short period. The sand, being composed entirely of fine round grains of quartz and the minute fragments of shells, settled at the bottom in a few seconds, leaving the diatoms all suspended in the water above, and forming by their abundance a chestnut-coloured cloud, but not more than 1 part in 1000 of the whole sand collected. The coloured water was then poured into another bottle and formed the gathering, while the sand was thrown away. The diatoms, in their turn, were separated from the superfluous water by subsidence, and brought home in 1½oz. bottles. In this manner I soon found that any quantity could be collected in a pure and unmixed condition, affording an excellent opportunity of examining their living forms, and one of which I availed myself on every occasion.

After carefully examining materials collected in this way from various parts of the beach, I detected not less than about 100 species, all these strictly marine, and, with a few exceptions, each species in considerable abundance. But I was not a little surprised to find that out of this large number it was utterly impossible to refer more than forty-eight of these to Professor Smith's 'Synopsis.' I found, too, that I had gathered eighteen of the new forms discovered by Professor Gregory in the estuary of the Clyde, and described in his various papers on the Glenshira Sand, and in his more recent and very valuable contribution on the Marine Diatomaceous Forms of the Clyde.* The remaining species, above thirty in number, are entirely new and undescribed, many of them of great interest and beauty. As, however, a description of the whole of these would extend the present communication to an undue length, I shall, on this occasion, confine myself to a few, and take an early opportunity to describe the remainder, together with my future investigations on this shore, in a separate paper.

In recording all the marine species found on the Northumbrian shore, I shall arrange them under the following heads for the sake of reference: I. *Species described in Professor Smith's 'Synopsis.'* II. *Species described by Professor Gregory*

* 'Trans. Royal Soc. Edinb., vol. xxi, part iv.

as new, or new to Britain, in his various papers. III. *Species entirely new, and for the first time described in the present paper.*

I. *Species described in Professor Smith's 'Synopsis.'*

Amphora affinis.
" salina.
Tryblionella punctata.
" acuminata.
Cocconeis scutellum.
" diaphana.
Eupodiscus Ralfsii, β sparsus.
Actinocyclus undulatus.
Coscinodiscus radiatus.
Nitzschia spathula.
" reversa.
" closterium.
Synedra superba.
" tabulata.
Navicula pygmala, β minutula.
" palpebralis.
" Smithii.
" punctulata.
" Jenneri.
" humerosa.
" didyma.
" crabro.
" lyra.
Pinnularia distans.
Pinnularia directa.
Stauroneis pulchella.
Pleurosigma formosum.
" elongatum.
" prolongatum.
" strigosum.
" quadratum.
" angulatum.
" æstuarii.
" balticum.
" hippocampus.
Amphiprora vitrea.
Biddulphia Baileyii.
" aurita.
Gomphonema marinum.
Achananthes brevipes.
" subsessilis.
Rhabdonema arcuatum.
" minutum.
Grammatophora marina.
" serpentina.
Melosira nummuloides.
Orthosira marina.
Isthmia enervis.

The stipitate forms enumerated above, I need not say, were not gathered in their natural habitat on the sands; but the frequent occurrence of their frustules, in such a locality, was a sufficient indication of their abundance on the larger Algæ, with which the neighbouring rocks of the shore are covered.

The beautiful and curious *Biddulphia Baileyii* was plentiful in several of the gatherings; it seems to me to be a free species; I have observed its frustules undergoing the process of self-division.

Navicula Smithii is here a plentiful species; *N. Lyra* is also very common in all its varieties; *N. crabro* frequent; and *N. humerosa* occurs abundantly in some localities; it is a species variable in its outline, but very uniform in its striation; its *dry valve is colourless,* thus differing widely from *N. granulata,* Bréb.

II. *Species new, or new to Britain; first discovered by Professor Gregory in the estuary of the Clyde.**

Campylodiscus simulans, Greg. ('Trans. Micr. Soc.,' vol. v, Pl. I, fig. 41).—This species occurs in Druridge Bay, but is somewhat scarce; it appears to me to be a genuine *Campylodiscus.* The valves, in all the specimens in my gathering, are orbicular and saddle-shaped; the *median* or *central space* is oval, with truncate extremities reaching nearly to the margin; it is marked transversely with parallel lines from side to side, and its *long axis in one valve* is at *right angles to that of the same space of the opposite;* the centre of the entire frustule thus presents a finely *fenestrated* appearance when in a certain focus, owing to the crossing at right angles of the transverse lines of the two opposed spaces. In these respects it differs widely from *Surirella fastuosa* and *lata,* of which Professor Gregory thinks it may be a variety.

Coscinodiscus concavus, Ehr. (Greg., 'Clyde Forms,' pl. ii, fig. 47).

Frequent along the coast.

Navicula granulata, Bréb.—The form of this species varies widely, from being in some specimens nearly orbicular to linear, or linear constricted in others; the extremities being always obtuse and produced. The striæ are coarse and widely punctate, *but always uniform.* It cannot be confounded with *N. humerosa,* Bréb. (*quadrata,* Greg., 'Trans. Micr. Soc.,' vol. iv, Pl. V, fig. 5), which also varies much in outline, by the most careless observer. As both forms were abundant in some of my gatherings, I have had an opportunity of comparing hundreds of specimens.†

Hab. Cresswell and Linemouth, abundant.

Navicula latissima, Greg. ('Trans. Micr. Soc.,' vol. iv, Pl. V, fig. 4).

Frequent at Linemouth.

* I have satisfied myself that all the species enumerated under this head occur on the Northumbrian shore, having carefully compared specimens with those contained in series of slides, kindly sent to me by Professor Gregory, illustrative of all his new Clyde forms.

I may also mention that, independent of these, I have detected several other species found in the Clyde, of which Professor Gregory intends shortly to publish a description. I have therefore not alluded to these in this paper.

† I have thought proper to give two figures of this large and beautiful species (fig. 19, *a* and *b*), to show how much it varies in its outline. The dry valve, when seen with a low power, is of a dull bluish colour, inclining to purple; while that of *N. humerosa* is colourless and hyaline.

Navicula clavata, Greg. ('Trans. Micr. Soc.,' vol. iv, Pl. V, fig. 17).

Frequent at Chibburn Mouth, Druridge Bay, and very large.

Navicula maxima, Greg. ('Cly. For.,' pl. i, fig. 18).

Frequent at Cresswell.

Navicula angulosa, Greg. ('Trans. Micr. Soc.,' vol. iv, Pl. V, fig. 8).

At Linemouth plentiful.

This species is very easily recognised from *N. Barclayana,* Greg. I did not find a single frustule of it in the gathering from Cresswell, in which the latter form was most abundant.

Navicula Barclayana, Greg. ('Cly. For.,' pl. i, fig. 9).

Frequent in many localities; at Creswell abundant. Easily recognised from *N. palpebralis,* Bréb.

Amphiprora maxima, Greg. ('Cly. For.,' pl. iv, fig. 61).

Frequent; at Cresswell plentiful.

Apr. pusilla, Greg. ('Cly. For.,' pl. iv, fig. 56).

Frequent; at Cresswell plentiful.

Apr. lepidoptera, Greg. ('Cly. For.,' pl. iv, fig. 59).

Frequent near Newbiggin.

Amphora Grevilliana, Greg. ('Cly. For.,' pl. v, figs. 89 and 90).

This beautiful and strongly marked species is abundant at Cresswell and frequent at Linemouth.

A. cymbifera, Greg. ('Cly. For.,' pl. vi, fig. 97).

Plentiful at Linemouth.

A. lævis, Greg. ('Cly. For.,' pl. iv, fig. 74 *c*).

This species is abundant near Newbiggin. In Druridge Bay I have found frustules identical with that of fig. 74 *d,* which Professor Gregory now considers to be a distinct species, and not a variety of *A. lævis.*

A. lævissima, Greg. ('Cly. For.,' pl. iv, fig. 72).

At Newbiggin very abundant.

A. robusta, Greg. ('Cly. For.,' pl. iv, fig. 79).

This interesting and well-marked species is frequent at Cresswell.

Cocconeis distans, Greg. ('Cly. For.,' pl. i, fig. 23).

Near Newbiggen frequent.

III. *New Species.*

The first two species which I have to describe as new are forms so remarkable, and so different in certain structural peculiarities from every member of any of the genera hitherto discovered, that it becomes essentially necessary to establish an entirely new genus to which to refer then. This genus (to be characterised by the curve of the median line, and by the structure of the valve) I have termed *Toxonidea* (*τοξον* and *ἰδεα*, bow-shaped).

TOXONIDEA.

Frustules free; valves elongated, convex, *with two sides not symmetrical;* striated, striæ oblique. Median or longitudinal line *arcuate,* with central and terminal nodules, *the latter curving towards the same side of the valve.*

One distinguishing feature, then, of this new genus, in addition to the *arcuate median line,* being the *oblique striation of the valve* (probably due to cellular structure), found so well developed in one section of the genus *Pleurosigma,* it is evident that it bears a close natural affinity to this latter group, and that both are members of the same sub-family. That the *arcuate curve* of the median line, together with the want of symmetry observable in the opposite margins of the valve, which indeed is strongly *arcuate* on one side, in one of the forms, and slightly so in the other, to say nothing of the total absence of any sigmoid tendency, is a structural difference sufficient to warrant the separation of these two species in question from the genus *Pleurosigma,* is apparent from the fact, that to admit them into it would be equivalent to abolishing the most distinctive character on which that group has been founded by Professor Smith, who observes that "the sigmoid flexure of the valve, more or less present in all our native species, at once distinguishes this genus from its allies."

1. *Tox. Gregoriana,** n. sp.—Valve straw-coloured, lanceolate; extremities obtuse, and curved strongly towards one side of the valve. Median line, on each side of the central nodule, curved first towards one side of the valve, then, some distance from the extremities, gradually and more strongly towards the opposite, until it reaches the terminal nodules; when viewed from one extremity to the other it has a most graceful appearance, resembling a representation of an unbent *Scythian bow.* Length from 0·008″ to 0·009″; breadth from 0·001″ to 0·0016″. Striæ oblique, fine, probably 50 in 0·001″.†

* I have dedicated this species to Professor Gregory, my former and highly esteemed teacher, by whom our knowledge of British marine Diatomaceæ has been considerably enlarged.

† I may here state that, in describing the *striæ* of this, as well as of the following seven species, I have merely attempted to *guess* the number of

I have already remarked that want of symmetry in the opposite margins of the valve is a well-developed character of the genus *Toxonidea.* This is well illustrated in the present species, and is more easily understood by examining the valve itself (fig. 1, Pl. III), which presents an appearance different from that of any other known diatom. One margin, which, as in the next form to be described, I shall term the *dorsal,* follows very closely the curve of the median line, and is gently arcuate through the greater portion of its extent; but near to the extremities of the valve it curves gradually backwards in the opposite direction. The ventral margin, on the other hand, bears no relation to the median line; it is almost linear, but slightly convex until near the extremities, where, after approaching close to the median line, it curves strongly backwards to its junction with the dorsal margin. The ventral margin then is linear elliptical. The striation appears to be as fine as that of *Pl. angulatum,* and the *areolation* of the *Pleurosigmata,* with a sufficient power and illumination, is very distinct.* The striæ, however, are much more easily resolved as *transverse* than as oblique; owing, doubtless, to some structural peculiarity of the valve not found in the *Pleurosigmata.*† When viewed with a good $\frac{1}{5}$ objective, and very oblique light from the mirror, the striæ always appear transverse, like a finely marked *Stauroneis,* unless the light fall upon it at a particular angle, when they come out distinctly in an oblique manner.

these in 0·001″, by taking *Pl. angulatum* as a standard, by which I visually compared them. It is therefore probable that I may be, in some instances, a little wide of the truth. If so, the error was unavoidable, as the highest power I possess is a superior one-fifth objective; with this it is quite impossible to count lines so fine as those with which the forms in question are marked. But this is a deficiency of little practical utility, as the microscopist must learn to measure the *marking* of minute objects by the eye rather than by the micrometer.

* With one of Smith and Beck's instruments, their one-fifth objective of 100° aperture, No. 1 eye-piece, five inches of the draw-tube, and the illumination afforded by their achromatic condenser, having the central portion of the illuminating pencil cut off by a central stop, the areolation becomes very distinct; but much more so with No. 2 eye-piece and the same length of draw-tube, giving a power of 655 diameters.

† On discovering this species, on the 28th of June last, I sent a specimen to Mr. Shadbolt, as a very remarkable *Pleurosigma,* which I termed *Pl. arcuatum,* not having then detected the smaller form which led to the formation of the present genus. After examining it carefully, he wrote to me as follows: "Your *Pl. arcuatum* is undoubtedly new, but I have some doubts about the *genus;* the aspect and general appearance is very like a *Pleurosigma;* but under a low power it looks like a *Stauroneis,* owing to a peculiarity in the internal part of the frustule. The areolation is very distinct, and is exhibited with a one fifth without difficulty when properly illuminated."

This splendid species I found plentiful in gatherings from Cresswell and Linemouth. In a gathering from Newbiggin, in which the next form abounded, I could not detect a single frustule. It occurs on several other parts of the coast.

2. *Tox. insignis,* n. sp.—Valve straw-coloured; dorsal margin strongly arcuate, ventral linear; extremities sub-acute, on dorsal margin produced. F. V. linear lanceolate, only seen in the living frustule. Median line not central, strongly arcuate near the centre. Length from 0·0048″ to 0·006″; breadth of S. V. about 0·001″. Striæ very fine, probably from 75 to 80 in 0·001″.

This very remarkable form in its outline, in short specimens especially, very much resembles a strung bow or a "cocked" hat. The strongly arcuate curve of the dorsal margin ceases a short distance from the extremities of the valve; the margin then pursues an almost linear course to its termination, thus giving the extremities on this side a produced appearance. The almost linear ventral margin at each extremity curves gently backwards. The median line is most gracefully arcuate; it curves strongly towards the ventral margin, and after nearly approaching it, continues an almost rectilinear course, though just perceptibly backwards to the terminal nodules, which are strongly curved to the dorsal side. The median line is far from central, being situated no great distance from the ventral margin.

The striæ are remarkably fine and most difficult to exhibit, and, as in the preceding species, come out transversely much more easily than as obliquely. The areolation I have observed with a $\frac{1}{5}$, but with this power it is very faintly seen, even with the most favorable illumination and careful manipulation. The valve is undoubtedly a far more difficult test object for a $\frac{1}{4}$ or a $\frac{1}{5}$ objective than any of the *Pleurosigmata* at present employed for that purpose, with the exception of *Pl. fasciola* and *Pl. obscurum,* which, however require the aid of a superior $\frac{1}{8}$ or $\frac{1}{12}$ for the full exhibition of the striæ, owing to their *faintness.*

I have frequently examined the living frustule of this species; it moves through the water with the S. V. uppermost, occasionally turning on its dorsal surface for a few seconds, thus exhibiting a good view of the F. V.

Hab. Frequent at Cresswell, and near Newbiggin abundant.

PLEUROSIGMA.

Ooservations made on some of the species of this genus, about to be described, have convinced me that *sigmoid flexure* *of the valve* is not so general as to render it applicable for one of the most important generic distinctions of a group so extensive as that of *Pleurosigma*. It appears to me, that *curvature of the median line, and not of the valve itself,* must be looked upon as a characteristic feature of this genus, and that all its known species prove these two important facts: First, that the median line may be sigmoid, even strongly so, without any obvious curvature of the valve; for example, *Pl. lanceolatum* and *Pl. carinatum* (figs. 4 and 5, Pl. III). Secondly, that when the valve is sigmoid, it is so in conformity with the median line, as in *Pl. hippocampus* and others; and that, although the whole valve may not observe the same amount of curve throughout as the median line, yet one margin at least, towards each extremity, generally does so.

Section I. *Striation oblique.*

3. *Pl. marinum,* n. sp.—Valve straw-coloured, lanceolate, straight, slightly sigmoid near the extremities, obtuse. Median line sigmoid on each side of the central nodule. Length 0·0055″ to 0·006″; breadth of S. V. about 0·001″. Striæ probably from 45 to 50 in 0·001″.

The well-marked sigmoid flexure of the median line, on *both* sides of the central nodule, at once distinguishes this from any other British species belonging to the present section, and renders it easy of recognition.

Hab. Newbiggin North Sands, plentiful. This is the only locality in which I have found this species.

4. *Pl. lanceolatum,* n. sp.—Valve straw-coloured, perfectly straight, broadly lanceolate, acute. Length from 0·0055″ to 0·006″; breadth from 0·001″ to 0·0014″. Median line straight, or *gently* sigmoid in the middle; terminal nodules curved in opposite directions. Striæ very fine, probably about 70 in 0·001″.

This species is remarkable in consequence of the valve being free from the slightest sigmoid flexure. In most specimens the only indication of curve exhibited by the median line is observable in the terminal nodules; in others again, in addition to this, there is a very gentle curve in opposite directions on either side of the central nodule for a short distance. The striæ are remarkably fine, and require the most careful manipulation with very oblique light to render them visible with a superior $\frac{1}{5}$ objective. The valve, therefore, is a test object of much greater delicacy than that of *Pl. angulatum,* though not equal to *Tox. insignis.**

* As corroborative of my opinion on this matter, I may adduce the tes-

Hab. Plentiful along the coast between the Coquet and the Wansbeck. Newbiggin North Sands, abundant.

5. *Pl. carinatum,* n. sp.—Valve straight, linear lanceolate, acute, very convex, colour dull purple. Length about 0·0046″; breadth about 0·0005″. Striæ fine, probably from 55 to 60 in 0·001″. Median line strongly curved on either side of the central nodule, until it approaches close to the margin of the valve, in which direction it continues to its termination; its marginal portion forming a prominent ridge or keel, which is *much more prominent on one side of the central nodule than on the other.* This peculiarity gives the F. V. an unequally keeled appearance, as seen in fig. 5 *b.*

The keeled appearance of the F. V. at first led me to suspect that the present form ought to be referred to the genus Amphiprora. But the strong sigmoid flexure of the median line, and *the distinctly oblique striation,* together with the absence of *marginal plates,** which Professor Gregory has shewn to be so generally present in the members of this genus, has convinced me that it is a genuine *Pleurosigma.* The striæ are not easily resolved in the S. V., owing to its great convexity; they however come out very distinctly in the F. V.

Hab. Newbiggin North Sands, abundant; Linemouth and Cresswell, frequent.

Section II. *Striæ longitudinal and transverse.*

6. *Pl. rectum,* n. sp.—Valve pale straw-coloured, very convex, linear, narrowest in the middle, straight, extremities rounded on one margin, somewhat obtuse. Median line strongly sigmoid; marginal for the terminal half of its extent on either side of the central nodule. Length from 0·0045″ to 0·005″; breadth about 0·0006″. Longitudinal and transverse striæ distinct, fine, probably 60 in 0·001″.

The S. V. appears sigmoid at the extremities; but it is not so. This appearance is due to one margin, on opposite sides near each extremity, following the convex curve of the median line.

Hab. Frequent. At Creswell, abundant.

timony of Mr. Shadbolt, who, after examining one of my specimens with a power much higher than I possess, sent me the following reply: "Your *Pl. lanceolatum* has markings as you indicate (oblique), which are easily resolvable under my one-twelfth, but with difficulty by the one-fifth. *They are much more difficult* than those of *Pl. angulatum.*"

* "On the Marine Diatomaceous Forms of the Clyde," 'Trans. Royal Soc. Edinb., vol. xxi, part iv, p. 32.

7. *Pl. Wansbeckii,* n. sp.—Valve pale straw-coloured, slightly convex, linear lanceolate, acute, slightly sigmoid near the extremities. Median line gently sigmoid, not central, not marginal. Length from 0·0045″ to 0·005″; breadth about 0·0006″. Longitudinal and transverse striæ probably 50 or more in 0·001″.

This species bears merely a *generic* resemblance to *Pl. angustum,* n. sp., and cannot be confounded with it. It differs widely from *Pl. rectum,* n. sp., in its much longer, acute, and gracefully sigmoid valve; in its median line, which is much less curved, and never approaches close to the margin; in its striæ, which are not so fine; and in its habitat.

Hab. Pools left by the tide, where the water is strongly brackish, at the mouth of the Wansbeck. It is not a *littoral* form. I have never met with a single specimen on the beach, where the other allied forms, described in this paper, are abundant. This fact alone, independent of structural differences, would prove it to be distinct from any of these.

8. *Pl. minutum,* n. sp.—Valve a very pale-brown colour, oblong, acute, exceedingly convex. Median line strongly sigmoid. Length about 0·0025″; breadth about 0·0005″. Striæ very fine; transverse distinct, probably 55 in 0·001″; longitudinal very obscure, owing to great convexity of the valve.

The median line in this minute species, the smallest of the genus I have seen, is not so marginal near the extremities as that of *Pl. rectum.* It differs also in its size and in the outline of the valves.

Hab. Cresswell, abundant. Frequent in some other localities.

9. *Pl. angustum,* n. sp.—Valve dull purple, rather opaque, exceedingly convex, linear; extremities acute, and slightly apiculate. Median line marginal, except in the middle, for a short space on each side of the central nodule, where it crosses the valve, forming a prominent ridge or keel. Length from 0·005″ to 0·0055″; breadth about 0·0006″, narrowest in the middle. Striæ obscure, longitudinal, visible a little on one side of the median line.

In this curious form the median line overlaps the margin of the valve on either side, and prevents its being seen in this situation. The great convexity (and opacity of the dry) valve renders it almost impossible to resolve its striæ; although I have seen the longitudinal near the concave side of the median line. It is evidently allied to *Pl. rectum,* but differs as much from it as is possible for two nearly allied forms to do.

Hab. Chibburn Mouth, Druridge Bay, abundant. This is the only locality in which it has occurred to me. In the Cresswell gathering, in which *Pl. rectum* was abundant, I could not find a single frustule of this species.

10. *Pl. arcuatum,* n. sp.—Valve very pale-brown, straight, broadly lanceolate; extremities produced into two long, obtuse, strongly arcuate beaks, curved in opposite directions. Length from 0·004″ to 0·0046″; breadth about 0·0005″. Striæ obscure. Median line straight, and terminating at the commencement of the extremities.

The long, strongly arcuate, and somewhat obtuse, extremities (resembling the *bill* of the *curlew, Numenius arquata*), and the short, wide body of the valve, distinguish the present species from *Pl. macrum,* to which, however, it is closely allied. It is, besides, much shorter than the latter species; never exceeding 0·005″, which is about half its length, according to the measurement of Professor Smith, given in his 'Synopsis.' The extremities, also, are much longer in proportion to the valve than in *Pl. macrum.*

Hab. Chibburn Mouth, Druridge Bay, and Cresswell, abundant.

COCCONEIS.

The species next to be described I have had some difficulty in referring to the present genus, in consequence of its frustules being *free,* and *not adherent* to the larger Algæ; a character which has been insisted upon by Ehrnberg, in the establishment of this genus, and adhered to by Professor Smith in his 'Synopsis.' The frustule in this species is also remarkable *in not having the median line central.* But in certain other respects it appears to me to be a true *Cocconeis.* I have therefore classed it as such, and have done so under the impression that, as our knowledge of the Diatomaceæ increases, it will be found necessary to extend the basis of distinction on which many of the present genera have been founded, in too limited and arbitrary a manner, in order that they may thus be made to embrace a much larger number of species, and thereby prevent the formation of new genera for the purpose of including every new form which may present certain structural peculiarities *apparently* anomalous.

11. *C. excentrica,* n. sp.—Frustules free. Valve disciform, convex near the margin. Median line not central, with terminal nodules not reaching to the margin. Striæ convergent, widely punctate, punctæ closer and more conspicuous

near the margin, thus forming a somewhat opaque and broad marginal band in the dry valve. Diameter from 0·001″ to 0·002″.

The eccentric position of the short median line seems to distinguish this species from every other member of the genus. The frustules are free, and have the power of moving. The endochrome is central, and of a pale-green colour, leaving the marginal portion of the valve with its radiate striæ distinctly visible. The dry valve is colourless, and the central portion much more translucent than the marginal. In balsam the opaque appearance of the marginal band becomes obliterated.

Hab. Linemouth, abundant; Cresswell, plentiful.

BACILLARIA.

12. *B. cursoria*, n. sp.—Frustules adherent, by means of some invisible connecting medium, into a filament, and having the power of moving, one along the opposed surface of the other. Form narrow, linear lanceolate, acute, with a central longitudinal line composed of thickly set, transverse punctæ, extending from one extremity to the other. Structure hyaline, not striated. Length from 0·0028″ to 0·0034″; breadth about 0·0004″. The only view which I have ever seen of this species is that which always exhibits the frustule with the central, longitudinal, and punctate line uppermost, as in fig. 12*a*. Whether this punctate line is situated on the middle of the S. V. and indicates a keel, or whether it extends down the centre of the F. V., corresponding with the intervalvular space, I am not prepared positively to decide, although I incline strongly to the latter opinion. My reasons for this opinion are the following:

First. Because a group of dry frustules preserving their natural, relative position, always presents each frustule to view with this line in the centre, and because *such a group* or filament always exhibits the F. V., and not the S. V., of each individual frustule. The same is seen in a *similar group* or filament of *B. paradoxa*; never the S. V.

Secondly. Because in frustules which appear to be undergoing the process of self-division, the punctate line is double, the distance between the two lines varying according to the degree to which the process has proceeded. (See fig. 12 *b*, Pl. III.)

This species is so abundant on the sands in some localities on this coast, that, in the clean gatherings from these, I have enjoyed frequent opportunities of observing the movement which a filament of its frustules exhibits. The following are the facts which I have ascertained regarding this most remarkable phenomenon:

1. When the filament is in a quiescent state, the frustules are all drawn up side by side, their extremities being all in a line, thus forming a *group*.

2. When a filament, previously at rest, resumes its activity, the movement is commenced by the *second* or *inner* frustule, at one end of the filament, gliding forward along the contiguous surface of the *first* or *outer* frustule, until their opposite extremities overlap each other. This is soon followed by a similar movement of the 3d, 4th, and 5th, &c., all moving forward in the same direction, and each frustule gliding along the surface of the one preceding it, until they have extended themselves into a lengthened filament or chain. In the course of two or three seconds after this has been accomplished, a *retrograde* movement, exactly of the same character, begins to take place, and continues until the filament has retraced its course, and stretched itself out in a direction exactly opposite to the position it had previously occupied. This phenomenon is repeated again and again, and in this manner the whole group is kept in a state of activity for an indefinite period of time, and all the while, if no impediment produces irregularity, the *outer* or *terminal frustule,* next to which the movement commenced, *maintains a stationary and fixed position.*

3. The rapidity with which each individual frustule moves is in direct ratio to its distance from the terminal *stationary* frustule, being most rapid at the opposite or moving extremity of the filament. On this account, most of the frustules, while the filament is moving to and fro, cross a line drawn at right angles to the middle of the long axis of the stationary frustule, at the same instant of time, afterwards shooting past each other like horses on a racecourse.

4. The force with which the filament moves is very great, so much so, that I have observed it upset and shove aside a large frustule of *A. arenaria*, n. sp., at least six times its own bulk, obstructing its path. This force is, in a great measure, due to the rapidity with which the frustules move. The time which a filament, even of considerable length, occupies in crossing the field of the microscope being only a few seconds.

5. Light appears to be a necessary stimulus for the maintenance of this motion. When a filament, in active motion, is placed in the dark for a short period, and then examined, the movement is seen to have ceased; but again commences

when the filament is exposed to the light for a short time. Is this singular movement, with which the present species is endowed, not a vital phenomenon and independent of physical causes for its existence?

6. When the moving extremity becomes entangled in any kind of substance intercepting its course, the opposite or stationary extremity commences to move, and continues to do so until the entangled extremity is set free; sometimes, in such instances, a frustule in the centre remains fixed, a movement of each half of the filament in opposite directions, on either side of it, taking place. But all these irregularities cease as soon as the impediment has been got rid of.

These facts lead to the conclusion that the present species is a true *Bacillaria,* although *apparently* somewhat anomalous in the structure of its frustule. The gliding movement of one frustule over the contiguous one is the same as is observed in *B. paradoxa.* But it differs from this latter species in this essential particular, that the *whole* of its filament *moves on one side* of a *terminal frustule which is stationary;* while in *B. paradoxa, each half* of the filament moves in *opposite directions* on either side of a *central stationary* frustule.

Whether the filament is at first *attached,* and afterwards *free,* as in *B. paradoxa,* I cannot positively decide, although I believe it to be *free,* owing to its only occurring in the shallow furrows on the beach, where there is not a single vestige of vegetable life, except the free species of diatoms with which it is mixed.

I think there can be little doubt that the form found by Professor Gregory in the Glenshira sand, and described as *Nitzschia socialis,* of which a group of frustules are figured ('Trans. Micr. Soc.,' vol. v, Pl. I, fig. 45) is another member of the same genus. "This species," he observes (*op. cit.* p. 80), "is remarkable from its occurring in the prepared material, after boiling with acids, in groups of six, eight, ten, or twelve, or more, without any apparent connection between them." Groups such as these, of the present species, are common on slides mounted from gatherings in which it occurs.

AMPHIPRORA.

13. *Apr. duplex,* n. sp.—F. V. rectangular, broad, rounded at the extremities, and very deeply constricted in the middle. Marginal plates also much constricted, and rounded at the extremities. Hoop broad. Structure exceedingly hyaline. Valve not striated, and without punctæ on either side of the

keel. S. V. narrow, linear-lanceolate, acute, exceedingly convex; keel strongly sigmoid. Length from 0·002″ to 0·0026″; breadth variable.

This form bears a strong resemblance to *Apr. alata,* in the contour of its F. V. But the absence of striæ in the valve and of punctæ on each side of the keel, together with the narrow linear shape of the S. V., prove it to be quite distinct from, though nearly allied to this species. The endochrome also is differently arranged from that of *Apr. alata.* The frustule undergoing division presents a very beautiful appearance, from the interlacing of the external surfaces of the contiguous and newly formed valves; as seen in fig. 13 *c.* A double appearance is thus produced. I may mention, as a curious fact, that nine tenths of all the specimens contained in a gathering from Druridge Bay, in which this species occurred abundantly, were in this double condition. This would show that the frustules remain adherent for a considerable period after being fully developed, by the process of self-division, which, in the present species, progresses with great rapidity.

EPITHEMIA.

14. *E. marina,* n. sp.—Form on F. V. rectangular, elongated; *"hoop"* on *dorsal* or *convex* surface of frustule ornamented with several longitudinal lines of round, distinct, and widely set punctæ; on *ventral* surface, hyaline. Length from 0·004″ to 0·007″; breadth from 0·001″ to 0·0018″. S. V. inflated, gently arcuate on outer or dorsal margin, on inner or ventral nearly linear, but slightly constricted in the middle; extremities suddenly produced, acute. Canaliculi conspicuous, 11 in 0·001″. Striæ 11 in 0·001″, widely punctate; punctæ large and rather inconspicuous. Dry valve a bright blue, in balsam colourless.

The fact of the "hoop" being hyaline in texture, on the *ventral* or *concave* surface of the frustule, and on its opposite, *convex* or *dorsal* surface, ornamented with six or more rows of large, round, widely set punctæ, as may be easily seen by carefully focusing, together with the peculiar incurved longitudinal line observable near the inner margin of each valve, shows that it is nearly allied to Professor Gregory's group of *complex Amphoræ.** But the outline of the entire frustule with its *inflated* valves, which appear to me to possess canaliculi and striæ which are widely punctate, have induced me, for the present at least, to include this large and beautiful

* 'Trans. Royal Soc. Edinb.,' vol. xxi, part iv, p. 47.

species in the genus *Epithemia.* With this opinion, I may mention, Professor Gregory concurs, while, on the other hand, Mr. Roper considers it to be a *Nitzschia.* But notwithstanding the high esteem in which I hold his accuracy and experience as a scientific observer, I cannot reconcile my views, on this point, with his. It seems to me, that this curious, and somewhat anomalous, form is without those essential generic peculiarities of the true *Nitzschiæ,* namely, compressed valves, with a keel to each, and its accompanying line or lines of punctæ.

AMPHORA.

In describing the following Amphoræ I have adopted the terms *dorsal* and *ventral,* as employed by Ehrenberg. These, though discarded by Mr. Ralfs and Professor Smith, are essentially necessary for the description of several recently discovered species of the present genus, in which the difference of structure, observable in each of these surfaces, is so great, that when a frustule is seen in a focus first shewing the one, and afterwards in a different focus exhibiting the other, the difference of appearance is so great that an observer, unaware of this fact, might readily suppose that he was looking at two widely different forms. This is well illustrated in fig. 15 *a* and *b.* The term "*hoop*" I have also used, in the same sense as employed by Dr. Carpenter,* to designate the siliceous plate intervening between the margins of the opposed valves. It will be observed that I have employed these terms, in the same sense, in reference to *Epithemia marina.*

15. *A. litoralis,* n. sp.—Form on F. V. oval, with truncate extremities. Hoop on dorsal surface broad, oval, slightly constricted, and marked with seven or more longitudinal lines of linear, transversely set punctæ; hoop on ventral surface linear, narrow, widest in the middle and at the extremities, hyaline. Length from 0·002″ to 0·003″; breadth from 0·0008″ to 0·0012″. S. V. dorsal margin arcuate, ventral linear; extremities obtuse; longitudinal line gently curved, situated some distance from the ventral margin, and dividing the valve into an outer and inner compartment; central nodule expanded into a strong, opaque, transverse bar, reaching to the dorsal margin. Striæ very distinct, moniliform; those of the inner compartment the finer.

The present species is evidently a member of Professor Gregory's group of *complex Amphoræ.* The *complex* structure,

* 'On the Microscope,' p. 303.

in this group, is apparently developed, only, in the hoop of the dorsal surface of the frustule, which seems to be constructed, like the bottom of a flattish boat, of several narrow longitudinal segments, which, like deals, are placed edgewise with their extremities convergent. This structure is well seen in fig. 15 *b*, Pl. III, and still better in *A. Grevilliana*, Greg., and *A. spectabilis*, Greg. The complex structure then is only observed as Professor Gregory has already pointed out "when the frustule is in a particular focus."

Hab. Chibburn Mouth, Druridge Bay; abundant.

16. *A. arenaria*, n. sp.—Frustule hyaline, colourless. F. V. rectangular; extremities slightly rounded; sides somewhat uneven, slightly bulged out in the middle and at the extremities. Length from 0·004″ to 0·006″; breadth about 0·0016″. S. V. convex, linear, dorsal margin rounded, near the extremities, towards the apices situated on the ventral margin. Central nodule some distance from the inner margin; longitudinal line much curved, first towards the dorsal, then near the extremities, to the ventral margin, where it joins the terminal nodules.

The F. V. presents a space of the shape of a sand-glass between the two gracefully curved longitudinal lines. This space, when the dorsal surface is in focus, is faintly marked with from six to eight longitudinal lines; the outer converging at their extremities. These indicate a complex structure of the frustule.

This large and interesting form is exceedingly hyaline and transparent when mounted in balsam. Mr. Shadbolt, who carefully examined specimens with a very high power, informs me that "it (the S. V.) is ornamented with markings of dots at right angles to the axis as well as parallel thereto; but these are of the most delicate nature, and discoverable with *difficulty* under the most careful manipulation with a $\frac{1}{12}$ objective of 165° aperture, and with peculiar illumination by the achromatic condenser."

The living frustule is remarkably beautiful; the whole being filled with endochrome, having a greenish apppearance, and collected in different places into large, bright-yellow globules. In the water the ventral surface is always uppermost.

Hab. Common along the southern portion of the Northumbrian shore. At Cresswell remarkably abundant, forming at least seventy parts in one hundred of the whole chestnut-coloured, diatomaceous mass with which the sinuosities in the sand, at low water, are covered.

NAVICULA.

17. *N. lineata*, n. sp.—Form of S. V. linear-elliptical, occasionally constricted a little in the middle. Striæ distinct, *costate,* and interrupted in the middle by a longitudinal, transparent line, running from one extremity of the valve to the other, nearly parallel with its margin; striæ also cut short, some distance from the median line, by another transparent longitudinal line parallel to the last, and succeeded by a line of indistinct punctæ. Median line broad, and bounded on either side by a narrow, rectilinear, transparent line. Length from 0·0023″ to 0·0035″; breadth from 0·0008″ to 0·0013″. Valve brown in balsam.

This species is easily recognised from *N. didyma* and its varieties by its *costate, bisected* striæ, and by the much larger blank space on either side of the median line; the constriction of the valve, when it exists, is also much slighter. Each half of the valve is divided into three distinct, narrow compartments, by three transparent lines running longitudinally between the extremities; the two outer being parallel to each other and to the margin, and the inner parallel to the contiguous median line. The two outer compartments each inclose a band of striæ, while the third or inner is hyaline, and bordered by a longitudinal row of indistinct transverse punctæ.

Hab. Cresswell Bay and Linemouth, abundant; not general in its distribution.

18. *N. æstiva,* n. sp.—Form gracefully elliptical; colour of dry valve blue, in balsam brown. Striæ fine, distinct, costate, or very obscurely moniliform, reaching close to the median line, and crossed a short distance on either side of it by a narrow, opaque, longitudinal line. Length from 0·0026″ to 0·0045″; breadth from 0·0012″ to 0·0022″.

This large and very beautiful species differs from *N. Smithii* in its much more gracefully elliptical figure, in its *costate* and much finer striæ, and in the much darker brown colour of the valve when mounted in balsam. *N. Smithii,* as it occurs on the Northumbrian shore, is a much smaller species, with rather coarse, moniliform striæ, and is nearly colourless in balsam when examined with a low power; it is likewise much more general in its distribution than the present species, and occurs in every strictly marine gathering which I have made.

Hab. At Cresswell and Linemouth, abundant.

Postscript.

Since the preceding pages were read before the Microscopical Society I have, by the kindness of Mr. Roper, and of Dr. Montgomery, of Penzance, been favoured with slides of *Pl. rectum*, n. sp., gathered at Penzance. The former gentleman informs me that Professor Walker-Arnott has very recently discovered it there, and named it *Amphiprora Ralfsii.* But as my description of this form has already been made public, I have retained it in the present contribution. I must also add, that however reluctant I may be to dissent from so high an authority as Professor Arnott, yet I am convinced that this species is a *Pleurosigma,* and not an *Amphiprora.* My reasons for holding this opinion are as follows: 1st. Because the S. V. has a sigmoid appearance; the sigmoidure resulting from the opposite margin, near each extremity, following the convex curve of the contiguous median line. 2dly. Because the *structure* of the valve is that of a *Pleurosigma*—the striæ being distinctly *longitudinal* and *transverse,*—as may be observed without difficulty by using a good $\frac{1}{5}$ objective and the achromatic condenser with a central stop, aided by careful manipulation. In this way the striæ, though very fine, come out very sharp and distinct. The only evidence on which it appears to me the supposition rests of its being an *Amphiprora* is the contour of the F. V., which is keeled and constricted. But the discovery of *Pl. lanceolatum* and *Pl. carinatum* show that this character, apart from the *structure of the valve,* cannot be relied upon. In both these species the F. V. is very distinctly keeled, and as deeply constricted in the middle as most of the *Amphiproræ;* and yet their valvular structure proves them to be *Pleurosigmata* —the striæ being very distinctly oblique, and indicating the hexagonal areolation of one section of that genus.

These facts show that the outline of the frustule and of the S. V. is not sufficient to determine whether a particular species belongs to the one genus or to the other, and that in every instance the structure of the valve is the only character on which any reliance can be placed. The presence or absence of *lateral or marginal plates,* which Professor Gregory has recently shown to be so universally developed in the *Amphiproræ,* is also a feature of great importance, and will materially assist in the discrimination of species. In concluding, I may add that all the new species of *straight Pleurosigmata* described in this paper are closely allied to the *Amphiproræ,* and form a connecting link between this latter genus and the one to which they belong.

It is necessary here to add that, while these pages were passing through the press, I have been informed by Mr. Roper that *Pl. lanceolatum,* n. sp., Pl. III, fig. 4, is identical with the *variety* of *Pl. transversale,* Bréb., described by him in the last (October) number of the 'Microscopical Journal'; that *Pl. lanceolatum,* however, is distinct from *Pl. transversale,* I think is proved by the fact that the former is the most common member of its genus on the Northumbrian shore, while I have never, yet, met with a single specimen of the latter. I may also state that De Brébisson considers it a distinct species; he has informed me, within the last few days, that in September, 1852, he discovered it on the sands at Dives, with many other species. But, unfortunately, he never published any description of these.

On a NEW METHOD *of* MOUNTING OBJECTS. By THOMAS SHEARMAN RALPH, Esq., Wellington, New Zealand.

(Read November 12th, 1857.)

WITH the accompanying specimens which I have sent for the acceptance of the Society, I feel much pleasure in adding a few observations as to the mode in which they have been prepared, and the manner of mounting them. I have looked over all the papers and communications of the Society in the 'Quarterly Journal,' and I hope what I have to say may prove as useful to some of the members as many of their observations have been to me at this far distant point of the globe. And I trust what I may have to say, if not savouring of novelty or usefulness, will be acceptable, as a proof that I have not been idle in the interests of the Society.

The specimens, as those now sent, will be found to be mounted on perforated slides of glass—a plan which I saw put into practice some years ago, but which was then only adopted with wooden slides; but I think the present is a more suitable mode of mounting, as the glass is less likely to bend. I found considerable difficulty at first in making the preparations; but practice has made me more handy, and I am able to complete a sample in ten minutes. And as they are neater looking, I think they may supersede the use of the wooden ones. The method which I employ, when put into practice, will also enable any person to make cells of any required form or size, such as those in which tongues of the mollusca have been put up.

Take a slide, of as great a thickness as can be usually had, and place under it a piece of blotting-paper folded so as to support the central square inch only, where the hole is to be drilled; have then prepared a steel instrument, called by watchmakers a broach, which is a five-sided, well-tempered tool, and sharpen it on a hone of some hardness (or on a a flint), so as to give it a three or more sided cutting end (this tool should be let into a cedar-pencil stick previously deprived of its lead and glued up again), dipping the point into oil of turpentine, place the end on the glass where the perforation is required, and endeavour to pierce it by a steady drilling movement; the first effect will be to break off a small piece of the surface of the glass, or, if the operator has been too rash, to break it into pieces. Once the surface has been thus scratched, proceed with the drilling, always keeping a drop of turpentine on the spot; in one or two minutes the drill should penetrate through to the other side. Sometimes I place my finger behind the spot where the glass generally drops out in a small piece before the point of the instrument. A small hole being thus made, proceed next with a fine rat-tail file, dipped in turpentine, and drill on, and use larger sized files till the required opening is made. *Mem.* These are standing rules: *Always* begin with a recently sharpened broach; *always* keep it and the files *wet* with turpentine, and in *screwing* the rat-tail file through the glass *always* use it with an *unscrewing* movement, as if you were using a turnscrew to take *out* a screw, for the reverse movement immediately *locks* the tool into the glass and a leverage is used, and the glass shivers into pieces; and *never* use the tool with any leverage against the edge of the glass. Two to three minutes more should suffice to drill through to the extent required (I have made myself a test tube-stand with holes large enough to hold the largest tubes made; and there are six or eight holes in the piece of glass); and the required evenness of the edges of the hole may be brought out by using a carpenter's *rose* or *counter sink,* previously sharpened, and *then* hardened in the fire to flint hardness. This is also to be used with turpentine, and in ten minutes from the commencement of the operation almost any person may have one ready for use. The other cells are made in the same way, only larger sized files and flat files are used, according to the fancy or need of the operator; but the edges of these cells do not require the labour of polishing off, as the faults are not discernible when the cells are filled with balsam; and if made of uniform shape or outline, they will be found to be quite neat enough.

A friend of mine here (an army surgeon) whom I have inoculated with a passion for the microscope, &c., and who has turned out better specimens of all kinds than I have, takes the following plan, for two reasons: one, that the process is quicker; and the other, that there is less likelihood of breaking the glass. He has prepared a stout plate of brass about the same thickness as the glass, and this plate is perforated with such sized and shaped openings as he wishes to make in the glass. The glass is then cemented to the plate with melted shell-lac or wax, and when cold, a diamond is drawn round the opening in the plate so as to scratch out the size on the glass—this is done chiefly to limit the fracture of the glass. He then perforates the glass, in the manner I have already described, with the broach, and uses the rat-tail files with the most unsparing vigour, so as to shiver the glass to pieces as far as the marked outline of the cell. This is done in a minute or two, and then, polishing the edges a little, he soaks off the glass in a solution of soda, or melts off the cement. I strongly recommend any microscopist who is in the habit of making a variety of preparations, to make trial of this method. The method once acquired will prove useful to him in a variety of ways, as the size of the cell can be enlarged when there is none at hand but a small one; and too large cells are objectionable; cells just sufficiently large to hold a specimen are, to my mind, better than those which are more roomy.

The question was asked me when I was in England if I knew how to fill a cell with Canada balsam and leave behind no air-bubbles. I replied in the negative, and now I can state how to accomplish this. Fill the cell with clear spirit of turpentine, place the specimen in it, have ready some balsam just fluid enough to flow out of the bottle when warmed by the hand; pour this on the object at one end, and, gradually inclining the slide, allow the spirit of turpentine to flow out on the opposite side of the cell till it is full of balsam; then take up the cover and carefully place upon it a small streak of Canada balsam from one end to the other; this, if laid on the cell with one edge first, and then gradually lowered till it lies flat, will drive all the air before it, and prevent any bubbles from being included in the cell. It can be easily put on so neatly as to require no cleaning when dry. If the cover is pressed down too rapidly the balsam will flow over it and require to be cleaned off when hardened, for it cannot be done safely while fluid at the edges.

Minute specimens, I find, can be very easily mounted, free from air-bubbles, by placing first the object on the slide, and then the cover over it, and afterwards allowing the

Canada balsam, thinned down or diluted with chloroform, to flow in till the object is surrounded by this medium, and the whole space under the cover occupied by it. The chloroform rapidly evaporates, leaving the Canada balsam in the condition it was before mixture with the chloroform, and harder at the edges. *Mem.* This mixture of chloroform and Canada balsam should not be kept mixed as it is apt to become clouded after some time, although it has no prejudicial effect on the specimens when recently made.

The advantage attending this process is well worthy of note, *i. e.*, that no application of heat to the animal tissues is needed, and no coagulation of albuminous fluids, &c., can take place. Those who have laboured in making preparations of various kinds can scarcely have failed in encountering some specimens difficult of preservation, such as tongues of mollusca, and other oily or fatty subjects. These, it is generally known, may be cleaned by immersion in turpentine, but if heat be afterwards applied in putting them up, they are very apt to become turbid; hence the value of the above process. I soak such fatty specimens in turpentine till I find them clean enough, but before this I wash the specimen clean with a brush dipped in turpentine, or, if spirits of wine or water is used, allow the specimen to dry first, before subjecting it to the turpentine. The object having been so cleaned and laid out on a small piece of glass, such as a piece of broken slide, place another piece of glass over it, and secure them by binding it round with fine silver wire (such as may be obtained by unwinding a harp string), and place the whole in a jar or wide-mouthed bottle filled with turpentine. When well soaked for several days, or it may be for weeks, take out, and carefully brush the specimen, if it requires and will bear it, to free it from turbid matters at the edges. *Mem.* Long continued soaking in turpentine is apt to render some objects brittle, but if cleaning is not very requisite they are not too brittle to mount.

In this way I have treated the polypidoms of Polypi, and as these also contain air, I find they require no aid from heat or the action of an air-pump, as I have lately seen suggested, but merely due time for immersion in a *sufficient body* of turpentine. When the turpentine gets too dirty to do this work, it may do duty in grinding holes in the glass slides.

I have found certain animal substances still more refractory; as, for instance, the parasite of the Whale, which is exceedingly oily, and difficult to purify under the influence of turpentine. As a rule, if I find these specimens become white or opaque under its action, I transfer them to rectified spirits of wine, and, after a good soaking, employ turpentine, and *vice versa.*

Again, the best way I know of preparing the feet of Insects, &c., is first to wash the feet, while the insect is alive, with spirits of wine, then holding it by a pair of forceps close to the edge of a clean piece of glass, the insect will lay hold of the upper surface by its foot, then suddenly drop another small piece of glass over it, so as to retain the foot expanded, and cut it off with a pair of scissors, tie up, and soak to get rid of air.

The tongues of flies are most easily made to protrude by pressing the head between the finger and thumb, over the eyes, or with a pair of forceps; the air appears to be forced into the trachea, and distends this organ freely, when it may be laid on a piece of glass, another placed over it, and *then* severed from the insect and subjected to the turpentine process.

With regard to vegetable tissues, I have had much difficulty, and shall be glad to obtain more information. My desire has been to obtain such a medium as will solidify or viscify around a specimen which has been previously prepared in glycerine, and such a medium must not disagree with the glycerine so as to exhibit oily globules, &c. At present, I cement glycerine contained in cells with mastic dissolved in creosote, the glass cover generally projecting over the edge of the cell, so as to allow the mastic to surround the edge of the cover both above and below. I am inclined to think that those glycerine-prepared specimens keep best which are mounted in a cell with a small bubble of air contained, as I think the glycerine does not escape so freely; the escape of glycerine from apparently well-secured cells, appears to me to be due to its great expansive property, besides its tendency to deliquesce.

March, 1857.

Since I wrote the above, some months ago, I have made a decided advance in the preparation of some insect-tissues. I adopt the following plan: Place the insect alive in sweet spirits of nitre; it will die rapidly, and the air will be freely expelled, partly by reason of the volatility of the medium, and those with a proboscis, &c., will protrude it. After soaking a day, the specimens are to be *rapidly* transferred to a small quantity of clean spirits of turpentine, when all the sweet spirits of nitre will be expelled in the form of globules charged with grease; immerse in a further supply of turpentine in a clean bottle, and when the specimen has been a day or two (perhaps a longer time may be required for some), it can be mounted in the chloro-balsam, as I have described above.

Refractory specimens, or those which are very oily, may, after immersion in sweet spirits of nitre, and cleaning in turpentine, be again soaked in sweet spirits of nitre, when the turpentine will be expelled. If they are then a second time taken out of the sweet spirits of nitre and plunged in turpentine, the clearness of the globules which escape will indicate if the specimens are sufficiently cleansed. *Mem.* The sweet spirits of nitre must be fully expelled, or the Canada balsam will assuredly quarrel with it, and form a cloud round the object.

I am modifying the above plan by using sulphuric ether dissolved in three times its bulk of spirits of wine.

I inclose three specimens for the acceptance of the Society, with four slides, illustrating that part of the paper on perforated slides for mounting objects.

No. 1, is a slide done with a broach.

No. 2, a further stage, with the additional use of one file—both done in eight minutes.

No. 3, a completely finished, perforated slide.

No. 4, a cell cut out of a portion of a slide, and roughly mounted.

Report *of the* Sub-committee *of the* Microscopical Society *on the* Best Form *of* Universal Attachment *of the* Object-glass *to the* Body *of a* Compound Microscope.

(Read November 12th, 1857.)

The practical inconvenience that has arisen from the adoption, by different makers, of various modes of attaching object-glasses has long since been universally admitted.

In recommending a form of attachment for general adoption, it appears necessary to consider the following conditions:

1. That the greatest amount of truth be ensured, both in the centering and in the parallelism of the axes of the body and object-glass.

2. That the linear aperture be large enough to transmit all the pencils that can fall upon any field-glass in ordinary use.

3. That the fitting must be capable of construction in an ordinary lathe.

In order to ensure parallelism of the axes, a face-fitting is generally considered necessary. It also appears desirable that the *inside* fitting should be in the body of the microscope, and the *outside* fitting on the object-glass. Of the various modes of attachment that have been suggested, that which appears likely to fulfil most completely the conditions of perfect centering, is a cone of about 40°, surmounted by a screw which enters a loose nut placed above the hollow cone in the body of the microscope, but the practical difficulties of manufacture appear insurmountable; it is therefore proposed to relinquish the greater degree of accuracy that might thus be obtained, in favour of a mode of fitting that is at present partially in use, namely, a screw, surmounted by a plain collar or guide, for facilitating the application of the object-glass. As the correct centering must practically depend on the screw, it is strongly recommended that the inside and outside screws should both be cut by a traversing mandrel, or by a traversing slide-rest.

Having thus considered the form of the attachment, it remains to determine the most appropriate dimensions of the several parts. A screw, containing thirty-six threads in an inch, having an angular thread of 54°, slightly rounded off at the top and bottom, has been considered the most appropriate. The largest linear aperture, at the junction of the object-glass with the body of the microscope, will be required for objectives of low power having the widest compatible angle of aperture; this is not likely to exceed ·72 to ·73 in. with the greatest diameter of field-glasses now in use; hence, ·8 in. may be taken as sufficient for the external diameter of the screw. The length of screw recommended is $\frac{1}{8}$, or ·125 in., comprising $4\frac{1}{2}$ threads; and that of the guide or collar ·15 in.

In order to ensure uniformity of dimensions among different manufacturers, it has been thought desirable that an application be made to Mr. Whitworth to construct the requisite number of hardened gauges, of exactly equal dimensions, and he has kindly undertaken their construction.

The proposed set of gauges consists of a templet and ring of exactly ·8 in. external and internal diameters respectively; another templet and ring corresponding in diameter to the bottom of the thread, which Mr. Whitworth has determined to be ·7626 in., to be used as gauges for the plain parts of the fitting; and a master-tap or "hob" for cutting screw tools.

It is further recommended that a set of gauges should permanently remain in the custody of the Society, for the purpose of comparison, in case of any question arising as to correctness of gauge.

(*Signed*) George Jackson,
Charles Brooke.
H. Perigal, Jun.

At a meeting of the Microscopical Society, held on Wednesday, the 11th of November, 1857, it was resolved—

That this report be received and adopted.

It was stated by a member of the sub-committee that the three principal London firms had agreed to adopt the proposed gauges, which are now in the course of manufacture; and that any microscope maker might obtain them from Mr. Joseph Whitworth, of Manchester, at the cost of £2 10*s.* the set.

Precise Directions *for the* Making *of* Artificial Calculi, *with some* Observations *on* Molecular Coalescence, *supplementary to those on the same Subject, published in the 'British and Foreign Medico-Chirurgical Review' for October,* 1857. By George Rainey, Lecturer on Anatomy, &c., at St. Thomas's Hospital.

(Read December 9th, 1857.)

Since my paper on the "Elementary Formation of the Skeletons of Animals, and other hard structures formed in connection with living tissues," was communicated to the 'British and Foreign Medico-Chirurgical Review,' my attention has been directed to the improvement of the process for the obtaining of artificial calculi therein given. In this respect I have fully succeeded, and am now enabled to give a formula and directions, which if strictly followed will never fail to ensure satisfactory results. I have, besides, in course of experimenting, observed some facts with which I was unacquainted when I wrote my first paper. And as the subject is especially connected with microscopical science, I am anxious of bringing it more directly under the notice of the Microscopical Society. My present process differs from that given in the 'Medico-Chirurgical Review' only in having the exact quantity of carbonate of potass indicated, and the precise densities of the two solutions specified. As several applications have been made to me, implying the want of explicitness in the first formula, I hope the tedious minuteness with which the details of the present process are given, will be excused.

This process consists in introducing into a two-ounce phial, about three inches in height, with a mouth about one inch and a quarter in width, either one ounce or half an ounce, by measure, of a solution of gum arabic saturated with carbonate of potass (the sub-carbonate of the old Pharmacopœas) of 1·4068 specific gravity, when one ounce of this compound solution will weigh 672 grains. The solution must be perfectly clear, all the carbonate of lime which had been formed by the decomposition of the malate of lime contained in the gum having been allowed completely to subside. Next, two clean microscopic slides of glass of the ordinary dimensions, are to be introduced, with the upper end of one slide resting against that of the other, and with their lower ends separated as far as the width of the phial will permit; and, lastly, the bottle is to be filled up with a solution of gum arabic in common water of 1·0844 specific gravity, one ounce of which will weigh 520 grains. This solution must also be perfectly clear, having been first strained through cloth, and then left to stand for some days to allow of the subsidence of all the floating vegetable matter. It must also be added gradually to the alkaline solution, that the two solutions may be mixed as little as possible in this part of the process. The bottle must now be kept perfectly still, covered with a piece of paper to prevent the admission of dust, for three weeks or a month. Time would be saved by employing a dozen bottles thus charged, and examining their contents at stated intervals according to the chief object sought for in the experiment. The soluble salts of lime to be decomposed by the subcarbonate of potass are contained in the gum, in combination with malic acid, and also in the common water. Muriate of lime dissolved in a solution of gum from which all the lime had been previously separated would answer a similar purpose, provided the quantity of muriate were not in too great excess for the gum, when crystals of carbonate would be formed with the globules, and the surface of the slide would become covered with coalescing patches of the latter.

But there is another crystalline compound in gum, which, when I wrote my first paper, had not occurred to my notice, and which, combining with the globules of carbonate of lime formed at the lower part of the slide, contributes to the formation of the largest and most beautiful calculi, and which are connected with some very singular facts tending to throw light upon the subject of crystallization. This compound is the ammoniaca-magnesian or triple phosphate. I am not aware that this salt has ever been noticed before in gum arabic; but the existence of all the elements entering into its composition are mentioned in the analysis of gum by several chemists. (See Turner's 'Chemistry,' p. 855.) It is thrown down by the excess of subcarbonate of potass ordered in the formula, for if no more of that salt were added to the gum than just sufficient to neutralize the vegetable acid in combination with the lime, the triple phosphate would be retained in solution. Hence this substance, not beginning to be deposited until after the carbonate is formed, occupies a place on the glass slides, just beneath the lowest particles of the globular carbonate with which it combines, forming a compound of carbonate of lime, gum, and triple phosphate all molecularly, and now, I believe, chemically, combined. But this latter fact would require a more accurate analysis of the compound than I have yet been able to make. The examination of these slides shows what is taking place in different heights in the solutions during the progress of their diffusion; and from the downward direction in the surface of the slide upon which the globules to be examined are deposited, they become attached to it as the result of their motion upwards—the necessary consequence of the diffusion of fluids of unequal densities so placed one with respect to the other. And the success of the process for forming the largest and most perfect globules will require that the adjustment of these densities be such that the two compounds—the globular carbonate and the triple phosphate—should be formed as nearly at the same time as possible, and at the same height in the fluid, and that they should remain suspended until all the smaller globules in the same vicinity have become attracted by, and incorporated with, one another. After which some of the larger ones thus formed will fall to the bottom of the bottle, whilst others, being attracted by the surface of the glass, placed in an inclined plane above them, will become adherent to, and blended with it, so that after their separation a mark will remain permanently on the glass, having the form of the part of the globule which had thus been connected with it. If the alkaline solution be too thick, and the simple solution of gum not sufficiently so, the alkali will ascend more rapidly in the bottle than the gum, which not being sufficient in proportion to the quantity of carbonate formed to prevent the crystalline arrangement of its molecules, regular crystals of carbonate of lime will result. These, however, will only exist towards the upper part of the slide; and examined from above downwards, they furnish an opportunity of seeing all the changes which the form of the crystals of carbonate undergo as they become combined with a successively increasing proportion of glutinous material. The particles, as thus examined, will be seen passing through all forms intermediate between the perfectly rectilinear figures and true spheres. (See Plate IV, fig. 1.) If, on the contrary, the density of the alkaline solution be not sufficient, the globules will fall to the bottom of the bottle too rapidly to coalesce in sufficient numbers to produce large calculi. When the densities of the two solutions are properly proportioned, as in the formula here given, the globular carbonate, without triple phosphate, will be found chiefly at the upper part of the slide, and the combination of the two at the lower. And still lower down are the crystals of triple phosphate unmixed with carbonate. Sometimes these crystals are very minute and imperfect, whilst at others they are larger, and exist in a perfectly crystalline state, increasing in size as they are deposited higher up on the slide until they come into the vicinity of the globules of carbonate, when they gradually loose their rectilinear form, and become so thoroughly incoporated with one another, or with the globules with which they are brought into contact, as to lose all traces of their previous crystalline arrangement (fig. 1).

It may seem singular that gum should have the power of opposing the rectilinear arrangement of the molecules of carbonate of lime, and not of triple phosphate or of phosphate of lime, as mentioned in my first paper, to which I must here refer, although each is equally in contact with the gum when it assumes its solid form. This probably arises from the carbonate of lime having a chemical attraction or affinity for the gum, and therefore combining with it, whilst the triple phosphate has not; and therefore, this substance not entering into intimate molecular union with it, the cohesive attraction between the molecules of the gum cannot influence effectively the repulsive force acting upon the ultimate molecules of the triple phosphate; but when the triple phosphate is brought into contact with carbonate of lime combined with gum, which has been shown to have a strong attraction towards solid bodies, as is seen, for instance, by its action on glass, then the molecules of triple phosphate becoming, through the chemical agency of the carbonate of lime, in more intimate union with the molecules of the gum, and now having the repulsive force separating them overcome or neutralized, are brought under the effective influence of the attraction of gravitation; so that the globular compound of carbonate of lime and gum act in the same way upon the triple phosphate as the simple gum did upon the pure carbonate of lime. Now a very simple fact will show that this reasoning is correct, and that the repulsive force acting upon the molecules of the triple phosphate, as also upon those of the pure carbonate in these compound globular calculi, is not destroyed, but only overbalanced by the cohesive attraction of the gum, and is there ready to display its repulsive power upon their molecules as soon as this balance is destroyed and a preponderance given to the repulsive agent. The fact here alluded to is shown by the immersing for an instant of a slide, on which calculi of triple phosphate combined with globular carbonate, and calculi of globular carbonate without triple phosphate have been formed, in any liquid heated to 212°, as, for instance, distilled water, turpentine, olive oil, Canada balsam, &c., when the molecules of the former of these calculi will instantly start from the curvilinear to the rectilinear arrangement, that is to say, will pass into well-defined crystals of various sizes, and of a more or less rhomboidal figure, whilst those of the latter calculi—the globular carbonate—will not be in the least affected. The explanation of this fact appears sufficiently obvious. In the calculi containing the triple phosphate combined with the globular carbonate there is a smaller proportion of gum than in the globular carbonate calculus, and hence the excess of the attractive over the repulsive force may be presumed to be less in the former than in the latter calculi; so that if the forces of attraction be equally weakened in both kinds of calculi at the same instant, one may pass into the crystalline state, whilst the other retains its globular form, as shown in the experiment. Now it is only necessary to suppose that heat, in this instance, has weakened these attractive forces.*

It seems to me that this experiment, in conjunction with the facts connected with the conversion of the crystalline into the globular form of carbonate of lime and ammoniaco-magnesian phosphate, by the action of a substance possessing a particular kind of cohesive attraction (for I may observe that gum is not the only substance which produces this effect), furnishes both analytical and synthetical evidence in proof of the correctness of the principle advanced in this and in my first paper. (See 'Medico-Chirurgical Review,' for July, 1857.)

After the slides have been withdrawn from the bottles, all

* It was my intention to have made some observations upon the probable nature of the repulsive force and its action in the production of crystals; but as such observations could only have been of a speculative character, I have thought it best to omit them.

the globules deposited on their upper surface may be rubbed off with the finger, and this surface, if necessary, washed with hydrochloric acid, care being taken that it does not touch the edge of the slide, and so reach the opposite surface. Afterwards, the lower surface, this having the clearest globules upon it, must be well washed for several minutes by a stream of water running from a tap, so that all the gum may be removed. It will then be necessary to wash it in distilled water, in order that no deposit from the impure water may be left on the glass. The specimen should now be dried on a plate over boiling water, especially if it is to be put up in Canada balsam, and washed with oil of turpentine. The Canada balsam must not be boiled on the same slide, as the globules containing the triple phosphate would, in that case, become filled with rhomboidal crystals, as before observed, but the inspissated balsam may be poured hot upon the calculi from another slide. Lastly, a thin glass cover, of the width of the slide, may be put upon it, resting at each end upon a ledge of thin glass. The calculi which remain in the bottle may next be examined. Those of the largest size are not quite so clear as those on the lower surface of the slide; but the rest, which are of all sizes, especially the very small ones, are much more accurately elliptical than those adherent to the surface of the glass—the mechanical conditions under which they are formed being less disturbed by the attraction of adjacent objects. The internal ellipses, also, and all other points indicative of the manner in which they were formed, are more recognisable in those which have subsided from the fluid in the bottle. There are, among these, calculi which have remained in the solution of gum for about a year, very large, generally dumb-bell shaped ones, of a transparency almost equal to that of glass. They especially resemble the very early deposits of the shell of the oyster.* Of these elliptical particles which are adherent to the slide, one of the poles, being blended with the substance of the glass, seems to be gradually shaded off, and is thus made to appear imperfect; this molecular union with the glass furnishing an example of the remarkable tendency which the carbonate of

* They exhibit somewhat of a nacreous appearance, being irridescent when seen by transmitted light; but by polarized light, though showing a very distinct cross, they do not exhibit prismatic colours. This I believe is to be accounted for by their cohesion being so perfect, that the molecules, though attracted in straight lines by the force of gravity, are still capable of resisting a force of repulsion which in a lower state of cohesion would bring them into a crystalline condition; which condition is, I believe, the cause of the exhibition of the prismatic colours in the other, larger calculi as seen by polarized light. (See plate, &c.) These calculi undergo no change by being boiled in distilled water.

lime has to combine with hard substances. The slide upon which these particles have been formed is permanently marked by the part of the globule which had thus been attached to it. The particles on a slide, where the experiment has perfectly succeeded, come in the following order, taking them as they are seen from above downwards. First come the minute spherules and dumb-bells, which get larger as they are situated lower on the glass; next, the particles are seen to get smaller, though of a more perfectly spherical form, and here begin to be mixed with very large globules. These, having the most carbonate in their composition, exhibit a laminated arrangement, whilst those which are chiefly composed of triple phosphate have their surface nodulated, being studded with minute crystals; this is especially the case in the calculi which have been several months in the solution; lastly come the crystals of triple phosphate passing into a globular form, being mixed only with a small proportion of globular carbonate; and, last of all, are the crystals of pure triple phosphate, with their sides and angles beautifully sharp and well formed. These appearances, and the proportions in which these several kinds of globules exist, will vary in different specimens, depending probably upon differences in the composition of the different kinds of the gum employed in the experiment, as well as upon other accidental causes.*

There is yet another description of artificial calculi presenting characters differing in many respects from those already described, prepared by dissolving one pound of gum arabic in two pints of water, and straining the mucilage through a fine hair sieve, and then putting one pint of the solution with two ounces of subcarbonate of potass, well mixed together, into a quart bottle, and after twenty-four hours adding, by means of a syphon, the other pint of mucilage,† and after that leaving the bottle at rest for six weeks or two months, when the calculi will be found adherent to its sides, or in the fluid at the surface.

* Besides these, there are other crystals formed in these solutions, but they are all soluble excepting those of bicarbonate of lime, which are produced by some of the carbonate becoming combined with the carbonic acid set free by the action of the acetic acid upon the subcarbonate of potass. The quantity of the acid being the result of the acetous fermentation, is most abundant in warm temperatures. All crystals produced by double decomposition in a solution of gum, which do not combine chemically with it, are large and well-formed; hence such a process may be taken advantage of to crystallize some salts, otherwise difficult of crystallization.

† It may be observed that in this instance the insoluble particles floating in the mucilage will not have had time to fall to the bottom of the bottle.

These calculi are very large, being $\frac{1}{80}$th or $\frac{1}{60}$th of an inch in diameter, and spherical, excepting sometimes on the side which was in contact with the glass, which is flattened. They are beautifully laminated, and coalesce in the same manner as those before described. When treated with weak acetic acid they effervesce, and leave a residue of amorphous matter. When dried they retain their globular figure, but have not the smooth and glassy appearance of those formed on the slides. Under polarized light they present a cross and appear somewhat coloured, but do not exhibit the prismatic colours. They cannot be preserved in any fluid, as they suffer disintegration and gradually disappear. Even if they are put up in a cell with the solution of gum in which they were formed, still they gradually, though only partially, suffer disintegration. All the carbonate of lime disappears, but a residue is left having the same laminated appearance (though seen very faintly) as the original calculus, but this residue is not in the least visible by polarized light. These peculiarities are, I have no doubt, due to the presence of a quantity of insoluble vegetable matter intimately mixed with the particles of carbonate, which prevents that complete coalescence which otherwise would have taken place; and hence in these calculi the molecules are kept together with but a very feeble cohesive attraction, as is indicated by the absence of that degree of transparency which characterises the other forms of artificial calculi when perfectly dry. Hence it is probable that the force which keeps these heterogenous particles together is chiefly, if not entirely, the attraction of gravitation. Consequently when they are removed from the bottle in which they were formed, where all the molecules entering into the structure of each of them would have been exactly balanced between the mutual attraction of the molecules themselves, and that exerted upon them by the various part of the bottle, to a small cell of glass where they will be brought into much closer contiguity with surrounding objects, this balance will be destroyed, and the molecules, being now attracted by surrounding substances more forcibly than by one another, their separation will ensue. The vegetable matter molecularly united with the carbonate of lime being very light, and probably having a slight cohesive attraction existing between its own particles, will retain its place, whilst the particles of carbonate will become attached to the sides of the cell. I consider that there is nothing wonderful either in the facts here stated respecting these calculi, or in the explanation of them here advanced. It is only just what might have been anticipated under such circumstances, and it is exceedingly probable that a process very similar to this frequently takes place in living structures, and that many of the facts presented by the molecular disintegration of living tissues, and usually attributed to the direct influence of a vital force, are the immediate effect of a mechanical agency. One thing is certain, that where the conditions necessary for the operation of physical forces upon the molecules of matter are present, whether in organic or inorganic substances, these forces do act either effectively or ineffectively. Vitality may oppose, modify, or direct their operation; but there is no reason to believe that it ever either creates or annihilates them. The force of gravity, or universal attraction, would want its most distinguishing attribute, if every molecule in the universe were not, at all times and in all places, under its influence; and it is illogical to suppose that in the case of vital organisms a distinct force exists to produce results perfectly within the reach of physical agencies, especially as in many instances no end could be attained were that the case, but that of opposing one force by another capable of effecting exactly the same purpose.

For a full discussion of the question of molecular coalescence, as applied to the hard structures of animals, I must again refer to my former paper in the 'British and Foreign Medico-Chirurgical Review;' but from what has just been stated, it would be unreasonable to conclude that this process ends there, and that the skeletons of plants, as well as all soft structures, both animal and vegetable, are not equally under its influence. Many considerations appear to me to justify the inference that the constituent materials act upon one another, and are acted upon by the physical forces in the same way in plants as in the shells of animals. And as to the effect of coalescence on the molecules composing soft structures, it must of necessity be the same as on those of hard ones, unless it be a fact that the physical laws which act upon matter in a feeble state of cohesion, are not the same as those laws which act upon it when this force of cohesion is augmented. It is true that the process of coalescence in soft structures does not admit of that rigid demonstration which it does in hard ones, in consequence of its being in the latter so slow and gradual as to afford ample opportunities of our observing it through all its stages, whilst in the former it would take place too suddenly to leave any traces of the precise manner in which it had been effected. And most probably the real nature of this process would never have been understood if it could not have been demonstrated on artificial products; for although there are evidences of its real nature in the calcifying shells of crustaceans and molluscs as demonstrative of the manner in which it is produced, as in the artificial specimens, still these occurring in contact with living structures, would always have left a doubt as to what part of the phenomenon was due to vital and what to physical agency, and thus the question would have remained a debateable one. And certainly the cytoblast theory of Schwann and others—the very foundation-stone of modern histology—would have contributed nothing towards the solution of this difficulty, or ever have led to the discovery of the fact, that the process of calcification in the shell of a crab or an oyster is a directly physical one.

On a Probably New Species *or* Form *of* Actinotrocha, *from the* Frith of Forth. By T. Spencer Cobbold, M.D., F.L.S., Lecturer on Botany at St. Mary's, London.

(Read at the Microscopical Society, December 9th, 1857.)

In the autumn of 1856, I procured from the south shore of the Frith of Forth, near Portobello, three examples of an animalcule, which, on microscopical examination, at once reminded me of Müller's *Pluteus paradoxus*, and other allied forms of echinoderm-larva described by him in the later volumes of the Berlin Academy's 'Transactions.' However, on recently going over these various memoirs, and comparing his figures with those here reproduced (Plate IV, figs. 10, 11, 12), I felt inclined to doubt the correctness of my original conception of its larval condition, and was thereupon induced to assume that it might with greater propriety be referred to the group of Polyzoa.

Although it should be fully proved to be a true echinoderm-larva, the remarkable analogy subsisting between Professor Allman's typical polyzoon and the creature under consideration, must be apparent to the most superficial observation. Commencing from above, the following parts may be recognised. In the first place, we have an enormously developed *epistome*, forming a kind of beak, which when closed or shut down rests upon a slightly convex *lophophore*. The latter is armed with numerous tentacula, clothed with highly active vibratile cilia, and is succeeded by a more or less funnel-shaped body, terminating abruptly at the caudal end. The margin of this disciform extremity is occupied by a slightly projecting ciliated band, and the anal orifice is placed in the centre. The stomach and intestine, though simple and continuous, are distinct from each other, and traces of additional viscera may be recognized. By reflected sun-light the tissue of the ciliated band is seen to contain a number of highly refracting corpuscles of a golden yellow colour.

Such, in brief, are all the facts I am enabled to give in regard to the organization of these interesting little animals. A more lengthened examination would probably have supplied me with further particulars; but having been anxious to watch their further development (at the time assumed possible), they were placed for this purpose in a small glass aquarium, in which situation they so effectually concealed themselves in a tuft of *Enteromorpha,* that I never afterwards succeeded in finding them. While on the move, they frequently displayed a most eccentric attitude, and when motionless, they rested on the caudal extremity in an upright position (figs. 2 and 3).

In answer to some inquiries respecting the polyzoal relations of this larva, Professor Allman has kindly furnished me with the following particulars:—"It appears to me," writes Dr. Allman, "that there are so many points which militate against its being a polyzoon, that I do not at all feel disposed to place it in that group. The lophophore and epistome seem in favour of its polyzoal relations, but then we have the same organs in *Phoronis,* and the epistome here seems to me, if I rightly understand your figures, not to be homologous with the epistome of the Polyzoa, as it here looks *towards the concavity* of the lophophore, while in the Polyzoa it looks *towards the convexity.* Then there is no distinction between a retractile and fixed portion (polypide and cell), and no system of muscles such as we find in the Polyzoa, while the position of the arms is so very different, as, I think, in conjunction with the other points, to decide against our associating this creature with the Polyzoa."

Until very recently, I was not aware that a form of animal very similar to that I have here imperfectly described and figured, had been noticed by J. Müller, and others, under the name of *Actinotrocha branchiata.* My attention having been drawn to this circumstance by Dr. Carpenter, I find, upon reference to Müller's paper contained in his 'Archiv' for 1846, p. 101, that there can be no doubt that the creature found by me in the Frith of Forth belongs, at any rate, to the same generic type as his *Actinotrocha branchiata.* In the same journal for the subsequent year, 1847, some additional observations on the same animal are given by Wagener, whilst two apparently distinct forms are briefly noticed by Gegenbaur, in Siebold and Kölliker's 'Zeitschrift für Wissenschaft Zool.,' vol. v, p. 347. From all of these, however, I am inclined to think that the form here noticed presents sufficient differences to justify its being regarded as representative of a distinct species, though obviously belonging to the same generic type. In the absence, however, of more precise knowledge than we at present possess, of the growth and development of these creatures, it is perhaps premature to offer any speculations upon its true relations. And, as suggested by Gegenbaur, with respect to the *Actinotrocha* described by him, the differences in the forms already noticed may be due to their having been observed in different stages of growth or development. The general opinion seems inclined to regard *Actinotrocha* as a larval form of some kind, and most probably of an echinoderm. Amongst those who have entertained this opinion, I would adduce Von Siebold, who compares *Actinotrocha* with a *Bipinnaria* from which the perfect asterid has become detached (Wiegmann's 'Archiv,' 1850.) At present we cannot be surprised that the true relations of this creature should be very obscure, but may remember that in the same paper in which J. Müller notices *Actinotrocha,* he for the first time describes a *Pluteus,* without then having any comprehension of its marvellous relations to the Echinodermata, subsequently ascertained by his unwearied researches in that and other allied forms—researches which have added so immensely to natural knowledge, and contributed another imperishable wreath to the well-won fame of the illustrious physiologist.

[*Note.*—At the meeting of the Microscopical Society, at which the above paper was read, Dr. Carpenter exhibited a specimen of *Actinotrocha* (apparently *A. branchiata,* Müller) preserved in dilute glycerine, and the inspection of which further confirmed the opinion above expressed, that the form described by Dr. Cobbold differed from that species in several important particulars, and more especially in the shape of the hood or epistome, and in the number of tentacles around the body. Dr. Carpenter also stated that the form shown by him was extremely abundant in the Isle of Arran, and probably elsewhere, so that it is to be hoped that opportunities will be taken to search for and examine this and allied forms, at different seasons of the year, on various parts of the coast. —EDS.]

TRANSACTIONS.

On the MILIOLITIDÆ (*Agathistègues, D'Orbigny*) *of the* EAST INDIAN SEAS. Part I. MILIOLA. By W. K. PARKER, Esq., Mem. Micr. Soc.

(Read January 13th, 1858.)

THE naturalist who would make the external character of the Foraminifera or Rhizopoda of the same value as in the Cephalopods and Univalves will find himself in a great dilemma as he proceeds: his method may seem to be the true one, if he only has to describe the specimens of a few gatherings from distant places; but if he goes on with his investigations his perplexity will increase, and he must invent new names by the hundred to keep pace with the fresh forms presented to him. If the foliar organs of our most familiar plants could grow detached from their common axes, botany would present just such a harvest to the species-maker as the Foraminifera have done. How many species, not to say genera, would the ivy, the abele-tree, or the bitter-sweet yield? Now I think that I do not go out of the way of true inductive observation by making this comparison; for, although these polythalamous shells are not ranked as plants, yet they are the very simplest of animals, and have scarcely any differentiation of tissues. They are merely sarcode and shell-matter, and neither of these appears to have been formed by the intervention of true cells; whereas the phanogamous plants just mentioned are, as every one knows, highly complex in their structure.

The living creature then that forms these exquisite rhizopodous shells is a mere point of gelatinous substance (called "sarcode"); it

> "Shape has none
> Distinguishable in member, joint, or limb."

What wonder then that their defensive structures should vary exceedingly in shape and in size?

Indeed, those who have honestly and earnestly set themselves to the task of distinguishing species, have found that they are dealing with an "unbound Proteus" in a thousand shapes, who must be distilled to his native form,—the true morphological idea of each species being only attainable by a long labour of observation and comparison, not only of the varieties of one species, but also of species with species, and of genus with genus.

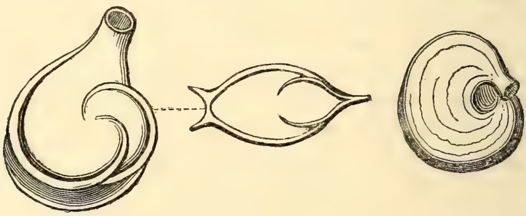
About five years since, being engaged in the study of Bryozoa and other small animals, I obtained a large quantity of clams of the East Indian seas, and among the débris obtained by cleaning their outer surface I collected an extensive suite of Foraminifera.

These presented themselves in such vast numbers, and in such an endless variety of forms, that I have been enabled to study nearly every one of the chief groups of Foraminifera, as represented in these seas, to much advantage.

From the series of illustrations I have prepared of these minute shells (which Dr. Carpenter has already referred to, as being likely soon to be brought forward), I propose to offer to the Society some characteristic forms of the *Miliolites.*

This group presents a whiteness and opacity of the shell, and a more or less folded arrangement of the chambers, with usually a single large aperture. These white, chalk-like shells commence with a sub-globular, partially divided, primordial

Fig. 1.—Young Miliolæ, usually known as Adelosina and Uniloculina.



a. *b.* *c.*

a. Adelosina. *b.* Sectional view of Adelosina. *c.* Uniloculina, highly magnified.

chamber, around which the subsequent segments of the animal are successively arranged.

Cornuspira.—The simplest form affected by the Miliolite family is that seen in *Cornuspira,* where the sarcode proceeds in a cylindrical wire-like shape, with a few irregular constrictions, and is continued in a flat helical plane, to the extent of five, six, or more whorls. The shell does not form a coiled tube, but a half tube, the shelly cover of one whorl resting by its lateral edges on the outside of the former whorl. This condition of the shell-wall is common to all the Miliolitidæ, the chambers being half-tubes or tent-like structures.

All the specimens I have yet collected of *Cornuspira* appear to me to be specifically the same, belonging to one characteristic genus.

Hauerina.—The next step from the simplicity of Cornuspira is seen in the definite and nearly regularly recurring constriction in the whorls of *Hauerina.* In the young state of this generic form (of which I can only recognise one species), the departure from the planorboïd shape is less than it is in the adult state, which has put on a somewhat three-sided or four-sided outline from the arrangement of the outer whorls, in which three chambers usually form the circuit. The chambers are here generally delicately striated in some varieties; otherwise smooth.

Sphæroidina.—In *Sphæroidina* we have the folding of chamber over chamber on the two sides of the axis alternately, the chambers being somewhat globose. This alternation in the position of the chambers is soon interfered with by their inclination to take a uniserial arrangement, an irregularly concentric, or a branched or cervicorn form. These secondary plans of growth are subject to much irregularity in the Sphæroidina in this East Indian fauna.

The Sphæroidinæ present two characteristic types of form; namely, those with very inflated chambers, having a slight valve on the aperture; and those with pleno-convex chambers, without a valvular process; the latter group have greatest irregularity of shape. In these I recognise two species.

Vertebralina.—A fourth form of growth is seen in another genus, *Vertebralina,* which is well characterised by a peculiarly patulous opening to the shell, and by a well-marked uniserial arrangement of the later chambers. The gaping shape of the aperture in young Vertebralinæ soon gives a conspicuous breadth to the chambers, which, where they have taken on the straight mode of arrangement, form a regular succession of adpressed, vase-shaped chambers, occasionally (in the so-called "Articulina") as narrow as the axis of a coralline, and sometimes forming a series of uniform width, distantly resembling in outline a shark's vertebra, or, at the other extreme, widened out to a successively greater and greater extent, until affecting an irregular triangular outline. Vertebralina is almost always striated, delicately sulcated, and ribbed in the direction of the axis of the shell. This genus presents but one true species.

MILIOLA.—Recurring to the uniform alternation of chamber on chamber alternately on two or more sides of the shell, as seen in the embryo and young forms of Hauerina and Sphæroidina, we have the form of *Miliola,* and amongst the innumerably various forms of this genus I can see only one specific type. The progressive construction of the shell is

Fig. 2.—Soft parts of a Miliola deprived of the shell.

characterised by the last chamber or loculus having a direction of growth exactly opposite to that of the former; so that, the chambers being continued backward and forward on the two sides, two turns complete the spire. In some forms the

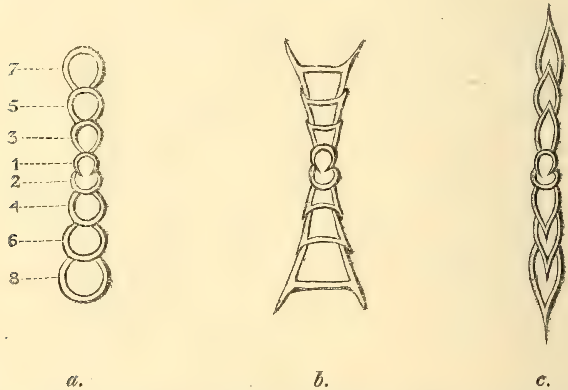


Fig. 3.—Ideal transverse sections of symmetrical flattened Miliolæ—Sproloculinæ.

chambers are narrow and of a uniform width (fig. 3); so that all the whorls are visible in the adult shell on both

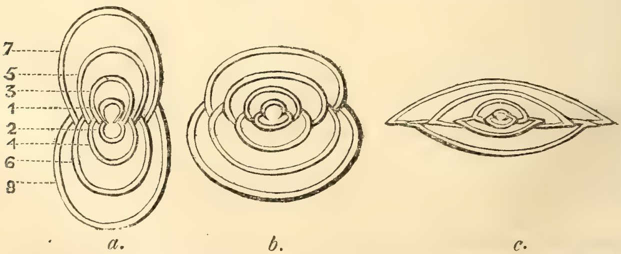
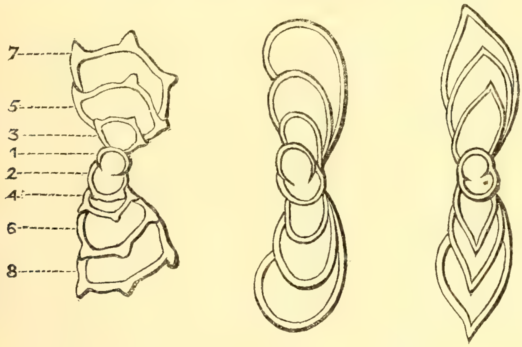


Fig. 4.—Ideal transverse sections of symmetrical Miliolæ—Biloculinæ.

its sides, as in *Spiroloculina* (Plate V, figs. 1 to 7). In others the chambers overlap to such an extent, that the later always envelope the older whorls; and only two, the last and the penultimate, are visible, as in *Biloculina* (Pl. V, figs. 29 to 35). These two forms are symmetrical. Several other forms, more or less overlapping in their habit of growth, are asymmetrical, and, in consequence, show more chambers on one face than on the other; from three to eight on one, and from two to six on the other; some shells having only two on

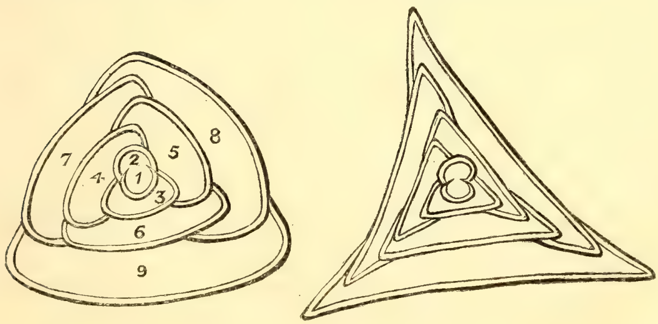


a. *b.* *c*

Fig. 5.—Ideal transverse sections of a symmetrical compressed Miliolæ—Quinqueloculinæ.

one, and three on the other side visible; but usually they show five on one side and three on the other. These are *Quinqueloculinæ* (Pl. V, figs. 8 to 21, and woodcut, figs. 5*a, b, c*).

Some Miliolæ affect a three-sided shell; the antepenulti-



a. *b.*

Fig. 6.—Ideal transverse sections of trifacial Miliolæ—Triloculinæ.

mate, as well as the penultimate and the last chamber, being externally visible. These are *Triloculinæ* (Pl. V, figs. 22 to 28.)

The ornamentation of the Miliolæ is probably the most varied of any group of the Foraminifera. They may be polished, scabrous, or sanded; marked by crests, ribs, or riblets; by pits of varying sizes, and honey-comb sculpturing. The ribs may be straight or sinuous, parallel with the chamber or oblique, continued or broken. The pitted sculpture usually affects the polished shells. The arenaceous individuals vary very much according to the size and character of the sandy material of the sea-bed of their several localities.

Ornamentation in Miliola, as in other Foraminifera, cannot be depended on as specific character.

Size is no criterion. The same variety retains its features whether it be $\frac{1}{100}$th or $\frac{1}{10}$th of an inch in length. (These are about the extreme limits of size for Miliolæ.)

The *overlapping of the chambers* occurs in such varying extent, and by such gentle gradations, that no line can be drawn marking any species as being characterised in this respect. The *symmetrical* arrangement of the chambers is persistent in Spiroloculina and Biloculina, but lost in the varieties included under the names Quinqueloculina and Triloculina.

The *construction* of Miliola is essentially the same throughout the above-named varieties—Spiroloculina, Biloculina, Quinqueloculina, and Triloculina. The differences arising from the asymmetrical growth—from variations of the cylindrical, flattened, or squared form of area of chamber—of the relative width or contraction, or of its length or shortness—must not be regarded as of specific value.

If the forms kept themselves as distinct as those represented in the diagrams, a naturalist might be excused for regarding them as separate types; but between any two of these there may be readily found innumerable gradations, in large and in small specimens, in the smooth and the ornamented, in the shelly or the sanded, in attenuated and in distended individuals, and in specimens with symmetrical or non-symmetrical, or with two- or three-sided shells.

The aperture of Miliola is round, oval, or square, according to the shape of the chamber; and has in it a tongue-like process of shell-substance, which also varies in shape in different varieties, being often forked (in Spiroloculina), crescentic (in Quinqueloculina), and oblong (in Biloculina): it acts as a partial septum between the chambers. In a Quinqueloculina abundant in the Tertiaries of Grignon, this plate becomes developed into a perforated septum, similar to what is a constant character in Hauerina, Fabularia, Peneroplis, &c.

Some of the Sphæroidinæ and all the Vertebralinæ are without this septal process. The terminal edge of the chamber in Sphæroidina is incurved in some degree; and in Vertebralina it is elegantly recurved. Both these conditions occur in Miliola; whilst in some varieties the margins are quite even.

Miliola occurs as low down in the strata as the Lias: it is rather abundant in the clay of that period from Stockton, in Warwickshire. Here, however, it is very small and delicate; a condition precisely similar to what is seen in dredgings of recent forms from 350 to 500 fathoms. It is small also in the Gault; but constantly present in that deposit, as well as in the Chalk-marl. From the Upper Chalk to the present period it is everywhere abundant. This species, like many other Foraminifera, is world-wide in its present distribution, and is most abundant from the shore to 150 fathoms. I have also found it in soundings obtained by Captain Spratt, R.N., between Malta and Crete, at 1620 fathoms.

I must not omit to say, that I owe to Dr. Carpenter the idea that these innumerable forms are not true species; and that my friend Mr. T. Rupert Jones has for a long while rendered me his invaluable assistance and oversight.

On a Finder *for registering the* Position *of* Microscopic Objects. By T. Maltwood, Esq.

(Read January 13th, 1858.)

One of the earliest wants I felt after beginning to use the microscope was that of an object-finder, and from the first of directing my attention to the subject it has appeared to me that a finder, to be efficient and of general utility, should possess the following properties:

1st. It should be adapted for use with microscopes, either with or without movement-stage.

2d. It should admit (without any previous preparation) of an object being registered, which has been unexpectedly brought into the field.

3d. It should be used under the microscope by making it take the place of the object, and should be capable of being made sufficiently correct, that objects registered by one finder might be placed in the field by another.

4th. The different parts of the scale should be so distinguished as to determine at once, on looking through the microscope, what part is in the field.

On reading the account of the different methods which had been brought before the Microscopical Society, that proposed by Mr. Farrants appeared to me to answer to more of these requirements than any other, but this was still deficient in the last particular, viz., that of being able to determine, on looking at it through the microscope, what part of the scale is in the field. The attempts I have since made have been to supply this deficiency.

The first idea I attempted to carry out was that of a scale divided into fiftieths of an inch ruled with coloured lines, the centre ones being black, and the others of four different colours in regular succession, every fifth line being a double one. By this method it was never necessary to pass more than two fiftieths of an inch across the field to the nearest double line in order to ascertain your exact position on the scale. The first one I made I ruled on paper gummed on a glass slide, but the difficulty of ruling it, with any degree of correctness for use under a high power, seemed an obstacle to its becoming a plan of general utility.

I afterwards thought of the possibility of photographing some kind of scale for the purpose, but not seeing at the time any good method for distinguishing the different parts of it, I did not attempt anything in this way, and was again engaged in endeavouring to carry out my first idea of the coloured lines upon a transparent section of ivory cemented on glass, when a friend, with whom I had talked over my different plans, suggested to me the possibility of distinguishing the lines in a photographed scale by using figures. This at once struck me as being very feasible, and, after a little consideration, I felt sure that a scale might be photographed, not merely with figures indicating the number of the lines, but that, by employing two sets of figures, I might have a finder in which every one of the 2500 spaces in the square inch would have both its latitude and longitude recorded. By simply writing down the figures that presented themselves in the field, when this scale was made to take the place of the object, you would at once have its precise position registered. I succeeded in carrying out this plan in the following way:

I had a scale, ten inches square, divided into fiftieths, each space being one fifth of an inch square, and wrote in the upper part of each space the figures representing the latitude, taking the top line as the equator, and beginning with the top row, all of which I numbered 1; in the second row from the top I wrote the figure 2 in the upper part of each space, and so on to the bottom. I then filled in the figures in the lower part of each space to denote the longitude, beginning with the first row on the right-hand side, all of which, from the top to the bottom, I numbered 1; the second row from the right I numbered 2; and so on to the last row on the left, which would be of course 50.

This scale I afterwards had photographed, taking great care that the negative produced in the camera should be exactly one inch square, which was done by marking a square inch upon the focussing glass, and making the image of the scale fill up the space. Having obtained a negative of the right dimensions, I had a positive printed from it. This now showed the scale in the proper way for reading it under the microscope, the figures being all inverted when the printed surface was placed upwards with the space numbered $\frac{1}{1}$ at the left bottom corner.

I then cut the glass on which the positive was taken, as near to the required size as possible, and afterwards ground down the edges, until I brought the centre of the scale—when placed under a quarter objective—to coincidence with the centre of the cross ruled on one of Mr. Jackson's glass standards.

The plan I should in future adopt, to get the scale correctly centred, would be, to cut the negative to the required size, and then to grind the edges till the centre of the scale is brought to one and a half inch from the right end (looking at it from the surface), and half an inch from the bottom of the slide. The positives may be printed from this negative on slips of glass three inches by one; and by taking care that the corner of the slide from which the measurement is taken be always placed in the same corner of the printing frame, and that both the negative and positive are kept well up together to that corner, it will not only ensure perfect coincidence in any number of positives that may be printed from this negative, but it will also materially diminish their expense, as the positive will require nothing further than to have a covering of thin glass cemented over it with Canada balsam.

Nothing can be more simple than the use of this scale. Whenever I find an object I wish to register, I fix a lateral stop at the left end of the slide, and after bringing the object to the centre of the field, remove it and place the finder on the stage, taking care that the left end is against the stop.

On looking through the microscope, if with a quarter objective, the whole of one space, or parts of two or more spaces, will be in the field, and the figures that are seen in them will denote both the latitude and longitude of the object; these figures I write on the slide, and on any future occasion, when I want to find it, I have only to fix my lateral stop, place my finder on the stage, and after bringing the required part into the field, remove it, when I get the object I wish to examine at once before me. I register my objects by marking a small square on the label on the slide; over this I write the latitude, and underneath the longitude. I then make a dot or cross in the square, or on one of the lines, as the case may be, to show the precise part of the square that has to be brought into the centre of the field.

This method is, I think, more simple and more exact than using decimal figures, and I find not the slightest difficulty, with a little care, in not only placing the object at once in the field, but nearly always in the centre.

The finder I have described I divided into fiftieths, because I had understood that such a division had been suggested by the committee appointed to consider the subject. I have since ascertained that this suggestion had special reference to a scale to be read by the naked eye, and not to one used under the microscope. When I found this to be the case, I had a new scale written, divided into hundredths instead of fiftieths, as such a division has obviously so many advantages, and can be used with the same facility as the other.

I have placed this scale in the hands of Messrs. Smith and Beck, who have undertaken to get it photographed. This will give a finder of the ordinary size of the glass slides, three inches by one, with the centre inch divided into ten thousand spaces, each space containing the figures denoting its latitude and longitude. It took so long to write the figures in this scale—there being no less than 38,400—that it has not been possible to get any of them finished in time for the meeting; but I have no doubt that a good supply of them may be got ready for use in the course of a few weeks, if the weather should be sufficiently clear to admit of the negatives being taken.

MICROSCOPICAL SOCIETY.

ANNUAL MEETING.

February 10*th,* 1858.

George Shadbolt, Esq., President, in the Chair.

Report of Council.

"In accordance with their usual custom, the Council have to make the following report on the progress and present state of the Society:

"The number of members reported at the last meeting was 267, including two associates and two honorary members. Since that time 26 ordinary members have been elected, making a total of 293. This number must, however, be reduced by 1 honorary member and 2 ordinary members deceased, and 6 resigned. To these must be added 17 names taken off the list by the Council for non-payment of arrears; making a final total of 267.

"The Library has been increased by various donations, and a few additions only have been made to the Collection of Objects.

"The Auditors' Report which follows gives the state of the finances, the balance in the Treasurer's hands being £45 0*s.* 3*d.*

"The 'Journal' has been distributed gratuitously as usual. The arrangements for that purpose, announced in the last report, having been perfectly satisfactory in their results."

AUDITORS' REPORT.

From February 11, 1857, to February 9, 1858.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance from the previous year	58	16	9	By Rent of room, one year	30	0	0
For entrance of members	42	0	0	Salary of Curator	5	5	0
Compositions (which have been invested)	32	0	0	Assistant-Secretary	21	0	0
Annual payments	152	16	0	Attendance at meetings, gas, oil, and firing	21	15	1
Sale of 'Transactions'	3	3	8	Refreshment at soirée	9	15	0
Dividends	11	4	10	Stationery, postage, &c.	17	17	11
				Printing 'Transactions,' &c.	103	17	0
				Commission to Collector	11	9	0
				Purchase of Consols	32	0	0
				Ray Society (two years)	2	2	0
				Balance	45	0	3
	£300	1	3		£300	1	3

9th February, 1858.

JOHN N. FURZE, } *Auditors.*
JOHN MILLAR, }

The President then delivered the following address:

The PRESIDENT'S ADDRESS *for the year* 1858.

By GEORGE SHADBOLT.

On reviewing our microscopic achievements during the past twelve months, I have much pleasure in being able to congratulate you, both with regard to the number and the interest of the papers that have been read at our usual eight ordinary meetings; and that pleasure is materially enhanced as regards myself, by the reflection that our microscopical brethren of the medical profession have most kindly responded to the invitation I addressed to them at our last anniversary meeting, by contributing the results of their investigations in a direction in which I had occasion to notice that there was a marked deficiency during the preceding year. To these gentlemen I consider it is therefore a duty, as well as a satisfaction, to tender my special thanks.

At the eight monthly meetings the papers that have been laid before us amount to *fourteen* in number, some being very elaborate and of considerable importance; and in addition to these papers, we have had some verbal communications, together with numerous discussions, in which much valuable information has been conveyed. It will no doubt have been noticed with satisfaction, that in one or two instances an attempt has been made to record the substance of these discussions, and I cannot forbear again pressing upon your notice the great advantage likely to accrue to microscopical science from carrying out as much as possible this plan, which may, by the aid of some little assistance from the members, be readily accomplished, without the necessity of employing a regular reporter, the limited funds of the Society not admitting of our indulgence in such a luxury; and in using this term I speak advisedly, as it is not upon every occasion that there would be work for such an officer to perform. I trust I may be permitted, without offence, to state that we are, as a body, sometimes guilty of neglect of our duty touching this same matter of discussion, for it does *not* always happen that the most universally interesting paper elicits the greatest amount of it, not from being unappreciated, but because very many of our members, well able to throw additional light upon the subject under consideration, suffer themselves, from a want of confidence in their own powers, or natural diffidence, to be deterred from giving utterance to remarks, which I am confident would always be received with gratitude: it therefore frequently occurs, that there is more discussion upon matters of comparatively restricted interest, than upon those of greater importance, simply because there may be some present who have fortunately emancipated themselves from the trammels of *mauvaise honte,* and who are unwilling to allow an author to labour under the impression that his exertions for our benefit have not been appreciated. Seeing that the conclusion just intimated is a very natural one, I trust that for the future we may be able to induce those who have any acquaintance with the subjects that may be brought under notice, to give utterance to their views, and thus become more useful members of our community.

But to return to the subject of our papers—they may be classified as follows, viz.,

Animal Physiology	5
Pathology	1
Botanical Subjects	4
Physics	1
Manipulation and Microscopic Adjuncts . .	3
Total .	14

It will be at once seen, by a comparison with our last year's classification of subjects treated of, that the former deficiency in animal physiology has been amply atoned for; and first in order we have Dr. Harley's interesting communication upon "The Organs of Cutaneous Respiration," in which he remarks, that though the theory of cutaneous respiration may be regarded as an established doctrine, there does not exist any description of the organs by which the phenomenon in question is brought about; and then proceeds to suggest that certain openings, proceeding from the superficial layer, and continuing into the cutis vera, where they terminate in a blind sac, are to be regarded as the apparatus immediately concerned. Dr. Harley discovered the openings referred to in the year 1855, and at the time imagined that they had hitherto been entirely overlooked, but subsequently ascertained that they had been previously noticed by Dr. Ascherson, who, however, was ignorant of their office. To Dr. Harley, then, the honour of determining their peculiar utility belongs. After detailing his method of manipulation, he proceeds to describe at length the appearance presented by the cutaneous respiratory organs, and points out their semblance to, and analogy with, the stomata in plants: he also compares the observations of Dr. Ascherson and Mr. Huxley, in connection with this subject, with his own personal experience, which differs in some of the details from the views promulgated by the gentlemen named.

It appears that, in corroboration of the idea suggested by Dr. Harley, the openings described are in truth the sought-for organs of respiration—the blood-vessels when injected are seen to be congregated in the immediate vicinity of these cavities; that Dr. Davy has pointed out that the pulmonary arteries of some of the Batrachia divide into two branches, one of which goes to the cutis, and is extensively ramified among the follicles, whilst the veins rising in this position *are said* to convey arterial instead of venous blood. Now the authority for this latter statement does not seem to be very definite, but it appears to me as of sufficient importance to engage the special investigation of microscopists, either to verify or disprove the allegation; and if solved in the affirmative, would go very far to establish the theory propounded.

In connection with the sacs, Dr. Harley describes a layer of parallel bands, and proceeds to remark upon the structure as compared with that of smooth muscular fibre, and further notices the occurrence of a number of oval bodies distributed amongst the pigment-cells of the rete mucosum, not unlike very small Pacinian corpuscles.

Next in succession we have two closely connected papers, viz., the "Description of an early Human Embryo," by my predecessor in this chair, Dr. Arthur Farre; and one "On an early Human Ovum," by Mr. George Blenkins, one of our joint secretaries.

In each of these cases, the precise age of the aborted specimens was not capable of accurate determination, but the respective authors of the papers estimate, from careful comparison with specimens of known age, that the first-named was voided about the early part of the fourth week of utero-gestation, while the latter was probably a few days younger. Dr. Farre regrets that, in order to avoid injuring the cephalic portion of the embryo, when opening the sac, he cut through the pedicle of attachment, and was thus unable to give any satisfactory account of the allantois; while in the specimen operated upon by Mr. Blenkins, this part was in excellent preservation; and generally, the observations made by each one of these gentlemen form an admirable commentary upon those of the other.

Dr. Farre's remarks apply more particularly to the *contents* of the sac, while those of Mr. Blenkins are directed more with regard to the investing membranes. It is noticed by the former, that those organs which bring the body into relation with the *external world* are the first to be developed, while of those devoted to the maintenance of vegetative life there is scarcely as yet a trace. The head is already represented by three vesicular swellings corresponding with the great nervous centres, and the vertebræ are marked out and plainly visible by transmitted light. The anterior extremities appear in the form of small fins or paddles, while the lower are discernible as buds projecting from either side of the trunk.

Mr. Blenkins minutely describes the appearance of the allantois, and corroborates the previous observations of Wagner, Müller, Coste, and others: he also remarks upon the vitelline sac, the chorion, and amnion, which two latter integuments, unlike Dr. Farre, he finds separate, and is unable to find a trace of any vessels in the villi of the chorion.

The two specimens, I would remark, differ materially in the point of size, although so nearly of an age; but this is by no means surprising, when we recall the great variation in size apparent in different children at the period of birth. It is not too much to say, that these papers contain observations of the highest interest, not only to the professional man, but to every student of nature.

We come now to a paper by Dr. T. Spencer Cobbold, "On a probably New Species or Form of Actinotrocha, from the Frith of Forth."

The observations that were made, though few, are important, as they go far to demonstrate a distinct specific difference from the *Actinotrocha branchiata* of Müller, as was apparent from inspection of an example of the latter species in the possession of Dr. Carpenter. Dr. Cobbold, though at first inclined to regard this species as allied to some of the echinoderm larvæ described by Müller, subsequently hazards an opinion that it might be more properly classed amongst the Polyzoa, but states, that on communicating this opinion to Professor Allman, that gentleman in reply considers that Dr. Cobbold's first idea is the more correct.

The concluding paper belonging to this section is one we had the pleasure of hearing read at our last meeting, and is by Mr. W. K. Parker, "On the Miliolitidæ of the East Indian Seas."

If I am not mistaken, this is only the fourth paper relating to the Foraminifera that has been laid before the Microscopical Society since its formation; and I confess that it is a matter of very considerable surprise to me, that a class of bodies of so highly interesting a nature, respecting which there is so wide a field open for investigation, and that is by no means difficult of acquisition, seeing that many of the species are very widely distributed, should not command the special attention of a much larger number of workers. It is very true, that in mentioning Dr. Carpenter and Professor Williamson as peculiarly devoted to these singular beings, we are mentioning a host in themselves; but great generals require the aid of multitudes of humbler assistants, and if we cannot all aspire to become officers in the army of investigation, many of us may do much service in the ranks. A solution of the mystery may probably be found in the fact, that the determination of the limits of each species in this class of organisms is by no means an easy task, as is apparent from the observations of Dr. Carpenter upon very many occasions at the meetings of this Society, no less than from Mr. Parker's paper, in which, by the way, he departs from the very common practice of giving merely dry details of special characteristics of genera and species, and discusses instead the broader principles of construction exhibited as much in variation of form as in unity of design.

The paper is illustrated with very numerous and beautifully executed drawings and diagrams, which testify to the industry as well as the talent of the author; and I am much mistaken if this communication does not act as a powerful stimulus to enlist a large number of microscopical labourers into so promising a field of scientific research.

I now proceed to consider the one paper that I have classed as pathological, which might with almost equal propriety have been included amongst the botanical; it is by Mr. Grove, and entitled, "On a Fungus parasitic in the Human Ear."

The fungus in question was removed from the ear of a gentleman suffering from inflammation of the meatus auditorius, and a carefully executed drawing of it accompanies the paper. There is nothing observable in the form or character of the fungus that is remarkable in a botanical point of view; but the most striking fact recorded appears to be, that although the destruction of the fungus was effected by the injection of a solution of alum applied to the affected organ, shortly afterwards similar symptoms were manifested in the other ear, but complete development was obviated by the use of the alum solution. It is not quite clear to me whether it is intended to be conveyed, that the *growth of the fungus* was actually observed in the second instance, or only that the *inflammatory symptoms* commenced. If the former, it does seem singular that *after removal of the fungus*, and the affection yielding to the administration of the alum, the plant should find its way to the opposite organ without any perceptible path; but if it were not actually observed in *at least* an early stage of development, it does not appear by any means certain that it would have been found *at all,* because, so far as I am enabled to judge, and from the all but universal testimony of those who have had opportunities of observation combined with the necessary capacity for coming to a sound conclusion, the parasitic fungoid growth should be regarded rather as the *consequence* than as the cause of organic disintegration.

I think it but right to observe that Mr. Grove does not express an opinion either way.

The four papers relative to botanical science are all of them connected with the Diatomaceæ, the especial pet subject of microscopists—a fact by no means surprising to those who have gloated over the elegance and variety of form and structure displayed by the gem-like remains of these minute members of the vegetable kingdom, especially as from their permanent character they are not liable to suffer from the destructive hand of time. The papers are, firstly, "On a Diatomaceous Deposit in Leven Water, near Coniston," by Amos Beardsley, F.L.S., &c., and "On the Menai Straits as a locality for collecting Diatomaceæ," by B. J. Nowell. These do not pretend to do more than direct attention to the favorable nature of the localities quoted for collecting specimens, as producing abundantly a considerable variety of forms, each paper being furnished with a short list of some of the species noted. Secondly, two papers, by Dr. Donkin, of Morpeth—one "On a species of Filamentous Diatom new to Britain;" and another, "On the Marine Diatomaceæ of Northumberland." The species of filamentous diatom alluded to is the *Sydendrium diadema* of Ehrenberg, hitherto only noticed as a fossil production, or found amongst the Peruvian guano. There appears to be a difference of opinion amongst "the authorities" as to the right of this genus to rank in the order of Diatomaceæ, the late Professor Smith and others having declined to recognise it as such, whilst many others have admitted the claim; but which ever way the controversy may be decided, the fact of its habitat as indigenous to our own shores becomes established.

Dr. Donkin's second paper contains a description of a mode of collecting Diatomaceæ on the sea-shore, that is well worthy of imitation, and I would recommend those who may be intending to collect in similar localities to read carefully the description given in pages 14 and 15 of the present volume of our 'Transactions.' On the Northumbrian coast Dr. Donkin collected not less than 100 species, including upwards of thirty which he regards as entirely new and hitherto undescribed, of which he gives a detailed account, with drawings of the principal species. I would say a few words relative to the two forms for which he proposes a new genus, "Toxonidea." Although they resemble in many respects the genus Pleurosigma, it is not merely in outline that they differ, nor that the median line loses its sigmoid character, though this latter is by no means an insignificant variation, but they appear to me to possess a *true structural* difference; under a low power having very much the aspect of a Stauroneis. Under these circumstances I consider that the author has done wisely in thus constituting a new genus.

With regard to another species I have a word or two to say, viz., *Pleurosigma lanceolatum.* This I think is identical with one described and figured by Mr. Roper, in the October number (1857) of the 'Microscopical Journal' (the plate being in the January number, 1858), vol. vi, pl. III, fig. 11, under the designation of *Pleurosigma transversale,* variety β; but that gentleman conjectures that it may be probably a new species, a fact of which I have no doubt. Under these circumstances Mr. Roper would have the privilege of naming it. This, by the way, gives me occasion to remark, that it is by no means clear that the Microscopical Society has not been (may I say) somewhat shabbily treated with regard to this same paper of Mr. Roper's; and I am convinced that the author would have been better appreciated had it been read at the meeting of the Society; for even if the plate had not appeared in the same number as the text, as is the case at present, the two would *certainly* have first come before microscopists together, and in all probability would have been published at the same time. A paper always suffers more or less by disunion from its illustrations, if any exist; but with regard to those on the Diatomaceæ this observation applies with increased force.

While on this subject, having alluded to Mr. Roper's paper, it may not be out of place to make one or two more remarks in connection with it.

Alluding to *Coscinodiscus labyrinthus,* n. sp., with cellules hexagonal, minute, arranged in quincunx, in large irregular hexagonal spaces, divided by lines of confluent cellules or dots, &c., he says, "The arrangement of the cellules is so different from any yet figured, that it may be fairly entitled to rank as a new species." Illustrations are added in the plate last quoted, figs. 2 *a* and 2 *b*. In the novelty of the species I quite concur; but this peculiarity of structure is by no means so singular as the author appears to imagine, neither do I think he has quite correctly interpreted the appearance presented—of course, not having seen the specimen itself, I may be in error—but I think it but reasonable to direct attention to what I consider a *very frequent* peculiarity of structure—somewhat difficult of demonstration, it is true, in ordinary cases, but thereby affording more zest in the pursuit, and an admirable exercise of manipulatory ingenuity. This same structure, but on a scale considerably more minute, I detected, and subsequently exhibited at a soirée given by this Society some years ago, in a specimen of *Triceratrum favus*, obtained from Ichaboe guano. I published no record of it, and therefore am the more pleased at a corroboration of my observations, by finding the same design upon a larger scale. Since detecting it in the *Triceratrum favus*, I have also been able to demonstrate the existence of it in *every specimen* of *Coscinodiscus radiatus* upon which I have attempted the feat; and this has been done on those obtained from various sources, viz., the stomach of a muscle, guano, the mud of the Thames, Barbadoes fossil, &c.

Now with respect to the interpretation of the structure. In describing the Arachnoidiscus, in one of the early volumes of the 'Transactions' of this Society, I showed that the frustule consists of a *siliceous framework*, over which is stretched a *species of membrane*, whether siliceous or not I do not presume to decide, but certainly pliant to a considerable extent, capable of being partially rolled up by mechanical agency without breaking, and elastic enough to return to its original position when the extraneous force is removed. Now the structure noticed by Mr. Roper, in *Coscinodiscus labyrinthus*, and by myself in the more common species—*C. radiatus* and *Tr. favus*—I believe to be of precisely the same nature, and I am much mistaken if we do not find it in many other species of the Diatomaceæ.

Mr. Roper's observations of structure in what he has termed *Actinocyclus triradiatus* are also well worthy of special attention. I may remark, *en passant*, that I dissent from the opinion that the frustule named belongs to the genus cited.

Before quitting the Diatomaceæ, I would also direct attention to Mr. Ralfs' interesting paper in the last October number of the 'Journal,' concerning one of the modes of reproduction prevalent in some genera of this natural order.

We have had one paper, a very important one, belonging to the class of experimental physics, entitled, "Precise Directions for making Artificial Calculi, with some Observations on Molecular Coalescence," by Mr. Rainey, Lecturer on Anatomy, &c., at St. Thomas's Hospital. Those who have seen the artificial calculi produced by Mr. Rainey, cannot fail to have been struck with the remarkably close resemblance they bear to those naturally produced in the urine of the horse, and what is still more surprising, having a composition chemically identical with them. Globular crystals of carbonate of lime, ammoniaco-magnesian or triple phosphate, and a globular compound of the two, being found in various forms, viz., laminated globules, dumb-bell shaped, nodulated, as well as the sharp angular forms of the triple phosphate. After a most ingenious enunciation of the theory of the production of these calculi, according to the author's conception, he says, "Many of the facts presented by the molecular disintegration of living tissues, and usually attributed to the direct influence of a vital force, are the immediate effect of a mechanical agency." Also, "that where the conditions necessary for the operation of physical forces upon the molecules of matter are present, whether in organic or inorganic substances, these forces do act either effectively or ineffectively. Vitality may oppose, modify, or direct their operation; *but there is no reason to believe that it either creates or annihilates them.*"

Mr. Rainey propounds the doctrine that all of the animal and vegetable tissues, whether hard or soft, are equally under the influence of molecular coalescence; and the views set forth in this paper, startling though they be, deserve the most patient examination and careful consideration of every philosophical explorer.

In the class of manipulation and microscopic adjuncts, we have had two papers by Mr. T. S. Ralph, of Wellington, New Zealand, which are interesting as coming from the antipodes. No new principle was involved in the subject of the former paper, the author probably being unaware of what had been done in this country more perfectly in a similar direction. There was, however, a useful suggestion in the latter, and it gave rise to an interesting discussion on mounting objects generally, in which much practical information was elicited, and which was pretty fully reported in the last number of the 'Quarterly Journal of Microscopic Science.'

The last paper on my list, a very unpretending one, but offering a suggestion of considerable value to the microscopists, is one by Mr. J. Maltwood, "On a Finder for registering the position of Microscopic Objects."

This is a subject that engaged much of our attention during the year 1856, and many very ingenious devices were brought under consideration, while a sub-committee of the Society reported upon them, and recommended the adoption of one of them. The great convenience of being able to note accurately the position of a very minute object in such a manner that it could not only be recorded, so as readily to find it again when wanted, but so that an independent observer at a distant place and with any microscope should be able to do this without difficulty, was admitted on all hands, and a very complete solution of all the conditions imposed was accomplished; but the paper of Mr. Maltwood's not only gives another solution to the conditions then imposed, but also includes additional conditions, while still further simplifying the method of using the apparatus—which it is proposed to produce by the aid of photography. The only requisite addition to any microscope is a simple pin or stop, either fixed or moveable, on the upper stage-plate of the instrument, in order to form a starting-point, against which the slide and also the "finder" are to be brought in close contact. The microscopic latitude and longitude being ascertainable by mere inspection, the figures denoting them being seen through the microscope. I see no difficulties in the way of producing these finders, but what can be overcome with a moderate amount of care, and I trust that we may soon be working with the new tools proposed.

At one of our meetings a new form of student's microscope was exhibited by the designer, one of our late presidents, Mr. Jackson, to whom we are indebted for so many microscopic luxuries; and this form of instrument has been adopted by one of our makers, Mr. Ladd, of Chancery Lane.

At another meeting we were favoured by our respected treasurer, Mr. Ward, with some interesting remarks upon mosses, illustrated by many preserved specimens. This was with a view to stimulate others of our members to undertake investigations in a branch of botanical science where much original information is yet to be gleaned. I trust that the hints thrown out may not be amongst those "that fell by the wayside or in stony places."

At our last meeting I had the pleasure of introducing to your notice a very simple and inexpensive lamp, that I am of opinion is admirably adapted for the use of microscopists; many of these lamps will, I believe, be on the table this evening, and thus an opportunity will be afforded of testing their qualifications.

The advantageous points consist in the following, viz.—

1st. A *flat flame*, of considerable intensity, not quite equal either in intensity or colour to that from camphine, but approaching it more closely than any other that I have seen.

2d. The material consumed (Paraffine oil) does not spoil by being kept any length of time, thus being suitable for those residing in any part of the kingdom, and obviating one of the principal objections to the use of camphine.

3d. Non-liability to produce "blacks" if made to smoke.

4th. The cotton very rarely requires renewal, and when it does the operation is most simply performed.

5th. Economy and great simplicity of construction.*

At the meeting of the British Association for the Advancement of Science, in Dublin, during the last autumn, there were several papers connected with microscopical science by Mr. Bowerbank (now, by the way, Dr. Bowerbank, the degree of LL.D. having been conferred upon him by the University of Aberdeen), Dr. Lankester, Mr. Joseph Lister, Dr. Redfern, and others; but as these have been reported in abstract, in the October number of the 'Microscopical Journal,' it is needless for me to increase the length of my already extended remarks by further consideration.

The microscope, as regards both the optical and mechanical excellencies, has attained a rank in the present day at which any alterations to be considered as improvements must of necessity be somewhat rare; and during the past twelve months I am not aware of any that call for special remark. I trust, however, that it may not be deemed pertinacious if I again draw attention to two desiderata in our objectives, which I pointed out last year, viz., a provision for reducing, *upon occasion*, the aperture of those transmitting very large angular pencils of rays, and also a substitution of a movement applied to the *back combinations* (instead of the front, as at present used) when adjusting for thickness of glass covering of the object to be viewed.

I find, from information supplied by Messrs. Powell and Lealand, Ross, and Smith and Beck, the three most eminent producers of our optical tools, that the number of instruments supplied by them in the year 1857 amounts to 385. The other makers quoted in my last address have not furnished me with any return; but as a microscope is not an instrument that requires frequent renewal, it is rather a matter of surprise that the number demanded should continue so large as it is.

* For the information of those who may wish to procure them, I may state that they may be obtained of Mr. M'Keand, 6, City Road, E.C.

With regard to our cabinet of objects, although we have received several presents, I am ashamed to state that the collection is most absurdly small, numbering but 351 slides. It is a reproach to every member of the Society that this state of things should remain, and it might be worthy consideration whether we might not establish a regulation that every new member elected henceforth should be called upon to supply a few slides upon his admission into our body. It would also be a work deserving the warmest thanks of all, if some energetic member would undertake the office of collector of objects: he would soon reap a rich harvest, as I must certainly admit that there is readiness enough *to give*, though not so to give *unasked*. An *asker-general*, then, is what we want—a sort of honorable as well as honorary beggar.

The numbers of members in our list is precisely the same as last year, but this is, *in reality*, an increase, for we have again weeded out some that were unprofitable; and I think we may now regard our list as thoroughly purged of those who were members in name only.

The number at the last anniversary was . .		267
Since elected		26
		293
Resigned	6	
Dead	3	
Removed for non-payment of subscriptions	17	
	—	26
Leaving the list now .		267

Those who have been taken away from us by death are—Jacob W. Bailey, Professor of Chemistry at the United States Military Academy, West Point, New York; Mr. F. J. Bell; and the Rev. J. Guillemard.

The name at least of the first mentioned must be familiar to every member, very many having participated in the diatomaceous fossils and other interesting specimens transmitted by him to Mr. Marshall, and liberally distributed by that gentleman.

Professor Bailey is also well known to us for his labours amongst the Diatomaceæ; many of his papers published in the 'Smithsonian Contributions to Knowledge' and elsewhere, in which he follows the views of Professor Ehrenberg in his descriptions of the various forms, being in our possession.

Science in general, and microscopists in particular, have also sustained a severe loss in the death of William Smith, F.L.S., Professor of Natural History at Queen's College, Cork, but better known to us as author of the 'Synopsis of British Diatomaceæ,' recently published by Messrs. Smith and Beck. Although not a member of the Microscopical Society, his labours for the benefit of microscopists demand a tribute of respect to his memory; Mrs. Griffith, the celebrated algologist of Torquay, who recently departed in her ninetieth year, is also entitled to a similar honour.

I have but little more to add. In resigning this chair to my successor, I have only to return you my warmest thanks for the kind consideration you have always accorded to me while presiding at our meetings; and I sincerely trust, if I have been found wanting, it may not have been in zeal or in earnestly endeavouring to further your interests to the utmost of my ability.

At the conclusion of the address the Society proceeded to the election of officers for the ensuing year, and at the close of the ballot the following gentlemen were announced as having been duly elected:

President—Dr. LANKESTER. *Treasurer*—N. B. WARD, Esq. *Secretaries* — JOHN QUEKETT, Esq.; GEORGE E. BLENKINS, Esq.

Four Members of Council.—J. G. APPOLD, Esq.; T. W. BURR, Esq.; HENRY DEANE, Esq.; JABEZ HOGG, Esq.;—in the room of T. K. HUXLEY, Esq.; M. MARSHALL, Esq.; W. PETERS, Esq.; and F. H. WENHAM, Esq.; who retire in accordance with the regulations of the Society.

The thanks of the Society were voted to the President for his exertions in promoting the objects of the Society during the past year.

The Society then adjourned to a soirée, at which nearly 300 persons were present.

TRANSACTIONS.

On some DIATOMACEÆ *that are found in* NOCTILUCA MILIARIS, *and the best means of obtaining them.* By Colonel W. H. C. BADDELEY. Communicated by Mr. F. C. S. ROPER, F.L.S., &c.

(Read April 20th, 1858.)

WHILE engaged in endeavouring to ascertain the mode of reproduction in *Noctiluca miliaris,* I remarked in all fresh specimens of this creature a mass of dark matter near the nucleus, and on a closer examination found it consisted chiefly of Diatomaceæ. This has before been casually noticed by Mr. Brightwell and others; it is therefore mainly for the purpose of inducing others along the coast to examine these creatures for the sake of the Diatoms they contain, that I send the method I employ to capture them, and some of its results.

The Diatoms lie in the so-called vacuoles, which the creature appears to have the power of moving by means of the threads to which they are attached. By this arrangement the vacuoles are brought towards the apparently slit-like opening of the mouth to receive the food, and are afterwards drawn back again into various portions of the body. Having ascertained of what this food consisted, it occurred to me that here was an easy method of obtaining different marine species of Diatoms, and I at once tried to ascertain the best means of securing a good supply of these interesting little animals. I adopt the following plan:

Attach a fine muslin net to the end of a light pole, and proceed to some spot where the Noctilucæ are likely to be driven.

A breakwater which causes an eddy to collect Medusæ, &c., generally yields a good harvest.

Skim the surface, and wash the net repeatedly in a can of salt water; at night, these creatures are easily seen by their luminosity; by day, if plentiful, they cover the surface of the sea in brownish streaks.

Having secured what is required, return home, and pour the water into a white hand-basin, allowing it to stand an hour or two. This rough treatment causes these creatures to disgorge their food, and if, after an interval, the water be carefully poured off, a sediment will be found at the bottom, which will consist of Diatoms mixed with some refuse.

A portion of this can be examined in this state; another portion, after being well washed in fresh water; and the remainder treated with acid as usual.

The result of the examination of the first will probably show many species of Diatomaceæ in their natural state, often alive, and with the Endochrome perfect. It is by this method that I have found several rarer species in their normal condition.

The best winds in which to capture these creatures appear to be those from south to west—during their prevalence I have taken Noctilucæ every month of the year on the east coast of England; but it is during the summer months that they are most abundant, and during calm weather.

Abroad, they are constantly to be met with in warm latitudes; and I feel confident some interesting results might be obtained by securing this creature in various parts of the world.

I now beg to mention some of the species I have found by the above-mentioned means:

Coscinodiscus radiatus.
,, concinnus.
,, eccentricus.
Eupodiscus argus.
,, subtilis.
,, crassus.
,, radiatus.
,, tesselatus.*
Actinocyclus undulatus.
Triceratium favus.
,, undulatum (and varieties).
,, alternans.
,, malleus.
,, striolatum.
,, newspecies, not named.
Campylodiscus costatus.
,, cribrosus.
Surirella fastuosa.
,, gemma.
Amphiprora didyma (and another species, not certain).
Navicula palpebralis.
,, elegans (and some others).
Pinnularia distans.

Stauroneis pulchella.
Doryphora amphiceros.
Tryblionella punctata.
Striatella unipunctata.
Pleurosigma elongatum.
,, rigidum.
,, formosum.
,, fasciola.
,, balticum (and several others).
Two or three Asterionella.
Rhizosolenia styliformis.
,, setigera.
Biddulphia rhombus.
,, aurita.
,, Baileyii.
Amphititras antediluviana.
Bacillaria paradoxa.
Eucampia zodiacus.
Grammatophora serpentina.
Several species of Melosira.
,, Podosira.
,, Orthosira.
Chætoceras (?), (also several others, of whose true name I am uncertain).

The above-mentioned species, however, will give some idea of the nature of the gatherings to be expected.

* I am endeavouring to ascertain to what species the several discoid forms attached to each other by stipes belong, and which are found in these gatherings.

On MICROSCOPIC OBJECTS *collected in* INDIA, *&c.* By G. C. WALLICH, M.D.

(Read April 20th, 1858.)

WHILST availing myself of the opportunity so politely afforded me, to lay before you this evening the general outline of a microscopic collection recently brought home by me from India, I feel that some apology is due for the unsystematic manner in which I am compelled to submit my observations and drawings to your notice. You will grant me your indulgence, however, I feel assured, when I state that I came up to town a few days ago, without the remotest idea that you would honour me with your attention on the present occasion.

I would beg you, therefore, to view my communication and figures as mere rough notes, the valuable portion of which has yet to be eliminated; and I would further ask you to bear in mind that my collection has been made under numerous difficulties, either whilst rapidly marching through the Bengal Presidency, or on shipboard, in the absence of libraries or museums to consult, and what is still more disheartening, in the absence of even one fellow-labourer, with whom to compare notes or interchange ideas.

In the Bombay and Madras Presidencies, I am aware that the subject of Microscopic Natural History has been sedulously cultivated by a few, and with highly valuable results. But in Bengal, I fear, little or nothing has been done, notwithstanding the widely extended and varied field that there presents itself for researches of this kind. This is the more to be regretted, inasmuch as few portions of the globe, in all probability, hold out greater facilities for the study of all microscopic organisms; and both as regards temperature, moisture, rich soil and abundant water, Bengal offers especial opportunities for the investigation of their progressive development and "Life History."

You will hardly be astonished, however, when I state that encouragement towards this department of science has hitherto virtually been withheld, on the principle that all kinds of research, to be of value, must exhibit *primâ facie* evidence of being likely to pay. The question is therefore not unfrequently asked, what substantive benefit can possibly accrue from investigations into the minute world?—a question, I humbly submit, absurd enough to rouse the bile of the most stolid microscopist under the sun.

But these drawbacks, gentlemen—disheartening as they are to some extent—possess their compensating advantages, for whilst they act in the light of a Microscopic Game Law, they enhance the delight with which the adventurous trespasser revels in so boundless and untrodden a field. He finds himself peering into a new world, beautiful and rich as his own, and he comforts himself with the conviction that, however little encouragement and sympathy may be accorded him on the other side the ocean, the deficiency is amply made up for on this.

As far as quantity goes, therefore, I have every reason to be satisfied with my fortune. But, gentlemen, I am painfully alive to the fact that scanty credit is due to the mere collector—to him who, having the opportunity thrust upon him, as it were, simply stretches forth his hand, accumulates material, multiplies species, often beyond all due limits, and winds up by an extensive contribution to the cacophonies of nomenclature—whilst legitimate reputation can only follow on the far more laborious and far more difficult task of working out, step by step, the physiological development and true relations of the structures that present themselves.

It is not therefore without considerable diffidence that I submit to the Society, in their present crude and unsystematised condition, the drawings and notes before you.

With regard to the probable number of new forms that have fallen under my observation, I feel it would be rash, as yet, to hazard even an approximate estimate; for, difficult as is the identification, in many instances, of the varieties of the best understood species, that difficulty becomes materially heightened when the diversified forms of less definite or unknown species exhibit themselves, under the influences of extremely rapid and luxuriant tropical growth.

I would observe that nearly the whole of the Desmidiaceæ figured by me, were gathered in two or three months, during the Santal rebellion, within a circumscribed district about 120 miles above Calcutta. It is easy to conceive, therefore, how amply the more general survey of Lower Bengal would repay the inquirer, who, having leisure and perseverance at command, simply enforced the will.

Again, the chief portion of the strictly Indian Diatomaceæ was derived from the Sunderbunds or Delta of the Ganges, a locality from which we might naturally anticipate highly interesting gatherings. But, beyond the tidal influences, the Diatomaceous forms of Bengal are peculiarly general. Indeed, along the entire Gangetic valley, they may be said to be so—a circumstance in all probability resulting from the extensive character of the annual inundation, which, sweeping across river and plain, converts the entire surface of the country, at times, into a vast inland sea, and of course favours the distribution of each minute organism throughout the entire range of its occurrence.

During the rains also, as the mountains contribute largely to these inundations, it is not to be wondered at that forms detected in the hill lakes and rivulets gradually find their way down into the plains below, and by degrees become acclimatized there. Indeed few species occur in the mountain lakes, such as those about Nynee Tal and Almorah, that are not also to be found in the plains. But it is remarkable that one well-defined species, which occurs somewhat sparingly in the lakes referred to, is completely lost sight of throughout the entire length of the Gangetic Valley, and reappears, strangely enough, in profusion amidst the brackish channels of the Sunderbunds, at a distance of 1200 miles.

Another species, well known in this country, and, if I apprehend aright, frequenting only brackish water, is not only common to the plains of Bengal, but presents itself in the same mountain lakes, and also in the primæval wilderness of the Delta.

I mention this fact to show under what widely differing circumstances species may exist, and still retain their specific characters unimpaired; and that the mere fact of a peculiar habitat *may* not, after all, be so useful in determining species as has by some observers been laid down.

My marine gatherings, I would mention, were made during the voyage round the Cape, in a sailing ship, under peculiarly favorable circumstances to the microscopist, though not so to the navigator; inasmuch as frequent calms, both in the Bay of Bengal, Indian Ocean, on the Lagalkas Bank to the southward of the Cape, at St. Helena, and off the Western Isles, afforded constant opportunities for using the casting net, towing net, or dredge, as the case might be.

Of course, from the open sea, the purely microscopic forms, with a few exceptions, could only be obtained by having recourse to the floating living creatures of various kinds that abound on the surface, under certain circumstances, in almost every latitude. It was only when going rapidly through the water, that is beyond five or six knots an hour, that it became difficult or impossible to seize upon some of these creatures. In the heaviest gales, off the Cape, so long as the wind was ahead, some one or other of these would present itself in the net, and rarely were their stomachs barren. But the question, gentlemen, I presume, is not from what source may we derive material, but from what can we not do so, when even the lazy turtles we caught napping in a calm, mid sea in the Indian Ocean, needed only to have their backs scratched to afford the desired Diatomaceous contribution.

The Salpæ, however, were the most prolific, and generally the most abundant, and from their tiny stomachs it was easy to extract a number of novel and most interesting species, including Diatomaceæ, Polycystinæ, and Foraminifera. When of the smallest, they could still be rendered available, for what was deficient in size was made up for in number, and my nets would frequently come up filled with their multitudinous bodies. In this case it was only necessary to crush or rather strain the mass through the material (crinoline by the way) of which the bag was composed, collect the heavier deposit, and treat it in the customary method. Sometimes the Salpæ were from six to ten inches in length, with a digestive apparatus as large as a large marble, and from these a rich harvest was afforded.

During the calms alluded to, I was enabled to observe that, extending for many degrees in the Bay of Bengal and Indian Ocean, the surface of the sea, to a considerable depth, absolutely swarmed with delicate yellow flocculent masses of the genus described by Mr. Brightwell, in the Society's 'Transactions', under Ehrenberg's name of Rhizosolenia. Indeed, I believe I was the first to point out to Mr. Brightwell its filamentous character, and the appearance of its flocculent masses. Near the Equator this organism was accompanied by a Coscinodiscus, the cylinders of which were so large as to be easily distinguishable with the unaided eye from the upper stern ports, whensoever the sun poured down his rays into the clear blue abyss below.

Nor was the Rhizosolenia confined to the eastern side of Africa. To the south of the Cape, and up the Atlantic as far as the Western Islands, it occurred frequently, but only in the Salpæ stomachs—a fact that goes far to show that many minute forms escape observation solely from the tempestuous nature of certain seas; whilst, although not more abundant, in the tranquil latitude of the tropics, or within land-locked seas, they rise towards the surface, and more readily exhibit themselves.

There are certain mysterious influences, atmospheric probably, apart from the broad distinctions of calm or tempest, which regulate the appearance or disappearance of many of the minute animal organisms from the surface, sometimes at a moment's notice; and I cite the circumstance in order to warn others, who may perchance "go down into the sea in ships," never to lose an opportunity of capturing any creatures that present themselves, however abundant they may appear to be, for whilst one cast of the net may contain a myriad, the next may be drawn blank and unfruitful.

In conclusion I would observe that it is my intention to work out as far as possible the Diatomaceæ and Desmidiaceæ at my command. The other families I shall not venture to approach; but any specimens, drawings, or information it is in my power to supply to those gentlemen who direct their labours towards them, I can only say shall be most cheerfully placed at their disposal.

Note on CAMPYLODISCUS HODGSONII. By G. A. WALKER-ARNOTT, LL.D. Communicated by Mr. F. C. S. ROPER, F.L.S. &c.

(Read April 20th, 1858.)

"ON examining with some attention your slide of *Campylodiscus Hodgsonii* from Lyme Regis, and comparing it with others in my possession, I find—

"1. That your specimen is the same as what I have from the River Orwell, contained in a slide from Professor Smith, named *C. Hodgsonii*, and marked, Collected by J. Hodgson, Esq., August, 1850."

"2. That it is the same as one I have from Carrickfergus.

"3. That it is the same as two frustules I have found in a gathering from Ipswich, obtained several years ago by the late Mr. Wigham, of Norwich.

"4. That it is the same as one frustule (one of four marked ones) contained in a slide from Poole Bay, of September, 1852, from the late Professor Smith.

"5. That it is the same as the *C. eximius* of Dr. Gregory. All these agree with the large state of the species, fig. 53, of Smith's 1st volume.

"I also find that the small state of *C. Hodgsonii* is not well represented in Professor Smith's book, fig. 53 A, there being no moniliform lines, but canaliculi on the central part or disk. This small state I find (from one to three frustules in every slide) in my Ipswich preparation. Three out of the four marked *C. Hodgsonii,* in Smith's slide from Poole Bay, belong to it. I have seen it also from Arran, and various other parts, so that it is much more common than the large kind, if it can be so called.

"In the large one there are no canaliculi on the disk or central portion, and the granular striæ are often very obscure, particularly after long boiling in acid. Smith's figure shows that they are placed in lines, but this arrangement is often so unsatisfactory in most specimens as to leave a justifiable doubt on Dr. Gregory's mind, if his *C. eximius* could be the same. The small one has the median line (?) sharp; it is scarcely a line, but a strong plica or keel; the canaliculi pass on almost to the middle line, being scarcely fainter on the disk than those of the margin, with which they are continuous and isometrical. The apparent separation between the disk and the margin is caused by a flexure or keel. If we were to suppose *C. Ralfsii* to have a flexure of this kind (to which there is an approach in figs. 52 and 53 of Dr. Gregory's Clyde forms), this small one would through it be more allied to *C. Ralfsii* than to the large *C. Hodgsonii.*

"It thus appears that the *C. eximius,* Greg., is the same as the large *C. Hodgsonii* of Smith, and the small *C. Hodgsonii* cannot be the same species. The large *C. Hodgsonii* is scarcely known, at least by that name; that which is usually so called (and which was probably alone known to Dr. Gregory) is the small one. If Mr. Hodgson had found both, it might suffice to give his name to the small one, and call the large one *C. eximius;* but if he did not find the small one, there would be an absurdity in giving his name to the species not collected by him, in which case this last might be called *C. Smithii.*"

The foregoing extract from a letter received from Professor Walker-Arnott, he has permitted us to bring before this Society. In his conclusion, as to the identity of the large *C. Hodgsonii,* Smith, and the *C. eximius* of Dr. Gregory, I entirely concur. I have specimens of the *C. Hodgsonii* from the River Cleddau, South Wales, from Lyme Regis, Weymouth, and Milford Haven, and find the markings in the central part of the valve in all states, from the distinct moniliform radiant lines, described and figured by Professor Smith, to the faint and irregularly scattered granules, characteristic of *C. eximius,* and in some specimens hardly any discernible at all, with any object glass or variety of illumination. These variations also are not dependent on locality, as they occur in the same gathering, and I think therefore they afford no sufficient grounds for separating two forms that agree so exactly in all their other characters. The smaller form alluded to by Dr. Arnott appears to have been considered a young state of *C. Hodgsonii* by Professor Smith; but as in addition to the difference of structure already alluded to, I never remember to have seen any valves of an intermediate size, that could serve as connecting lines between them, and though both may be considered among our rarer British species, the smaller one is by far the most abundant, I am inclined to concur in the propriety of giving it a distinct specific name.

On the DIATOMACEÆ *of South Wales.*

By FITZMAURICE OKEDEN, C.E.

(Read June 16th, 1858.)

HAVING read the remarks made in his address by our late president as to the paucity of slides contributed to the cabinet of the Society, I must confess that I feel the justice of them, and the more so as, if I mistake not, the subject has been alluded to by a former president in his address. I have, therefore, ventured to come forward to assist in removing that reproach which our late president considered as resting upon the members from the smallness of their contributions.

During the last five years, while resident at Haverfordwest, in Pembrokeshire, I have employed my leisure hours in studying the Diatomaceæ of the country.

The town itself is situated on the banks of a tidal river, overlooking extensive salt marshes, which are frequently overflowed by spring-tides, and abounding in shallow pools and ditches; not far from it are some large and quiet fish ponds. A few miles to the north, at a place called Churchland, is a large tract of boggy land, at the foot of a mountainous district; mill-streams, over-falls, and weirs, so favorable to Diatomaceous growth, abound in the neighbourhood; while near to Carmarthen is a vast and extensive morass, intersected by ditches, and excavated into pools by the turf-cutters. And lastly, there are the shores of Milford Haven, and the extensive mud-banks of the tidal estuary of Neyland, which latter I have penetrated by boring to a depth of twenty, thirty, and forty feet, and succeeded in obtaining many interesting species at these depths.

The result of a five-years exploration of all these localities has been the collection of upwards of fifty genera, including above two hundred and thirty species, many of which are either new or interesting varieties of known species, which, from having such an *embarras des richesses,* I have been able to collect a tolerable number of the more known species in a very fair state of purity.

With a very few exceptions, the whole of these genera and species are contained in the accompanying slides which I have now the honour of laying before you, and which I beg the Society to accept, if they think them worth adding to their cabinet. The cabinet in which they are contained is one I designed some time ago for the purposes of travelling, and which I have found extremely convenient, as it holds a large number of slides (228) in a small compass, and requires no packing; the mere shutting of it up keeps every slide in place, while, from their arrangement, every label can be read, and each slide easily got at. Its economy is no small recommendation, the cost being only fifteen shillings.

Accompanying it, I beg to hand in two documents; one is a catalogue of the slides and their contents, the slides being numbered to correspond; the other is an alphabetical catalogue of the genera and species; and opposite each species is the number of the slide in which it is to be found. Where the same species occurs in more than one slide, the best sample of it is shown by underlining the number of the slide in which it occurs.

Where I have thought it necessary, I have mounted a slide dry as well as in balsam; and most of the filamentous species I have mounted so as to show them in their natural state, unboiled in acid. This has been done by burning out the endochrome of the living plant, and then mounting in balsam in the usual way. This will be found a very good plan for these species, and I would cite Nos. 66, 42, 62, and 89, as a sample.

In order to render the habitats more distinct, labels of different colours are used, thus:

Fresh-water . . .	White.
Brackish	Dark yellow.
Marine	Light yellow.
Clay-borings* . . .	Pink.

Of course I am not going to weary you by a recapitulation of the whole of the genera and species in the catalogue, but I would wish to call your attention to a few of those which are of the most interest, as being either new—I mean

* Clay-borings are numbered separately.

genuinely new, and admitted as such into the standard works on the subject—or as being interesting varieties of the more known species; and also to the doubtful forms, the position of which has yet to be determined. Taking them therefore in the order in which the numbers of the slides run, they are as follows:

No. 9. I give this as containing a curiously distorted form of *Surirella biseriata,* having a central construction; this does not appear to me a common variety, as I have only once met with it.

No. 10. I give as being my original gathering of *Surirella apiculata,* first pointed out by me to the late Professor Smith in April, 1854. I have never found it since, and I am inclined to agree with him when he terms it "a close ally, if not a variety, of *S. angusta.*" (Page 88, vol. ii, 'Synopsis'.)

Nos. 19 and 19 *a.* This is my original gathering of that curious species *Orthosira mirabilis,* and was first obtained by me at Haverfordwest, in April, 1855. In the April of 1857, I made a second and more copious gathering from the same spot; this will be found in No. 129. It has since been found by Mr. Ralfs and others, in the interstices of the barks of various trees. The Navicula in these gatherings I at first referred to *N. tumida,* but was corrected by the late Professor Smith, who pronounced it to be *N. pusilla,* and in this he is also supported by my kind friend and correspondent Dr. Walker-Arnott, I must, therefore, bow to such authority and name it as *N. pusilla,* but then the characteristic of "brackish" must for the future be omitted in giving the habitat of this species in any specific description, as the locality where this gathering was made was purely a fresh-water one, and totally free from marine or brackish influence.

Nos. 29 and 59. In these two slides will be found a Pinnularia with somewhat constricted ends, which I consider as a variety *P. radiosa.* I see nothing to warrant the erection of them into a new species; I therefore merely point them out as an interesting variety of the above. A reference to the catalogue of the slides will, however, show that the two gatherings are from two widely different localities; thus we may assume that the variety is a well marked one.

No. 35. I merely point this gathering out as being interesting from consisting of *Synedra radians* in a state of congregation, as shown in plate B, vol. 2, of 'Synopsis'; of course the boiling in acid has destroyed the gelatinous envelope, but the bundles still remain perfect.

Nos. 49, 50, 51, 52, and 53. I give these as affording excellent samples of *Navicula firma,* and its varieties. First in Nos. 50 and 51, we find the true *N. firma,* with the valve truly "elliptical, and slightly attenuated towards the rounded extremities;" next, in No. 53, we have the variety β, with the ends "suddenly attenuated;" next, in No. 49, we have the variety γ (page 90, vol. ii, 'Synopsis'), with the ends "curvate," a much larger form than any of the preceding, and with coarser; and lastly, in No. 52, we shall find (if carefully looked for) an intermediate variety between β and γ, namely, one in which the ends are slightly constricted, while the very apices of those ends are cuneate. I may add also, that No. 49 abounds in fine specimens of *Surirella biseriata,* while in No. 53 will be found, though rare, good specimens of Dr. Gregory's *Surirella tenera—S. linearis* of the 'Synopsis'.

No. 67. I give this slide as containing a curious variety of *Diatoma elongatum,* for I can refer it to no other species. I allude to the small form in the slide, the side view of which shows a central inflation; in fact, in outline it much resembles the S.V. of *Navicula inflata,* for which it might be mistaken, did not a careful examination of the slide show the frustules, growing in the zigzag chains, characteristic of the genus Diatoma. I have marked one of these chains with an ink ring, to facilitate the examination of any member interested in the matter. I give this doubtfully as a variety of the above species (*D. elongatum*), for in many respects it must be confessed, it widely differs from the specific description of that species in the 'Synopsis', (see vol. ii, page 40.) The description there given says "Valve linear extremities slightly inflated;" and again, at page 41, in describing the difference between *D. grande* and *D. elongatum,* the author says, "In *D. elongatum* the extremities in the mature valve are absolutely wider than any other portion of the valve." But in the Diatoma under consideration, it is the centre which is inflated and wider than any other portion of the valve. Still I see not sufficient grounds at present for erecting it into a new species, and I therefore leave it for future observers as a (?) variety of *D. elongatum.*

No. 69. I merely draw attention to this as being a fine gathering of *Nitzschia plana,* by no means a common species; *Tryblionella scutellum* also occurs here, though rarely.

No. 85. I would draw attention to this as being a fine gathering of that rare Diatom, *Nitzschia scalaris.* Up to the present time I am not aware of any other habitats for it except Poole Harbour (the original one), and the Haverfordwest Salt Marshes, in which this gathering was made in 1856. Allusion is made to it by the late Professor Smith, in his paper on the Pyrenean Diatoms, in the 'Magazine of Natural History,' for January, 1857.

No. 92. In this gathering will be found rather plentifully a minute oval form, with median line, which I give doubtfully as (?) *Achnanthidium lineare.* The side views are the most abundant, but a careful examination of the slide will detect the F. views, which exhibit decidedly the geniculate character of the genus. As the present gathering has never been treated with acid, *does* not exhibit stripes, and *did* not do so even when fresh gathered, I place the form in question with the genus *Achnanthidium.* I refer it *doubtfully* to *A. lineare,* because a careful examination will show that it does not entirely agree with the specific description of that specie in the 'Synopsis,' and thus I leave it for other observers.

Nos. 99 and 99*a*. In this gathering will be seen somewhat plentifully a small, elliptical, lanceolate form, with an apparent stauros, but the application of a sufficiently high power will show that there is no true stauros, and that the striæ extend over the whole surface of the valve. It is the *Stauroneis dubia* of Dr. Gregory, and is allied to his *Stauroneis rectangularis* (now *Navicula lævissima* of the 'Synopsis,' vol. ii, p. 91). For the reasons above stated, however, its removal from that genus becomes imperative, and it must follow his *Stauroneis rectangularis* into the genus Navicula. Adopting the suggestion of my friend Dr. Arnott, I propose to name it *Navicular decipiens*.

No. 102. In addition to the *Nitzschia Closterium* in this gathering, will be found a small form which I refer doubtfully to the frustules of a Schizonema. The valve is laurestale, acute on side view, and linear on F. view. When gathered fresh, the frustules were certainly free; yet a peculiar arrangement of them, in which they appear to be congregated into something approaching to a filamentous state, leads me to suppose them to be the produce of a Schizonema, either broken loose or preparing to throw off the mucus which is to form their envelope.

Nos. 104 and 104*a*. In this gathering will be seen two Synedræ, one an extremely long form, with rather coarse striæ, which I refer to *Synedræ longissima;* the other, a shorter and more slender form, with more delicate striæ, I am inclined to refer to *S. radians*, var. γ. A better and purer gathering of the *S. longissima* will be found in No. 146, from Tenby; I think it cannot for a moment be confounded with *S. radians.*

Nos. 107 and 107*a*. Are worth notice for a curious small form of *Pinnularia interrupta,* which is abundant in them.

No. 109. I give this as the true *Cocconema parvum,* not a common species. When first gathered, the stipes were quite distinct.

No. 114, 114', 114*a*, and 114*b*. I give this as *Homœocladia filiformis*, to which species it most nearly approaches; still it differs from that species in one respect, namely, that whereas in the specific description of *N. filiformis* in the 'Synopsis' we find "fascicles containing three or four frustules," while in this specimen the frustules are closely and densely packed in large numbers. A reference to the slide marked 141[1], which contains the Diatom in its natural state of growth, burnt on the cover so as to show the threads, will explain what I refer to. I have put a ring round a well-marked collection of these threads. Nos. 114*a* and 114*b* contain the Diatom boiled in acid for further examination and comparison, and I feel sure that a careful examination of these slides will convince any one that this species is to be referred to *H. filiformis*, and to none other.

Nos. 120 and 120 *a*. This is the gathering of *Achnanthes parvula*, of Kutzing, to which Dr. Arnott alludes in his paper on Rhabdonema.* I found this interesting species in profusion at Neyland, in the March of 1857. I am not aware that it has ever been found by any one before or since in any British locality. It would be presumption in me to add anything to the description given of it by Dr. Arnott.

No. 121. This gathering is interesting, as containing *Nitzschia linearis* in a state of conjugation. I have marked on the slide several bundles of the Nitzschia, which, when the gathering was freshly made, were to be seen surrounded with a mucous envelope, and exactly similar in appearance to the bundles of *Synedra radians* in No. 35. This, therefore, adds one more to the list (at page x. of the introduction to volume ii, of the 'Synopsis') of those species in which conjugation has been observed.

Nos. 121 *a* and 122. These are interesting, as being gatherings of *Amphora minutissima*, perfectly *free* and *non-parasitical*. A reference to the index to the slides will show how widely apart are the localities of the two gatherings; No. 121 *a* being from Neyland, while No. 122 is from the Vale of Neath, near Swansea. This, I think, goes far to prove that *A. minutissima* is not *naturally* a parasitic Diatom.

No. 123. Is my original gathering of *Surirella Amphioxus*,† first pointed out by me to the late Professor Smith, in 1855. I should be glad to know whether other observers have found it.

* 'Micros. Journal,' Jan. 1858, p. 92.
† 'Synopsis,' vol. ii, p. 88.

No. 130. This is the acute variety of *A. longipes* (*A. brevipes* of Kutzing), also noticed by Dr. Arnott, at p. 92 of the June, 1858, number of 'Microscopical Journal.' I have nothing further to add to his excellent description of it. I merely point it out as interesting to the observer.

No. 140. I must call attention to this splendid gathering of *Epithemia Argus;* at least, to this species I refer it. The very conspicuous foramina on the F. V. would lead one to refer it to *E. ocellata;* but the perfectly linear character of the F. V. precludes it from that species. Perhaps it may become a question at some future time, whether *E. Argus* and *E. ocellata* should not be united.

Nos. 141 and 142. This gathering is from the same spot as the last. Here is the *Navicula scita* of Professor Smith's Pyrenean paper. A careful examination of the slide will show a variety of the above having a central inflation.

This concludes all I have to remark on the gatherings of the living plant. I now pass on to the clay boreings, all of which are numbered separately from the other gatherings.

These slides, twelve in number, consist of samples of clay from tidal deposits at various depths, obtained by a special boreing apparatus. A description of the apparatus and mode of using it, and also of the various clays, is given in a short paper of mine, in volume iii, p. 26, of the 'Microscopical Journal;' I need not, therefore, repeat it here.

Nos. 1, 2, and 3, from brickyard, will be found rich in *Triceratium favus* (especially No. 1). In No. 2 will be found a good specimen of *Triceratium armatum,* first found by me in the Neyland mud. I am not aware whether it has occurred to any one else. And, lastly, in Nos. 1, 2, and 3, will be found also beautiful specimens of Mr. Roper's *Actinocyclus sedenarius.*

No. 4. Again, in No. 4, which is a boreing of the Neyland mud, at twenty feet in depth, will be found some fine side views of that fine Diatom, *Biddulphia turgida,* of which I think I may also claim the first discovery.

Nos. 5 and 6. Are also Neyland mud, but from a depth of thirty feet. These contain fine end views of the *Biddulphia turgida.* In all these slides, viz., Nos. 1, 2, 3, 4, 5, and 6, I have marked with an ink ring all the objects of interest, so as to render the reference to them more easy.

Nos. 7, 8, 9, 10, and 11. Are from clays at various depths of fifteen to twenty-five feet, from the bed of the new docks now excavating at Swansea. These are all very rich in *Epithemia musculus,* while in Nos. 8 and 11 will be found good specimens of *Surirella fastuosa.*

My task is now completed. The slides which I have sent will, I think, afford a very good illustration of the Diatomaceæ of this part of Wales. With one exception, that of No. 146, which was from Tenby, and sent me by my friend Mr. Roper; the whole of the gatherings have been made by myself, and I can therefore vouch for their authenticity.

I trust that the little I have done will prove of interest to some of the members of this Society; at any rate, if it only be the means of inciting others to better and more extensive contributions, I shall feel amply repaid for any trouble I may have taken in the matter.

Description *of a* New "Secondary Stage." By W. Hislop, Esq.

(Read June 16th, 1858.)

The want of some simple and effective means of affixing the various illuminators beneath the stage of the microscope, which shall possess the necessary adjustments for centering and focusing, is felt by every one who makes use of the instrument for purposes beyond those of mere exhibition. Several 'secondary stages' have been constructed, which have more or less answered the requirements of the case, but have also left room for improvement. Most of these arrangements have the disadvantage of weight, an element of inconvenience in the better class of instruments which it is to be hoped has reached its limit. All these various methods, too, require the attachment of the various pieces from the top or bottom, thus increasing the necessary space between the stage and mirror, and risking the derangement of the light, which it is often desirable to retain in precisely the same conditions. In some instruments the adjustments are attached to each piece of apparatus, but this immensely increases the quantity of extraneous mechanism.

The contrivance I have now to submit is one which I have had in use for some months, and which I have found effective and convenient. It possesses the advantage of adaptability to almost every stage; the illuminators can be instantly inserted and removed from the side, and are adjustable in two directions for centering, and vertically to the stage for focusing.

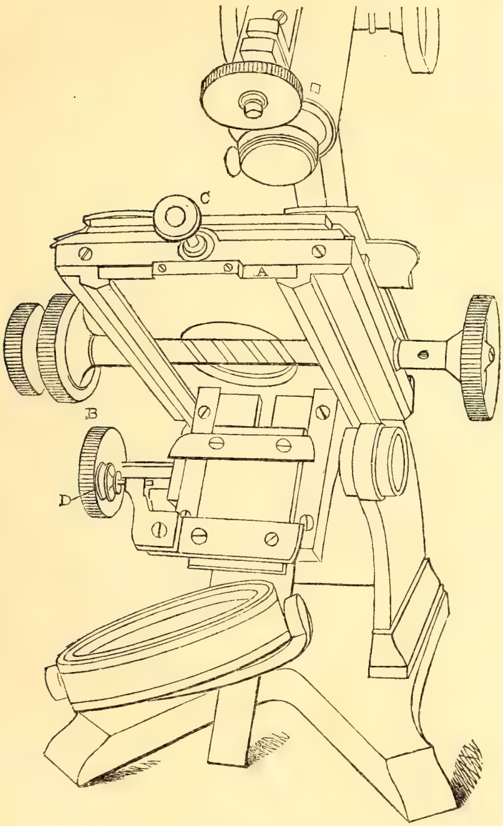


Fig. 1.

Fig. 1 shows the contrivance attached to the instrument, and fig. 2 when separated from it.

It consists of a base plate, A, which slides beneath the stage. A limb is attached at right angles to this plate, which limb is ploughed out for a slide actuated by a rack and pinion, the milled head of which is seen at B. On this slide, and at right angles to "its plane of motion," are affixed a pair of cheeks, between which a smaller slide, carrying the achromatic condenser, Nicol's prism, spotted lens, &c., is inserted. The base plate has an adjusting screw at C, which centres in one direction by bearing against the stage; and at

D is a second adjusting screw, which bears against the slide carrying the illuminating media, and thus gives a second centering adjustment at right angles to the first.

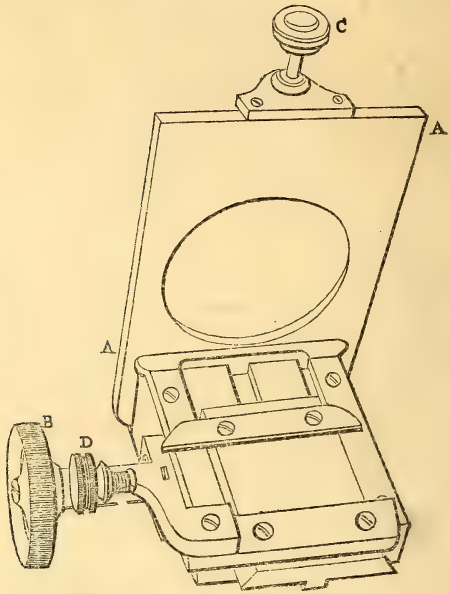
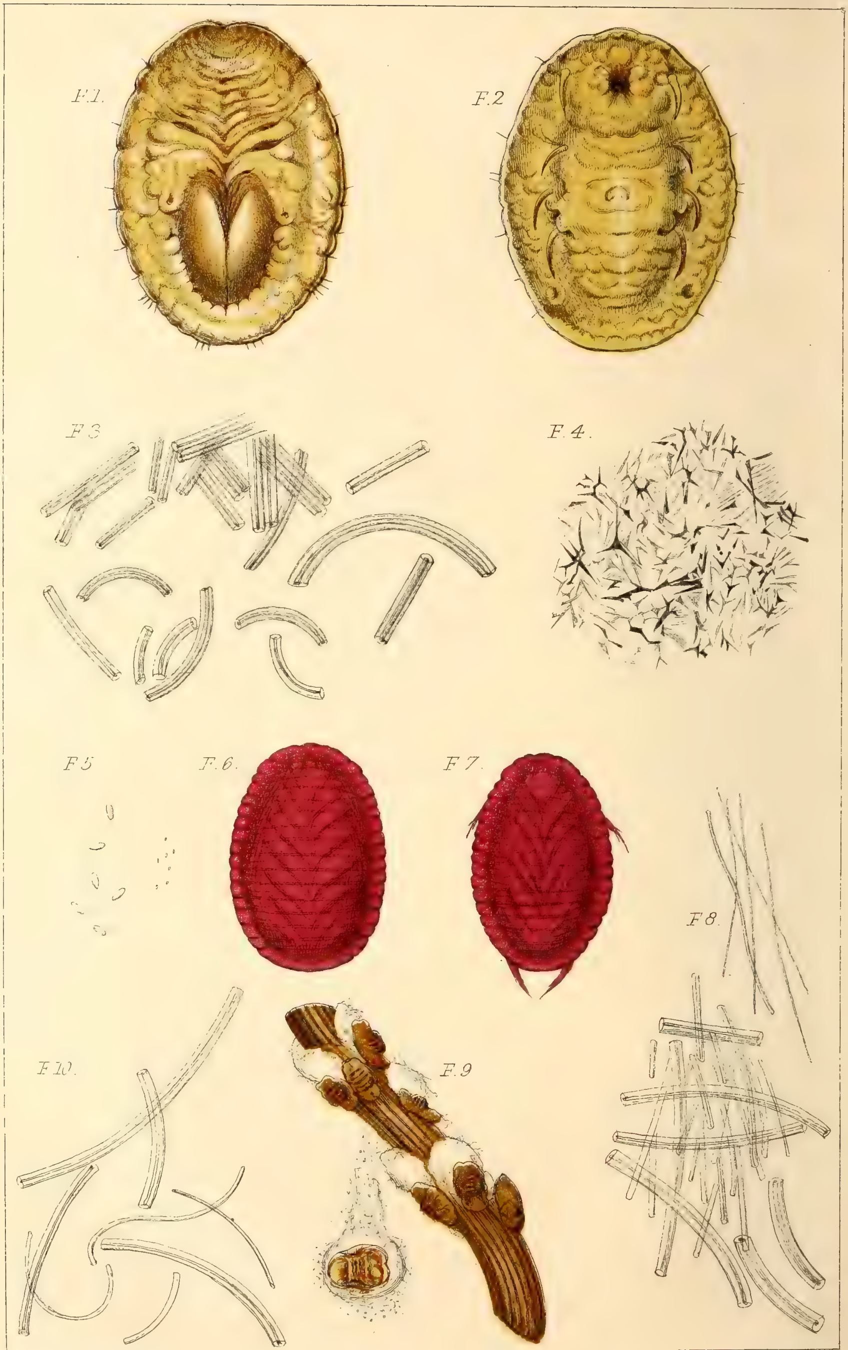


Fig. 2.



Lens Aldous del. Tuffen West sc W West imp.

DESCRIPTION OF PLATE I,

Illustrating Mr. Quekett's paper on the White Filamentous Substance surrounding the so-called Mealy Bug of the Vine.

Fig.

1.—Back of *Coccus Sinensis.*

2.—Under part of *Coccus Sinensis.*

3.—Waxy secretion, × 450 diameters.

4.—Wax crystallized after fusion.

5.—Young of the cochineal insect and cocoons.

6.—Back of cochineal insect.

7.—The same, showing the legs.

8.—Wax of cochineal insect.

9.—Mealy bug.

10.—Wax surrounding the mealy bug.

TRANSACTIONS OF MICROSCOPICAL SOCIETY.

DESCRIPTION OF PLATE II,

Illustrating Mr. Blenkins's paper on an Early Human Ovum.

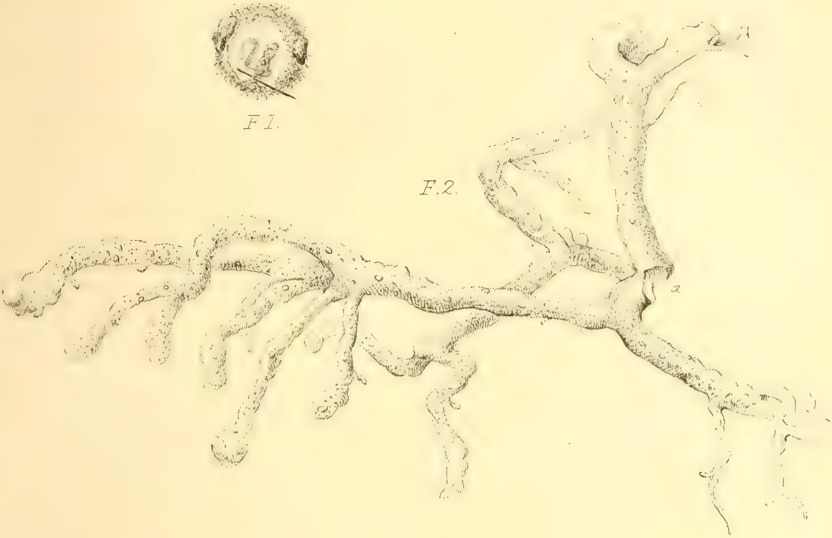
Fig.

1.—Natural size of ovum. The chorion opened and partly removed to expose the embryo.

2.—One of the villi of the chorion, highly magnified, taken from the point where the allantois joins it. At A, it is nearly torn across, and shows its tubular character and the absence of blood-vessels.

3.—Magnified view of fig. 1.

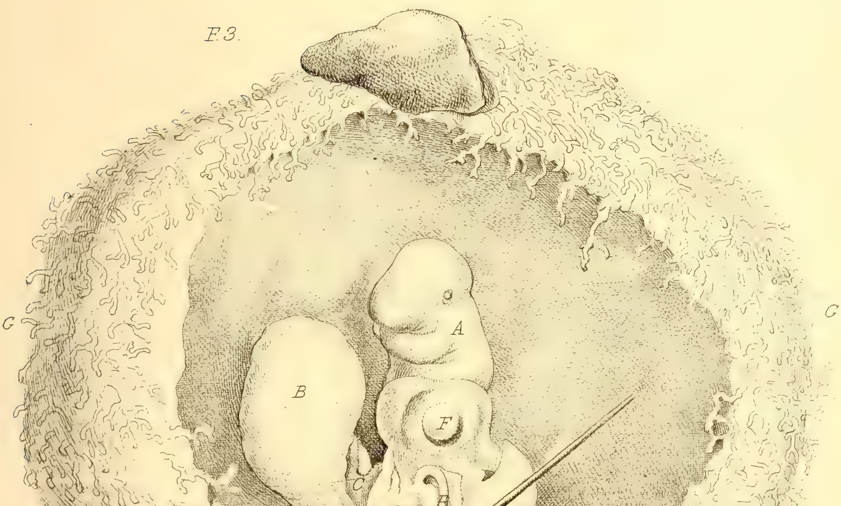
- A. Cephalic extremity, in which the rudimentary eye is distinctly seen.
- B. Umbilical vesicle.
- C. Shows where the vesicle was divided in opening the chorion.
- E. Allantois, with the duct running through it; a bristle is passed beneath.
- E. Intestine communicating with the umbilical vesicle above and with the duct of the allantois below.
- F. Heart.
- G. Chorion, with its numerous branching villi.



F. 1.

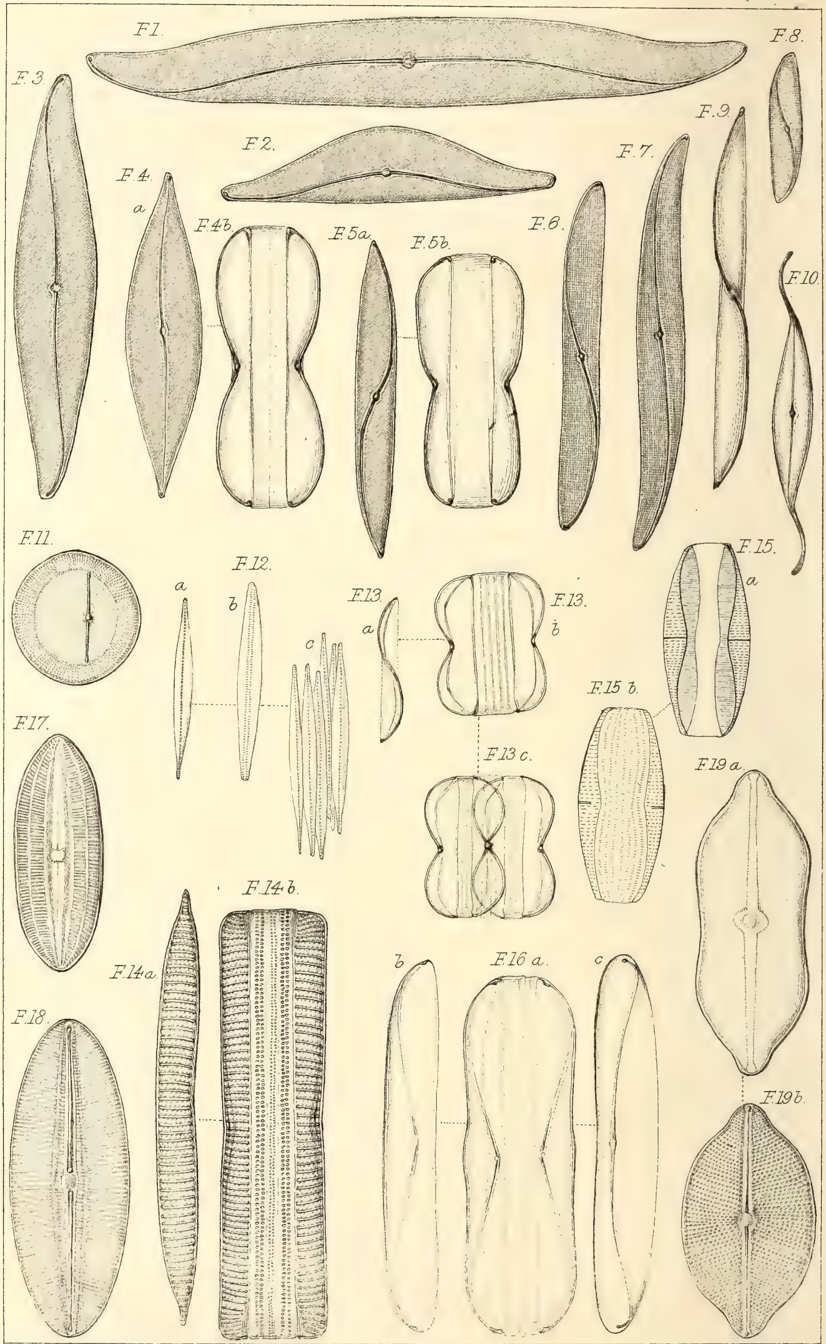
F. 2.

F. 3.



G. E. Blenkins & R. W. Burford del. T. West sc.

W. West imp.



A.S. Durham del. Tuffen West sc. ad specimen

W. West imp.

DESCRIPTION OF PLATE III,

Illustrating Dr. Donkin's paper on the Marine Diatomaceæ of Northumberland.

Fig.
1.—*Toxonidea Gregoriana*, n. sp.
2.— „ *insignis*, n. sp.
3.—*Pleurosigma marinum*, n. sp.
4.— „ *lanceolatum*, n. sp. (*a*, S. V.; *b*, F. V.)
5.— „ *carinatum*, n. sp. (*a*, S. V.; *b*, F. V.)
6.— „ *rectum*, n. sp.
7.— „ *Wansbeckii*, n. sp.
8.— „ *minutum*, n. sp.
9.— „ *angustum*, n. sp.
10.— „ *arcuatum*, n. sp.
11.—*Cocconeis excentrica*, n. sp.
12.—*Bacillaria cursoria*, n. sp. (*a*, F. V.; *b*, frustule undergoing self-division; *c*, a group of frustules.)
13.—*Amphiprora duplex*, n. sp. (*a*, S. V.; *b*, F. V.; *c*, a double frustule.)
14.—*Epithemia marina*, n. sp, (*a*, S. V.; *b*, F. V.)
15.—*Amphora litoralis*, n. sp. (*a*, F. V., ventral surface in focus; *b*, F. V. dorsal surface in focus; both drawn from the same frustule.)
16.— „ *arenaria*, n. sp. (*a*, F. V.; *b*, S. V., outer surface; *c*, the same, inner surface.)
17.—*Navicula lineata*, n. sp.
18.— „ *æstiva*, n. sp.
19.—*a* and *b*. *N. granulata*, Bréb.

Magnified 400 diameters.

DESCRIPTION OF PLATE IV,

Illustrating Mr. Rainey's paper on Artificial Calculi.

Fig.

1.—*a.* Globular carbonate of lime in all states of coalescence.
b. Crystals of triple phosphate becoming globular.
c. Crystals of carbonate of lime becoming globular.

2.—Globular carbonate of lime with triple phosphate (not laminated).

3.—Globular crystals of carbonate of lime with triple phosphate (laminated).

4.—Globular carbonate deposited at the bottom of the bottle after standing twelve months.

5.—Globular carbonate deposited in lines and coalescing as in the prawn's shell.

6.—Porous globules undergoing disintegration in gum-water, after two months.

7.—Prawn shell simply dried and placed in Canada balsam.

8.—Calcifying shell of crab (very early stage).

9.—Calcifying shell of oyster (very early stage).

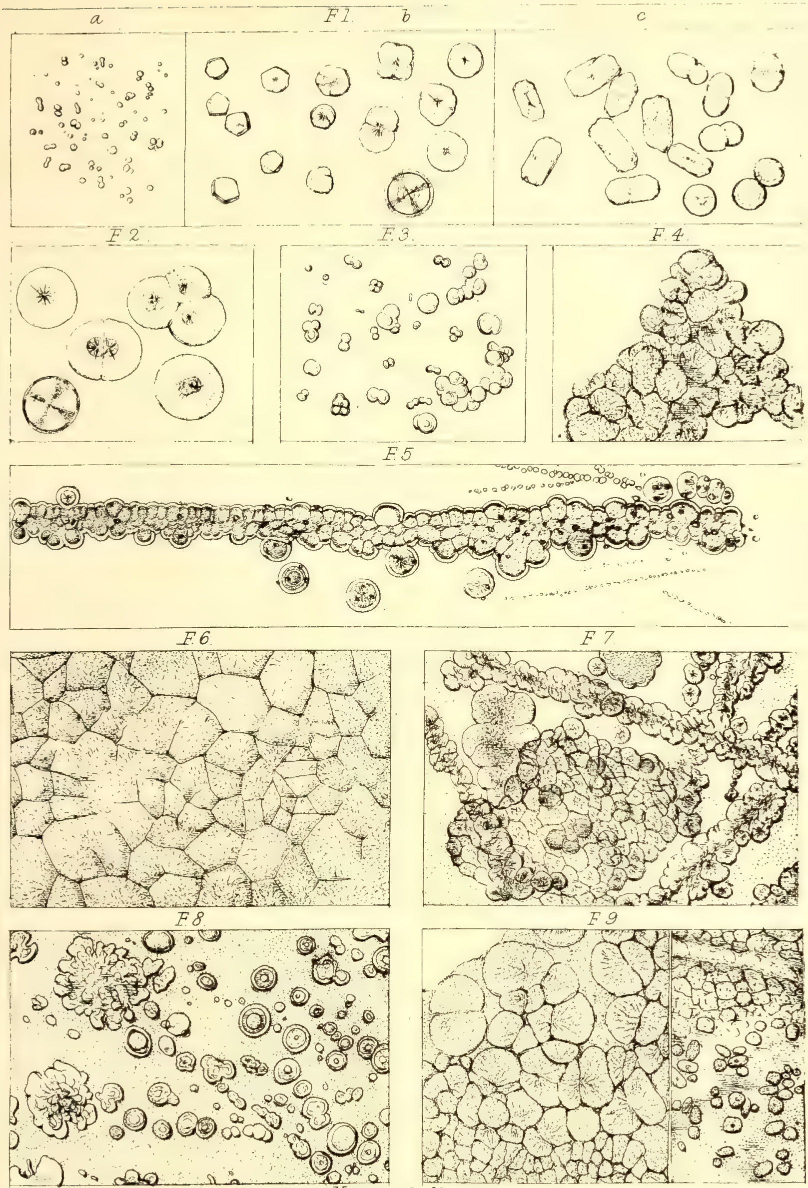
Illustrating Dr. Cobbold's paper on *Actinotrocha*.*

10.—Lateral view of the larva with the epistome partly raised, exposing the mouth.

11.—Posterior aspect showing more particularly the terminations of the incomplete circle of branchial tentacula.

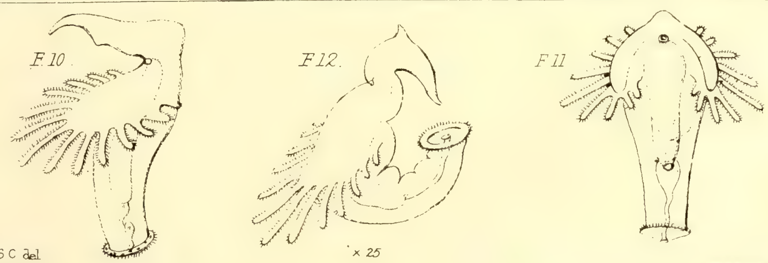
12.—Position frequently assumed by the sudden approximation backwards of the epistome and caudal extremity.

* Figures magnified 40 diameters linear.



T W ad nat.

Magnified 50 diameters

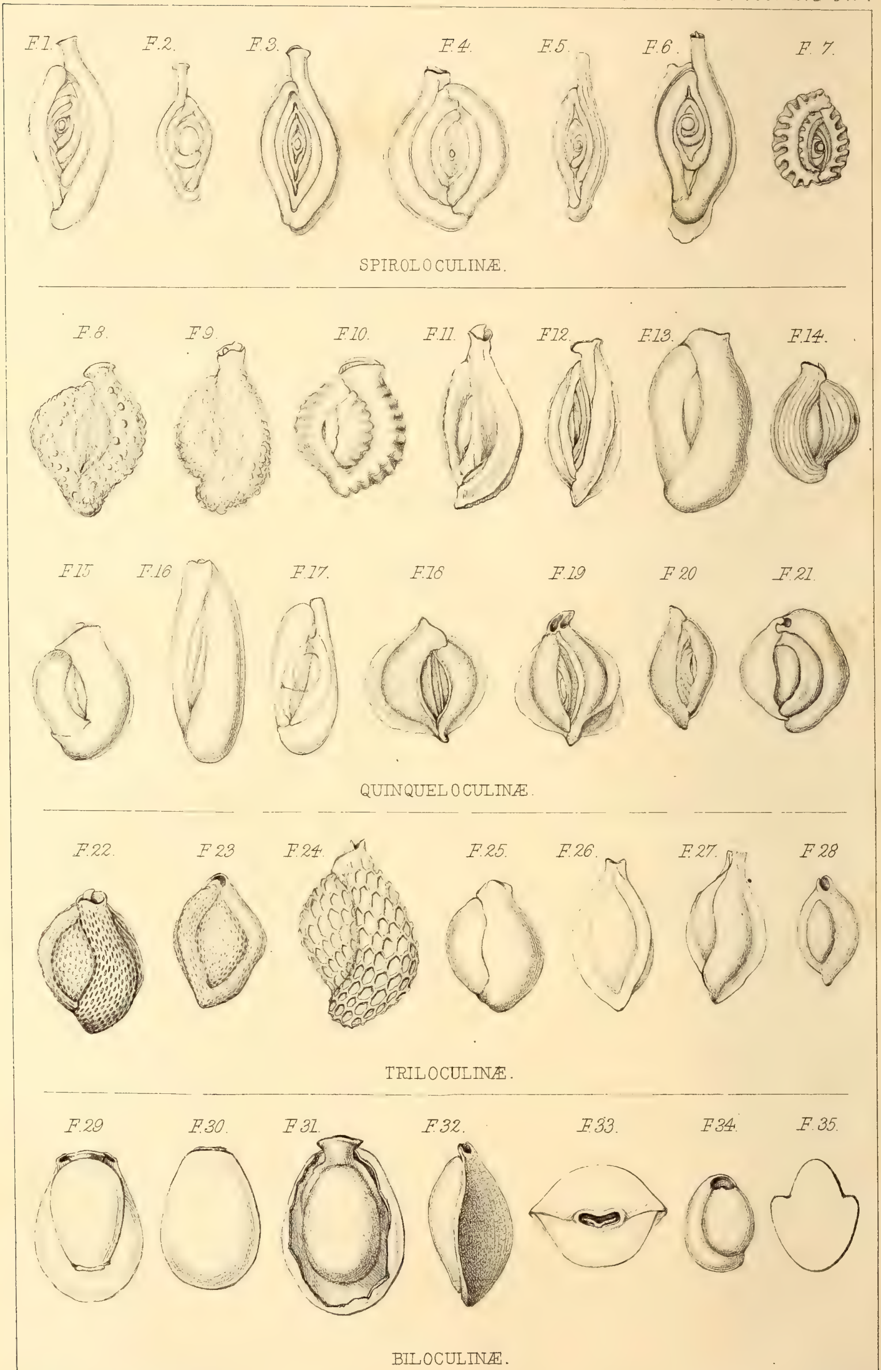


I S C del.

× 25

Tuffen West sc.

W. West imp.



W.K. Parker del. Tuffen West sc. W. West imp.

DESCRIPTION OF PLATE V,

Illustrating Mr. W. R. Parker's paper on East Indian Miliolæ.

Spiroloculinæ.

Fig.
1.—Smooth and sub-cylindrical.
2.—Young of same, more highly magnified.
3.—With square cells and produced edges.
4.—A broader variety of the last.
5.—Sub-cylindrical with riblets.
6.—Flattened variety, with a keel.
7.—Small flat variety, with comb-like cells.

Quinqueloculinæ.

8.—Broad sandy form.
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