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On the Salivary Glands of the Cockroach.

By T. Charters White, M.R.C.S., F.R.M.S., &c.

Read Sept. 25, 1874.

As my communication this evening must be regarded more in the light of an introduction to an interesting object than in that of an elaborated paper, I shall not enter to any great extent into the structure and functions of the various glands met with in the animal frame, but it is necessary to the proper understanding of the salivary glands of the cockroach which I exhibit to-night that I should, for the advantage of those present who may have no technical knowledge of the subject, explain briefly the functions destined to be performed by a gland, and the types upon which the various glands are constructed. The office of a gland is the elimination of certain materials from the blood, which are either stored up for future use in the animal economy, or are cast out as effete and deleterious to the system; we may instance the gastric juice and the saliva, as illustrating the first, and the urine and sweat as examples of the second. That this process may be fully and perfectly carried out, the blood must be brought into close proximity with the agents by which this eliminating process is effected, and an examination of the gland will show the elements whereby this change is produced. We may realise from Dr. Sharpey's description better than from any words of mine, the structural elements concerned in secretion, and therefore with your permission I will quote them. He says—" In the structural adaptations of a secreting apparatus, it is in the first place provided that the blood vessels approach some free surface from which the secretion is poured out. The vessels, however, do not open upon the secreting surface, for the coats as well as the tissues covering them are permeable to liquids; and the most favourable conditions for the discharge of fluid are ensured by the division of the vessels into their finest or capillary branches, and by the arrangement of these capillaries in close order as near as possible to the surface. In this way their coats are reduced to the greatest degree of tenuity and simplicity, and the blood brought into contact with the permeable parietes of its containing channels, as well as effectually and by reason of its slow motion, for a long time exposed to those influences, whether operating from within or without the vessels, which promote transudation."

One of the elements of this process is the extension of the surface over which the blood may be exposed; it may either be spread out like the sweat glands in the skin, or it may be drawn into complicated folds, as in the kidney; but, however accomplished, the blood must be brought into contact with the layer of secreting cells by which the peculiar elements are withdrawn. We have various examples of the types upon which the glands were formed depicted in the diagram taken from Quain and Sharpey's Anatomy, and by it you will see that whatever the form of the gland, the elements entering into it are a layer of capillary blood vessels, a basement membrane, and a layer of secreting cells. The glands may be simple membranes with a plain secreting surface, or they may be pouch-like inflections of that surface, or these pouches may have pouches again on their walls, and so the gland may become sacculated or lobular. Those of you who have read Mr. Lowne's valuable monograph on the anatomy of the Blowfly, will remember his drawing of the salivary glands of that insect, and will readily recognise in it the simple tubular character of the gland, while a reference to the salivary glands of the Cockroach which I exhibit under my microscope, will give you a very good illustration of glands of the compound or lobulated kind. These organs occupy in the Cockroach the same position as the salivary glands of the fly, and are analogous to them in function without a doubt; they are situated in the anterior part of the thorax, and in front of the anterior thoracic ganglion from which they may derive part of their nerve supply; to expose them, it is necessary to remove the segment carrying the first pair of legs, when upon searching amongst the muscular *débris* left by that removal, the glands will readily be found attached to the œsophagus on either side. They are of a twofold character, being made up of two sacs and two compound glands. The salivary sacs are not at first readily distinguishable as sacs, as they are collapsed and not inflated as the air sacs of insects usually are—they appear to be formed of two coats, the external being composed of nucleated membrane, while the internal coat appears to be basement membrane carrying a layer of columnar epithelium. The sacs communicate with the mouth by means of ducts which unite as a common channel as they emerge from the anterior part of the thorax. The ducts bear a general resemblance to the tracheal tubes, but of a larger calibre, a slight constriction being noticeable at the point of their union with the sacs, but nothing resembling the valve pointed out by Mr. Lowne as existing in the salivary duct of the fly exists in the case of the Cockroach. More closely attached to the outside of the œsophagus, and lying between it and the salivary sacs, the glands may be found spread out as a layer; they are exceedingly delicate, and require very tender manipulation to detach them from the œsophagus, which they embrace very closely. Upon a more minute examination, they will be seen made up into a number of lobes, like a bunch of grapes, each lobe being a congeries of cells, attached by fibres of connective tissue to adjoining lobes. Between the cells small passages may be observed which form the beginnings of fine tubes, these, coalescing with others, ultimately join to form the principal duct, which running on by the side of the duct of the salivary sac meets its fellow of the opposite side a short distance anterior to the bifurcation of the two ducts of the salivary sacs, the four ducts there uniting and entering into the formation of a common duct, which eventually opens on the upper surface of the labium. The supply of nerves to these glands has been a point of great difficulty, and I have not made a demonstration of them that I can positively rely on, but I believe that the common duct passes down between the ganglionic cords, and there receives some of the fibres of the anterior ganglion, but you can easily imagine that in a dissection of this kind, where great delicacy of touch and manipulation is required, that many of these fine nervous fibres would of necessity be ruptured and their traces lost.

On Cutting Sections of the Eyes of Insects, and on a New Instrument for that purpose.

By R. Packenham Williams.

(*Read Oct.* 23, 1874.)

The general subject of cutting sections of soft tissues, has been so much before the Club of late, that I fear it may have lost some of the interest properly belonging to so important a branch of practical microscopy. Insect eye-sectioning is, however, a speciality which will I am sure command a special interest; as it is comparatively speaking, a new field of labour for the enthusiastic microscopist, and one in which extraordinary activity has recently been exhibited.

Skilful dissectors have no doubt been able to make out sufficient of the structure of insects' eyes to justify them in presenting the *ideal* sections of those wondrous organs of visions, which are to be met with in the various hand-books for the Microscope. Indeed it must be conceded, that the ideal sections are in advance of those that are real, for, are they not the results of the "Scientific use of the imagination?" and can we not conceive of things as they ought to be, far more easily than we can execute them? I, therefore, think it unlikely that any one has ever seen, or ever will see, a real section as perfect as the ideal one figured on p. 663 of "Carpenter's Hand-book for the Microscope," for the necessities of the case demand that a section to be as perfect must be considerably thinner towards the ganglion, so as to show the filamentous termination of the diaphanous bodies.

Be that as it may, sections of wonderful perfection have been exhibited from time to time in this room; and I, as one of the workers in this field, am encouraged to hope that what little information I have to give, will be regarded in the light of a contribution to our knowledge of a somewhat difficult subject.

I propose treating, in the first place, of the preparation of the head for cutting; in the next place, of the method applicable, whatever instrument may be used for cutting; and finally, of the instrument I have devised for this purpose.

The preparation for cutting is to the last degree important, for, however perfect the cutting instrument may be, if the head be not properly prepared, all attemps at sectioning it will be in vain I have found, after many trials, that alcohol, 60° over proof gives the most uniform results: but previous to putting the insect into spirits I give it a gentle shaking in a phial of Benzine. I do so because, in the subsequent embedding in bees-wax, greasiness would prove fatal to the adhesion of the wax. Now oil dissolves wax, with which it mixes mechanically, but alcohol effects the complete separation of its components, so that alcohol as a hardening medium has here a great advantage, there being an affinity at the temperature necessary to melt the wax, between it and that substance. The head may be allowed to remain in spirits from four to forty-eight hours. I have cut some very good sections after four hours' soaking, while others, after forty-eight hours' preparation, were still soft; again others, after forty-eight hours' soaking were absolutely brittle. This appears to indicate that some condition of which we can only guess the nature, influences the result.

The great difference *inter se* in the composition of the layers of the eye, and the different extent to which they are influenced by alcohol, constitutes to my mind the difficulty of preparation.

I have therefore thought that the best heads on which to operate, would be those of insects just on the point of emergence from the chrysalis or pupa state, as the mass of the head is then more nearly homogeneous, the integuments not having been hardened by exposure.

The head having been hardened, the next step is to imbed it in wax or some other more suitable material, to hold it firmly during the operation of cutting. For this purpose I have used unbleached bees-wax, which I abandoned for a wax of my own preparation; I did so, because I found that the melting point of the wax (142° F.) was dangerously near that at which complete collapse of the head might be expected—if the cornea be at all soft, as in the case of dipterous insects. Some use solid paraffin, which melts at the temperature of 128° F. This is certainly a safer medium, but it is to my mind rather brittle; I therefore sought for some wax which would have a low melting point, and would be at the same time capable of being cut into very thin slices without breaking. Such a wax I at length obtained, by melting together butter of cocoa and bleached bees-wax, adding a little new Canada balsam. Butter of *cacao*, extracted from the seeds of the *Theobroma cacao*, melts, according to Thompson, in his "Chemistry of Organic Bodies," at 122°, and is capable of being rendered almost colourless by agitation in hot water. I could not succeed in doing so with the samples I obtained, which also had very variable melting points; one sample melting at 80°, and another as high as 100°. However, a compound wax with any desired melting point can be readily prepared in the manner just mentioned. That which melts at about 120° can be safely recommended

Let the head be put up in the wax in such a way that the cutting instrument shall be presented at right angles to the chord of the more or less circular segment, which is the figure of the outline of the eye; thus, the plane of the section will pass through the centre of figure of the eye.

By far the most satisfactory section to take, is that cut in a direction to show the structure of both eyes,* as sometimes a feature not observable in the one may be discovered in the other. It may at first sight appear difficult to imagine how this can be the case, and, indeed, it has been questioned if such a section *can* be cut. It will, I am sure, be evident that it can be done, when we reflect, that if a plane passes through a line joining the centres of two contiguous spherical segments, that it must—it would appear almost superfluous to add—be radially presented. If the head, having been put up in the wax, be tilted up a little at the crown, such sections may be removed, when the cutter passes in the direction indicated, *i.e.*, through a line joining the centres of figure for each eye, and only such sections will show the radial arrangement of the vessels, whatever position the head occupies whether cutting for one eye or for both. The razor or cutter being presumably perfect, must be moistened with spirits of

* These sections, in the case of the Blow and House Flies, will show, when well cut, not only the structure of the compound eyes, but also the very curious membrane named by Mr. Lowne, the "Frontal sac," and which is said by him to be an auxiliary organ of special sense—that of the olfactory. It is suspended almost free in the frontal cavity, being attached but slenderly to the integument in front and posteriorly to the central ganglion of the head. (See "The Anatomy of the Blow Fly," pp. 40 and 94.)

turpentine,* and having cut from the edge towards the summit of the segment, and having arrived at that point where we may expect to get the more perfect sections, the operator will find it to his advantage to have a wax with a little lower melting point, and taking up a bead of it on the end of a small steel rod, hold it in a spirit lamp until it melts, then apply it immediately to the exposed cut face of the head. This will have the effect of supporting by a thin film of wax the next offcoming section, and with respect to the cavities of the head, previously unfilled with wax, filling them, and so supporting the head more effectually. A much more delicate adjustment of the setting screw can be made by this means, to the extent of one-third the thickness of those sections unsupported in this way. I have found a small piece of tissue paper dipped in turpentine, gently laid on the face of the section, to answer nearly, if not quite as well, and it has the advantage of rendering the application of any further heat unnecessary. The wax may be removed from the section by heating—*very* gently—in spirits of turpentine, and may be kept in that medium, till it may be convenient to mount them, which is most easily done by arranging on the slip with turpentine, and letting quite new balsam be taken in by capillary attraction, in the usual way.

Let me now direct your attention to the instrument I have devised for the cutting of these delicate sections. It is probable that we are all more or less disposed to look upon our own handiwork with too partial eyes. I have, nevertheless, keenly criticised the theory on which the instrument is constructed. I invite you to do the same, knowing well that the result of your criticism—whether favourable to the machine or otherwise—will be to the advantage of microscopical science. The indispensable conditions of success in soft section cutting, where extreme thinness is desired, are, I apprehend, first, perfect stability of the object—with relation to the cutter's motion; secondly, that the resultant motion, whether of the cutter, the object, or both, *must be positively*

* Some objection having been taken to the use of turpentine as a lubricant, I think it proper to add, that such objections are completely met by the following very simple plan. Place the sections in a small test-tube with turpentine, drain off the turpentine when the wax is dissolved, and substitute absolute alcohol. After allowing it to remain some few minutes, drain again, and add fresh alcohol. It will then be found possible to stain with any of the aqueous solutions. The secret of the success of this operation, is the use of *absolute alcohol;* none other, though considerably overproof, having the desired effect on the turpentine. It is right to add, that it was Mr. McIntire who communicated the fact to me, that absolute alcohol dissolves turpentine.

in one plane. This is the "*sine qua non*" of the operation, which it is the object of the constructors of such instruments to meet in the most effective manner. Now a circular cutter fully meets these requirements—as it can be made perfectly true, can be ground, polished, and sharpened on the points, and in the position which it will permanently occupy, and when made, can be submitted to a rigid test in the following manner.

Let the image of a small fixed object, reflected from the acting part of the disc, which is highly polished, be observed during revolution, at a moderate speed. If it has been worked to a true figure, the image will appear as fixed as the object viewed, directly; if, on the contrary, it be untrue, the extent of the error will be seen at once, in the aberrations of the image.

If a disc be executed so as to stand this test, then, the section of its cutting edge will be represented by a right line; that is to say, its parts will lie evenly between its extremities, and it is only necessary to make the object we desire to section move by mechanical contrivances in a direction parallel (one plane of course coinciding) with the plane of the cutter's motion, to have a theoretically perfect section-cutting machine.

I have sought to accomplish this in the machine before you, by a screw underneath the plate, the circular motion of which is made available by band and pulleys, for revolving the cutter, which revolves in a vertical plane in the same direction as the object is caused to move in, by means of the aforesaid screw. A second sliding apparatus is securely screwed to the first mentioned slide. This second slide is to advance the object for each successive section, and is furnished with a fine screw for that purpose, with 100 threads to the inch. By the milled head and index, a further division of a hundredth of that interval can be effected, so that the finest setting possible, is the $\frac{1}{10000}$, expressed decimally 0·0001 of an inch.

The slide to which the adjusting screw is attached, carries a little block faced with ebonite, on which the head is placed for sectioning. This block is capable of motion round its centre, for the adjustment of the head in any vertical plane, and the frame carrying the cutter being moveable, is set so as just to clear the cutter of the ebonite, which provision also enables us to introduce cutters of larger size. One turn of the traversing screw advances the object through a space equal to $\frac{1}{50}$ of an inch, the cutter having simultaneously revolved three times, being equivalent to a straight draw of three inches for every $\frac{1}{50}$ of an inch; thus, if the head or object be $\frac{1}{10}$ of an inch thick, and a cut be made through it, the cutter will revolve six times, or eighteen inches of cutting edge will have been employed. I would point out, too, another advantage, in the fact that the motions of the object and cutter are correlated, so that if the motion of the object is retarded, or stops altogether, so does also that of the cutter. I have tried the effect of great speed, by means of a multiplying wheel, but was so ill satisfied with the result, as to return with greater confidence to the velocity here adopted; there appears to be a very sensible advantage in a tolerably quick, very steady, and correlated speed. It (the instrument) cuts with a mechanical ease—so to speak—which delights me every time I use it.

A clear idea of the construction of this machine may be obtained, if you conceive of it as being composed of two parts, one having two dove-tail slides urged by screws, at right angles to each other, like the slide rest of a lathe, for carrying the object underneath the cutter, and for adjustment. The other part is a contrivance for transmitting while changing the direction of the motion of its traversing screw to the cutter. It is, you will see, then, not quite so complex as it might at first sight appear to be, and is suitable for cutting any soft tissue. One word with reference to the shape of the cutter. It is of the utmost importance with this cutter, as with any other, that it should be perfectly flat at the extreme edge, even the feather edge thrown up in the process of sharpening, must be removed by attrition with an equally flat surface.

While recommending thus briefly to your notice a machine which has cost me many troublesome, not to say anxious moments, I am vividly conscious that no machine, however delicately perfect, can supply the place of that happy knack of doing things which is such an essential element of success in microscopical manipulation. But there can be no real objection to the proper use of instruments for all that, for I make bold to say, that, although there may be members present who can cut a very presentable section with an ordinary pen-knife sharpened for the purpose, yet, where great delicacy is required, the ordinary means must perforce be superseded by that which promises better results, and is therefore of more delicate construction.

It will be seen that I have drawn no comparison between this instrument, which I propose calling the Quekett Section Cutting Machine (if it finds a place in your favour), and others. All I need say on this point is, that it may fairly be left to the operation of the law of "natural selection," as to which being the weakest shall go to the wall, for doubtless the fittest will survive.

EXPLANATION OF PLATE.—I.

Fig. I.

a. The adjusting screw for regulating the thickness of the sections.
b. The main or traversing screw moving the slides.
c. The cutter.
d. d. d. Guide pulleys for carrying the string to the cutter pulley.
e. Small frame for supporting the object.
x. Cutter frame moveable on its pivots.

Fig. II.

Sectional view of the object-frame.

e. Frame as in figure 1 capable of motion on its pivot horizontally.
f. Brass piece also capable of motion on its pivot (p) and faced with,
g. A piece of cork.
h. The head or object.
c. The cutter.

On the Generative Processes of the Oyster, Mussel, and Cockle.*

By Daniel Moore, M.D.

(*Read* Oct. 23, 1874.)

The three common edible shell fish—the cockle, mussel, and oyster—belong, as you know, to the Lamellibranchiate Mollusca. The general anatomy of this class I do not intend to touch upon, and the special anatomy only in so far as the generative glands of the three I have named is concerned, feeling sure that you must all be more or less familiar with these creatures. I think I cannot do better in introducing the special subject I wish to draw your attention to to-night than by quoting a passage from the second edition of Professor Owen's "Lectures on the Comparative Anatomy and Physiology of the Invertebrate Animals," published in 1855. In p. 522 he says:—"The latest and best observations of naturalists and physiologists on the sexual characters and generation of the Lamellibranchs have established the correctness of Leuwenhoek's original conclusion, that these mollusks are of distinct sexes, some individuals being male and others female. In the small species of *Anomia*, parasitic upon fuci on the south coast of England, I have found the males and females nearly equal in number, the males being distinguished by their opaque white testis abounding in spermatozoa, the females by their yellow or orange-coloured ovarium." I would contrast with this, the statement on the subject found in Professor Rolleston's "Forms of Animal Life," published in 1870, Int. p. xcvii. He says:—"The Lamellibranchiata are, with a few exceptions, such as *Ostrea* and *Cyclas*, diœcious. There is no sexual congress in this class; the spermatozoa find their way to the ova either in the circumam-

* The Publication Committee, in printing the above paper, do not commit themselves to the opinions advanced in it, which are much disputed. At the same time they are desirous of drawing the attention of the members of the Club to what they deem a thoughtful and carefully considered paper upon a subject of great interest to Microscopists.

bient water or in the cavity of the mantle, or in that of the outer gill, or in the cloacal space, or in the few viviparous species, *Kellia*, *Galeomma*, *Montacuta*, within the ovary itself." This evidently indicates a change of opinion among naturalists within the last 20 years with regard to one, at least, of the creatures I wish to draw your attention to. Professor Owen distinctly asserting that the oyster has two sexes, Professor Rolleston, 20 years after, as distinctly stating that the sexes are united in one individual. I have been led by the facts I have observed to think that the cockle and mussel ought also to be classed as having the sexes united in one individual. The plan I adopted in studying the subject was to examine a few of these creatures week by week, knowing that I was more likely to thoroughly master one or two at a time, and thinking that as the breeding season approached I was sure to see individuals exhibiting characteristic phenomena. I was indebted to the great kindness of Mr. Fell Woods, the managing director of the South of England Oyster Company, for a weekly parcel of oysters and cockles. The mussels I received week by week from friends at Hastings.

The generative gland in the cockle is a somewhat loosely attached, racemose structure, with its principal mass at the base of the foot, but ramifying freely among the intestines and throughout the muscular structure of the foot. The gland thus distributed is made up of a vast number of lobules, connected together by stalks; roughly it may be compared to a very large bunch of grapes, or many bunches united together by a common stalk; the stalk varying according to the state of gland, being either a delicate transparent thread, or a convoluted mass of tubes, and the lobules or grapes either containing spermatozoa in all stages, or spermatozoa and clear cells, or eggs in various stages of perfection. An isolated lobule appears to be composed of two membranous sacs, one within the other; when spermatozoa are present they are found between the outer and the inner sac; when eggs are present they are found to be attached by their micropyle to the circumference of the inner sac, and when hatched the young find their way into the tubular structure, which appears to be continuous with the outer sac. The tubular structure, when full of young, appears muscular, and exhibits faint indications of striation, and when ruptured forcibly expels its contents. The young are gradually expelled from the genital orifices as they come to perfection.

The generative gland of the mussel is a closely packed, racemose structure, distributed chiefly between two layers of the mantle in each shell, but also extending throughout all available parts of the body, around the base of the foot, and the muscles of the byssus. The gland thus distributed is made up of a vast number of lobules, as in the case of the cockle, being also connected together in the same way by stalks, using the same illustration of bunches of grapes, the gland of the mussel might be roughly compared to closely packed raisins, united together by a common stalk. The stalk varying again with the contents of the gland, in the same way as in the cockle, the tubes containing the young, however, being much more limited in extent, and found chiefly among the muscles of the byssus. The lobule, when filled with spermatozoa, or spermatozoa and clear cells, appears as if composed of a radiating and branched tubular structure, uniting in the common stalk, the spermatozoa being confined to the radiating lines, the clear cells being disposed between them. When the eggs are present they appear to open by their micropyle into the branched tubing, which ultimately unites into the common stalk. When the young are hatched they are found in all stages of growth in the tubular structure, and are ultimately expelled from the genital orifices when sufficiently advanced. The tubular structure is much like that of the cockle, being, however, much less extensive, and not so muscular.

The generative gland of the oyster is a branched structure of large size, and is distributed around the liver and intestines, so that it may almost be described as encasing the animal. The portion which gives origin to the spermatozoa is a branched and reticulated structure which forms an expanse immediately beneath the mantle, sending prolongations down into the general substance of the gland. When eggs are present they are found arranged in an early stage around and between the prolongations of the spermatic portion of the gland. At a later stage they occupy the whole gland, and may be described as forming its branched structure. The eggs, instead of hatching into tubes as is the case with the eggs of the cockle and mussel, are extruded from the genital orifice, and, enclosed in a gelatinous substance, lie in the buccal pouch, between the palpi and branchial plates, until they are developed into actively moving ciliated young, when they are puffed out from the parent shell in small quantities at a time.

In the foregoing description of the generative gland of these creatures, I have taken for granted that the sexes are united in one individual; that the gland with spermatozoa is only a prior stage in the history of the gland with eggs and young. If these creatures are of different sexes, of course I ought to have described the male gland and female ovarium. It is impossible to prove that I am right in any direct way. We cannot open a cockle, examine the contents of its gland, and then keep it separate to allow it to go on to perfection. One great difficulty in the way of these investigations is the necessity of causing the death of the animal, or so injuring it as to render it incapable of carrying out its natural processes. I can only say that I have seen in the different animals examined such a continuous series of steps, from the presence of imperfect spermatozoa to the last stage of extruding the young, that I personally believe I am right, and that I think any one with sufficient patience, and using right methods, would also convince himself that the description I have given is substantially correct.

I should like to add a few general considerations which I think have some weight in deciding the question. Those who advocate the opposite theory to the one I have put before you ought to furnish conclusive evidence of the discharge of spermatozoa from the glands of these creatures. I have never seen any such evidence, and personally I have never seen an animal in the breeding season whose gland did not contain either spermatozoa, eggs, or larvæ, and surely if it be held that the spermatozoa from one animal impregnate the eggs in another, we ought, at the same time we see eggs and larval forms, also to see in other animals glands emptied of spermatozoa. I have never seen such. Then, again, I think the mechanical difficulty is great. In none of these creatures are the eggs discharged before impregnation. The cockle and mussel are ovo-viviparous, and in the oyster (although it retains the eggs in the layers of the Branchiæ until fully developed, possibly thus affording an opportunity for impregnation) such a provision is manifestly unneeded, as we may find eggs in an early stage in the gland with spermatozoa in another part. The confusion in studying the oyster, arising from the fact that different portions of the same gland are in various stages of progress, is very great, although doubtless this fact led to the early assertion that it was truly hermaphrodite from the presence of easily recognized eggs with bundles of spermatozoa in the same gland. But in the cockle and mussel we have to imagine the discharge of spermatozoa into the water, or mud and sand, to be taken up by the genital orifices of other creatures and distributed throughout their very complex glands—a very difficult thing to imagine, I think. But supposing this mechanical difficulty not insuperable, evidence, I think, ought to be furnished of this influx of spermatozoa into the glands of animals containing eggs. I may mention also that the gradual change in colour of the glands of the creatures points in the same direction. In mussels especially this variation of shade from pale creamy white to a rich orange is very noticeable. I have not examined the *Anomia* mentioned by Professor Owen in the extract I read, but I was struck with its truth in reference, we will say, to a bed of mussels. Roughly examining any number, seeking for the presence of spermatozoa or eggs, you would probably find a nearly equal number of animals containing each, but the intermediate stage would require a much more thorough examination to discover. The fact of the aggregation of these animals in beds has been accounted for as a wise provision of nature, to allow of the easy access of spermatozoa to the females of these anchored mollusks, and the transmission of spermatozoa by water has been compared to the transmission of the pollen of plants by the air. I think the fact might be more reasonably accounted for by the limited power of motion in the young, and by the fact that the places in which they are found are suited to their requirements in the important matters of food and temperature. I will now conclude, gentlemen, hoping that you will deal leniently with me in the matter of criticism, and that your remarks may furnish me with facts about the three mollusks to set me right where I am wrong, and to help me in any future investigations.*

EXPLANATION OF PLATE II.

The plate attached to this paper gives, as far as possible in so limited a space, a concise history of the changes in the generative glands of these creatures, from

* The lateness of the hour at which the above paper was read precluded any discussion upon it. Dr. Moore has promised a further paper upon this very interesting subject, in March or April—a suitable time to commence practical observations. This paper will have special reference to the supposed larval forms of the Cockle and Mussel.—Ed. J. Q. M. C.

the presence of immature spermatozoa to the young animal ready to be set free from its parent.

The necessity of getting many objects into a small space has obliged me to alter the figures slightly from the original camera lucida drawings, so that although there is some approach to micrometric exactness, the magnification given may be taken rather as an indication as to what may be seen with certain magnifying powers than as exact results of careful measurement. About 100 diameters, or about 250 diameters, &c., would be a more truthful statement than $\times$ 100, $\times$ 250, taken literally.

Cardium edule.

Fig. 1.—A shows a lobule of the generative gland containing immature sperm cells. B is a highly magnified perfect spermatozoon.

2.—A shows a lobule slightly compressed in the compressorium, the spermatozoa being nearly all squeezed out; clear cells are seen remaining. B is a small quantity of the expressed spermatozoa and clear cells from the above, and C shows what I believe to be the act of impregnation in the cockle by the entrance of a spermatozöon into a clear pellucid cell, which I take to be a germinal vescicle. The extremely rapid lashing motion of the spermatozoon after its entrance into the cell is very remarkable, and continues unabated long after surrounding spermatozoa, which have not penetrated, are still. After some hours of movement the spermatozöon seemed to fade, if I may so express it.

3.—A, shows a lobule filled with eggs; the attachment of the lobule to the tube is shown. B, Some eggs, showing the micropyle well. This, I may mention, is more easily seen after staining with carmine.

4.—A is a branched portion of ovarian tubing.

B, a yelk ball. Yelk balls are found abundantly mixed with the young in these tubes.

5.—A, an early stage of young, showing it enclosed in a membranous sac. B.—The larval form as it appears when discharged from the parent.

Mytilus edulis.

1.—A, a transverse section of the generative gland, containing immature spermatozoa. B,—A highly magnified perfect spermatozoon. The point of this spermatozoon moves at right angles to its length, C, and presents a very curious and interesting appearance when in active movement.

2.—A, a more advanced stage, when spermatozoa are present, which are shown expressed at B; the section is through the long diameter of a lobule.

3.—A, a lobule with eggs. B,—Eggs. The micropyle is shown.

4.—A, a branched portion of ovarian tubing. B.—A yelk ball. Yelk balls are abundantly distributed among the young in the tubes.

5.—A, an early form of young.

B, the larval form as discharged from the parent.

Ostrea edulis.

1.—A, a drawing of a stained section of generative gland, containing immature sperm bundles. The darker portion shows distribution of the male element; the line above represents the surface of the animal. B, a perfect spermatozöon highly magnified.

2.—A, the sperm bundles mature and breaking up, drawn from a stained section of gland, out of which the clear cells and bundles of spermatozoa at C were expressed. D, shows a perfect bundle of spermatozoa, with their extended filaments; the other represents a bundle breaking up into its individual spermatozoa. B is a bundle of imperfect sperm cells.

3.—A is a drawing of a stained section of generative gland containing eggs The dark portions represent the places where the male element was. In this animal it had not entirely disappeared.

B are eggs.

4.—C is an egg after its discharge from the gland, when it is retained between the branchial plates, &c., until it reaches the larval form.

5.—A B, possessing cilia, by which it moves freely, and is soon puffed out of the parent shell.

Notes on "Personal Equation," with reference to Microscopy.

By John E. Ingpen.

(*Communicated Nov.* 27, 1874.)

Abstract.

The subject of Personal Equation is probably less interesting than important. It is well recognised in astronomy, especially as regards transit observations. But the term is also applied by astronomers to all differences by a constant quantity between observers, short of actual defects of vision. The subject has not attracted so much attention among microscopists as it deserves, and it is worthy of consideration now that very delicate observations are being frequently made, and high powers employed; while many differences of opinion, otherwise inexplicable, may possibly be traced to this source. *Mental* personal equation is very obscure, though it certainly exists. It may be suggested that many of us see what we wish, or expect, or have been taught to see—particularly in the case of test objects. As an instance may be quoted the difference of opinion as to when certain objects, such as blood discs or Podura scales, are in focus. The interpretation of this and similar problems seems subject as much to an "equation" as to any difference in reasoning.* Closely allied to this is *nervous* equation, as when observations are affected by the greater or less

* Dr. Richardson, in an article in the "Monthly Microscopical Journal" for January 1, 1875, p. 21, remarks:—"How few investigators have minds achromatic enough to enable them to see objective facts without subjective colouring."

rapid transmission of sensations to the brain. It is known that the ear generally transmits impressions more quickly than the eye. Differences exist in the power of observing ciliary and other movements, and more especially in sensibility to vibrations, causing more than one conflict between the advocates of the Jackson bar and the Ross arm on the score of steadiness. Optical differences are numerous, and may be classed under the heads of *colour*, *focus*, and *form*. With regard to *colour*, much *equation* exists; probably scarcely any two observers see an object exactly alike in this respect. In Admiral Smyth's "Sidereal Chromatics" the difficulty of deciding upon the colours of certain well-known double stars is narrated, and *equation*, in many cases, can be traced. The same subject formed the basis of some acrimonious remarks respecting "Bluish-green and greenish-blue" in the "Quarterly Journal of Microscopical Science" for 1861. It is found that, even between the right and left eye of the same person, a difference often exists, one showing an object bluer or yellower than the other—in other words, referring the colours of all objects to points a little nearer the violet or red end of the spectrum. This subject formed part of an interesting lecture by Professor Liebreich upon "Turner and Mulready,"* in which he traced the blueness of Mulready's later pictures to the existence of yellow crystalline lens, which was affected differently by natural colours and pigments. The effect of a "bluish haze" caused by partial opacity of the cornea or crystalline is also noticed, and its existence may account for certain differences of opinion concerning the colour correction of objectives. Some eyes have a greater power than others in distinguishing the Fraunhofer lines at the violet end of the spectrum; this in some instances almost amounts to fluorescence. In a case of cataract, in which a yellow crystalline lens had been extracted, this was particularly noticed. The effect of contrasts is also of importance—white upon black giving the greatest amount of irradiation, while to some eyes definition is clearest on a red, to others on a blue or green field of view. Sir John Herschel advocated red for viewing sun spots and measuring double stars; some observers have used full deep yellow with good effect. The eye is not achromatic, and the objective is sometimes blamed for colour due to defective vision. Slight colour-blindness also frequently exists, though unsuspected,

* Delivered at the Royal Institution on the 8th of March, 1872.

and greatly influences the observer's judgment. These causes may also affect the length of focus, and with it the cover corrections of high power objectives. *Focal* equation causes many differences of opinion. Great difference often exists between the focus of the right and left eye. In such a case, even if each has the power of throwing a clear image upon the retina, those images are of different sizes, and cause confusion when combined in the binocular microscope. An eye of short focus projects a smaller image upon the retina, and generally has a larger angle of aperture, and greater capability of resolving surface markings, but it has less depth of focus than a long-focussed eye. In using high powers eyes of different focal lengths often require different adjustment of the objective; this is peculiarly apparent with Dr. Piggott's "Searcher," where the range of adjustment is great. The difficulty of realising binocular vision from the above causes, as well as the want of accommodation and non-union of focus and other differences of the *camera* effect of vision, frequently cause dissatisfaction with binocular arrangements;—the matter is worthy of careful investigation. *Form.*—The general tendency of the eye is to show ultimate particles *circular*, and lenses rather exaggerate this than otherwise. In the use of double cylindrical lenses, however, for examining photographs, &c., a fictitious squareness is produced in two directions, which has the effect of simulating greater sharpness of definition. Triangular apertures have often been used in star-gazing, and diffraction rings are thereby got rid of, except in certain directions. A hexagonal aperture has also been used to counteract certain atmospheric effects. The existence of astigmatism produces great differences in estimation of form—particularly in the examination of closely-ruled lines or rows of dots. Though long known as a scientific fact, it is only of late years that public attention has been prominently drawn to it, or its effects taken into consideration. It forms part of the subject of Professor Liebreich's lecture on "Turner and Mulready" above cited, in which he attributes to this defect the extravagances of Turner's later paintings. Astigmatism is caused by the distortion of the lenses of the eye from a globular to a slightly ellipsoidal figure. Its effect is to elongate points into lines, squares into oblongs, circles into ellipses, &c., thus giving to rows of dots greater distinctness when viewed in a certain direction. Similarly lines appear black and distinct in one direction—grey or confused in all others—the clearest view being at right angles to that which is least distinct. The direction and amount of this defect can be ascertained and corrected by the use of cylindrical lenses. The existence of astigmatism can sometimes be inferred from the observations both of astronomers and microscopists, and it is probably very common, though in general unsuspected.

The foregoing notes are only intended to draw the attention of microscopists to a subject which has not hitherto been considered of importance. Its full discussion, if undertaken by some competent authority, could not fail to be of great interest and utility.

The Aquarium as a Field of Microscopical Research.

By T. Charters White, M.R.C.S., F.R.M.S, &c.

(*Read Jan.* 22, 1875.)

It is now nearly 25 years since the Aquarium, as it exists in its present form, elaborated by the observations of Dalyell, Warrington, Gosse, and Lloyd, became *un fait accompli*: and although it has been largely employed and productive of much good work by many observers, it is to be regretted that it has not been more freely used as an aid to microscopic research.

While the last quarter of a century has seen much progress in other departments of natural science, comparatively little has been added to our knowledge of the *development* of the many forms of animal and vegetable life with which the aquatic kingdom abounds, and two causes exist which may account for this. First, microscopists as a rule are too much satisfied with the collection of pretty objects for their cabinets, and not sufficiently alive to the interest and importance of observing and recording the various stages through which those much admired objects attain their ultimate condition; and secondly, an idea seems prevalent that the maintenance of an Aquarium in such a state as would conduce to the growth and development of microscopic life is a matter of immense difficulty, and only to be undertaken by a few especially gifted individuals. No greater mistake can interpose itself in the way of your intellectual enjoyment than this, for the maintenance of an Aquarium is a much more easily managed affair than the keeping of a birdcage, and should offer no obstacle even to a child.

As I feel, from the qestions often put to me by members of this Club, that many would willingly adopt this means of adding additional observations to those already made in this department of natural history if they could be put in the way of aquarian research, I propose this evening to lay before the Club such directions as an experience of 10 or 12 years' successful management of a small marine Aquarium may enable me to offer towards the attainment of a similar success by any member who may feel inclined to take up this particular study. If in carrying out my proposal I may seem to dwell too much upon details, I must crave your indulgence, asking you to believe that they are not trivial, and that while their faithful observance will ensure success, their neglect will result in failure.

The treatment of this subject will naturally resolve itself into three divisions—first, the vessel employed to hold the water; secondly, the water employed; and thirdly, the most suitable occupants of the Aquarium.

The vessel employed may be anything that will hold water, and at the same time keep its natural character unaltered. Successful observations have been made in vessels of every size and shape, from earthern pans and pie dishes through the entire range of glass jars and propagating bell glasses up to the regularly constructed tank, and therefore the vessel employed should present no difficulty to those who wish to commence this method of microscopical research. In these days of amateur ingenuity a tank could be constructed with much facility by anyone wishing to possess one, or, if money be no object, tanks can be bought ready for the reception of the inhabitants intended to be observed.

These tanks are formed of slate and glass—materials which are not affected by sea water. *No metal entering into its construction should be allowed to come in contact with the sea water.* The form of tank I have found so successful is of an oblong shape, three feet long, eighteen inches wide, and nine inches deep, and capable of containing sixteen gallons; its bottom, back, and two ends are of slate, and the front of stout plate glass; these are all firmly bolted and cemented together, and all the joints are perfectly water-tight. Inclining from before, upwards and backwards, at an angle of about 15° with the glass in front, a slate false bottom is placed. This should not fit too accurately round its edges, so that if necessity requires its removal, no difficulty may be experienced in doing so. The object of this inclining false bottom is worthy of being borne in mind, as it is of some importance. It affords, in the first place, a varying depth of water, enabling your animals to select the depth most suited to them, and secondly, it divides the tank into two compartments, that under it being filled with water which is always cool and in a state of rest, while that above it is exposed to the light, and actively engaged in ministering to the animal and vegetable life growing in it, and a compensating action takes place between these two compartments which very materially aids in keeping the water in a wholesome and healthy condition. The great object to be kept in mind in working an Aquarium is to assimilate its conditions as much as possible to those of natural rock pools. All attempts to construct grottoes, arches, or temples, or, in short, any such like ornamentation, are to be strongly deprecated ; but sandstone rockwork, roughly disposed, is of much use, affording shelter for your stock, and, by extending the superficial area of the bottom, increasing the aërating capacity of the vegetation, which will ultimately clothe it. This rock may be cemented on the sloping bottom with Portland cement, but none must be placed on the sides of the tank, as that would interfere with the removal of the false bottom, should that be required. Care must then be taken to thoroughly soak the rockwork and cement for a fortnight, or even longer, frequently changing the water, that all the soluble matters may be removed from them. When you feel sure that these are sufficiently soaked, and that no more lime will be eliminated from the cement, you may move on a step further. While some forms of animal life cling to the rocks, others will burrow in the sand, therefore a supply of this must be added. If you are not in a position to get sea sand, an excellent substitute may be found in the silver sand sold at any of the oil shops, and for an Aquarium the size of mine, two gallons will not be too great a quantity. This must be repeatedly washed till the water is quite clear when the sand is stirred up in it, and then it may be placed in the tank. Everything being now ready for the sea water, this brings me to the second division of my subject. The water employed may be artificial or natural sea water. Of course, where attainable, the preference is to be given to real sea water, because however closely its composition may be imitated in these days of accurate analysis, there are principles in it which no chemist can supply. There are, however, many difficulties in obtaining real sea water in London, and in some inland localities these would constitute an almost insuperable barrier to the establishment of an Aquarium had we not the artificial substitute to fall back upon. But since science has furnished us with the constituents of sea water, this may be concocted in any place where the necessary chemical salts can be obtained, and we may feel great confidence in employing it, since most of Mr. W. Alford Lloyd's first observations were made while using it, and in his hands it was productive of very satisfactory results. As the cost of its production is about 3½d. a gallon, I shall introduce to your notice the formula for making it, as given by Mr. Gosse in his "Handbook to the Marine Aquarium"—

"Common Salt, 3½ ounces	. . .	Avoirdupois.
Epsom Salts, ¼ "	. . .	
Chloride of Magnesium, 200 grains	.	Troy.
Chloride of Potassium, 40 "	.	

These salts are dissolved in little less than four quarts of fresh water, so that a specific gravity bubble of 1026 would just sink in it." Having made sufficient of this solution to fill your tank, wash several handfuls of freshly-gathered sea-weeds in it, especially "*Ulva latissima*," but do not leave them permanently in; also add any pieces of rock that may have Marine Algæ growing on them, and let the water be exposed to the sunlight for about a fortnight. At the end of that period it will be fit for the reception and healthful preservation of your animal life, the rockwork will have become fairly covered with the growing Diatoms, and the germs of marine vegetation will be giving off a plentiful supply of bubbles of oxygen.

Now, all these preliminaries may seem very tedious to those who are anxious to see their tank blossoming with all its animal beauty, but the great error into which so many fall who start an Aquarium is that of being in a hurry to see the occupants placed in it before its vegetation has sufficiently advanced to supply the atmosphere necessary to their existence, and thus too many begin in haste and leave off in disgust; but follow minutely these details, and I promise you success and satisfaction. There are one or two pieces of accessory apparatus which, while not of absolute importance, yet will be of great service—a specific gravity bubble, that will just sink in sea water of the right density, may be kept in your tank; if it floats to the top of the water you may know that the water has evaporated and become too salt, when it will require diluting with fresh water till the bubble slowly sinks again. Many mark the side of the tank by gumming a piece of paper at the level of the water, but this method is not sufficiently delicate. I have recently added a means of injecting atmospheric air into my Aquarium, which serves the double purpose of aërating the water and creating a current in it, which seems to be appreciated by my anemones, and it may be of service to describe it. At one end of my Aquarium, and just above high water mark, a hole has been drilled through the slate and a piece of tin gas pipe cemented in; it is left projecting about one inch on the outside, and on the inside just sufficient to carry a length of glass tubing about the diameter of an ordinary quill; this is bent at several angles to enable it to lie safely along the sides and bottom of the tank, and at its extremity is bent, so that its end, drawn in a gas flame to a capillary point, projects into the middle of the water. To the metal tube on the outside of the Aquarium a piece of elastic tube, attached to an india-rubber bellows, is fixed, and by this means I am enabled to drive a stream of air into the water till it appears effervescing; the fine bubbles from the spray remain in suspension for hours, and become ultimately absorbed. This apparatus, although not absolutely necessary, is attended by such good results that I recommend its adoption; but a great deal of benefit arises from syringing the water with a glass syringe. And now for a few words on the third division of my subject—the Occupants of the Tank. If you add nothing more to your Aquarium than what will be found growing and multiplying, as it were spontaneously, you will have abundant material for microscopical observation. I have been enabled in mine to watch the conjugation and multiplication of some of the Diatomaceæ, the development of the Foraminifera, the growth of the germs of the Marine Algæ, the development of the Polyzoa, and the various transitional stages through which all these forms of marine life pass; these, and many other subjects of study, a successfully-established Aquarium would afford, and if, after the example of Drs. Drysdale and Dallinger, these researches were recorded, and every change faithfully drawn and preserved for future reference, abundant light would be thrown upon many obscure points in the developmental history of these subjects. Every fact impartially observed and faithfully recorded, although *per se* but of small value, yet in the aggregate will prove that no more enticing path for the student of microscopic life can be offered than that which leads him through the comparatively untrodden and, therefore, unreaped fields of aquarian research. But I know that an apparently empty Aquarium looks a joyless wilderness, and you will be anxious to see it tenanted by more visible objects of interest; and here let me give you a word of caution, *be content with still life.* Crabs and the Crustacea generally may be very amusing and lively denizens of your tank, but they are fatal to that state of rest required for the development of microscopic life; they are like mischievous puppies in a boot-room, and everything is overhauled by them in a most ruthless manner.

Eolis and the Nudibranchiate Mollusca devour everything, and are to be avoided, unless they are especially to be studied, and scarcely anything more favourable can be said for the Echinodermata; therefore the student must be guided by his subject of study in stocking his tank. No harm will arise from putting in a few of the hardier varieties of the Actinidæ, some Serpulæ or Sabellæ, and such like objects, but my experience is decidedly against *overcrowding* with anything; the atmospheric condition of your Aquarium, if I may use the term, must not be abused any more than that of our own. We may now consider your Aquarium in healthy working condition, and the probable objects of interest that may soon present themselves. One of the first may probably be the multiplication of the Actinidæ. This process takes place in three ways, by *gemmation* most commonly, especially in *Actinia mesembryanthemum*, sometimes as many as thirty tiny well-formed anemones being ejected from the oral opening of the parent at a time. Again, buds may be given off from the sides, as in *Sagartia bellis.* Multiplication takes place *by fission*, as may be observed in the Plumose Anemone (*Actinolobus dianthus*), which often slides, like a snail, along the glass front of your Aquarium, leaving in its trail little pieces of its basal disc, which ultimately become young anemones; or fission may take place bodily, as in *Anthea cereus*, which often divides into two or more parts by a gradually deepening sulcus, which, forming from crown to base, results in the establishment of two or more of these anemones where only one existed.

But the third and rarest form of multiplication consists in the ejection of ova, and this I was fortunate enough to witness in my Aquarium. It occurred in a specimen of *Bunodes gemmacea*, which had taken up a favourable position close to the glass. I was attracted to it by noticing a drab-coloured stream of ova pouring from its mouth and falling in a heap at its feet; upon more closely examining the creature with a pocket lens I found it distended with water, and the tentacles especially so, while globular bodies were circulating up and down the interior of them, but did not pass out at their extremities. I examined some of these bodies under the microscope, and found them opaque, and non-ciliated spheres filled with granular contents. I had hoped to have seen the development of these ova into the adult form, but, as in Mr. Gosse's experience of similar ova, decomposition speedily set in. Dr. Spencer Cobbold was more fortunate, and in the annals of "Natural History" for February, 1853, he describes the various changes through which these ova at last arrive at their final shape. A depression takes place in the surface of the globose embryo, which becomes the general cavity, the edges become incurved, and descend into the cavity, forming the stomach; septa spring from the inner wall beginning from the summit and extending downwards, and tentacles bud from around the mouth. He made these observations at a continuous sitting occupying the whole of one night before decomposition had commenced its attack upon them. I once saw the ejection of ova in a Serpula; noticing occasional bursts of cloudy matter from the centre of its plumose branchiæ, I collected some of it by the dipping tube, and found it consisted of an immense number of minute orange-coloured globules, each enveloped in a clear sac of a probably albuminous nature. I was not fortunate enough to trace out the development of these ova, but I shall hope to do so at some future time by means of a method I have the last few months adopted. I place ordinary microscopical slips of glass in various parts of my Aquarium, and especially near such objects as are likely to eject ova or to develope a stem like the Polyzoa, and then they can be taken out and examined under the microscope, a drawing made of any developing form, and replaced to undergo further examination as changes advance. In this manner I have been much interested in watching the growth of Foraminifera, which have attached themselves to these slips, and which, apparently, have not suffered from the trip they took out of the

Aquarium. In a short practical paper like this I cannot do more than suggest various objects of interest to be taken up and followed by ourselves; therefore I can only briefly describe such as have presented themselves to me at various times, and afforded me the pleasure I hope you may derive from similar observations. I have been much pleased by the hatching of the Zöe of the Crab and Prawn, and can recommend this to your notice. Crabs and Prawns bearing ova can be safely transported from the coast packed in wet sea weed. I once brought a pint of live Prawns, most of them bearing ova, from Dawlish, merely packing them together in a basket in their wet state. They endured a twelve hours' journey without apparently suffering, and I placed a dozen of them in the Aquarium; in about six weeks the young ones hatched out, and could be distinguished in the sunlight as clouds of tiny specks swimming together in shoals. They, like the Crabs, are entirely unlike the adult form at first, and it would have been interesting to have observed the number of moults they underwent before arriving at that condition; but, unfortunately for my observations, the Anemones and the parent Prawns admired the young fledglings as much as I did, but after a different manner, and they gradually disappeared. It would be better in this case to establish a separate tank for the study of these Crustacea, removing the parents when the hatching was complete, for I can promise you a rich store of interest in observing the changes which are effected in these creatures in passing from the strangely-shaped Zöe to the final stage of development. I would also suggest the study of Foraminifera as likely to interest you. The stock may be procured from many sources, but the most abundant is the ooze of oyster beds, where living specimens of many varieties may be found. They may also be found attached to sea weeds and to old shells dredged up from the sea bottom, and in your tank they will soon multiply, and present themselves in every stage of development. In my Aquarium various stages of the *Miliolidæ* may be seen in the summer time, anchored up by their pseudo-podia to the front glass. I have had also an abundant supply of Textularia and Rosalina. I do not point to these as rarities, but only to show that once get your Aquarium fairly started and it will form an inexhaustible store of interesting study. The Chitonidæ live well in confinement, and a study of their developmental changes will repay you. The eggs are exceedingly interesting objects. The

Chitons deposit their eggs closely united in clusters, each egg presenting a curious appearance from the folds of transparent membrane, which, gathered up in branches at different points on its exterior, give it the appearance of a statoblast. The young have no shell when first hatched, but their backs are marked with seven furrows, between which close granules indicate the future shelly structure. I have placed upon the table, among other microscopic slides illustrating the minute life of my Aquarium, some of these eggs mounted in sea water. The shells that are sometimes dredged up from a good depth at sea will be found most prolific in developing forms of animal life, and some kindly sent me from Weymouth bore several specimens of *Grantia compressa* in a living state, but unfortunately sponges do not live long in a tank, nor are they desirable tenants, they exhaust the water very quickly, and then dying, poison it. This is to be regretted, for much has yet to be learned in reference to them, especially about their reproduction. Some sections of a *Grantia* are on the table. Various forms of Tunicata are found attached to these shells, and to sea weed. Many of you may remember some *Perophora* I have exhibited on our gossip nights, which were brought from the Aquarium, where it grew and budded for months. The growth of Bowerbankia, Syncoryna, and other Polyzoa, may be readily observed and noted by this additional aid to microscopic research, and I should, I fear, sadly try your patience if I detained you while I enumerated the many forms of marine life I have had brought thus before me, but which, alas! I have been too lazy to profitably use as I ought; but if I can by these few suggestions stimulate any amongst you to adopt this line of observation, I can promise you that your pleasure shall not be satiated, but that fresh stores of interest will be continually opening to your gaze.

PROCEEDINGS.

AUGUST 14TH, 1874.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Animalcules from rain-water	by Mr. Ingpen.
Vegetable organisms from the water in St. James's Park	,,
New Miniature Portable Lamp	Mr. Moginie.
Section of Sori of *Puccinia Malvacearum*	Mr. Sigsworth.
Sheath of Chrysalis *Acherontia Atropos*	Mr. G. Williams.
Mantle of *Terebratula*	,,

Attendance—Members, 31; visitors, 2.

AUGUST 28TH, 1874.—DR. MATTHEWS, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations were announced :—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	,,
"The 2nd Annual Report of the Zoological Society of Philadelphia"	from the Society.
"The American Naturalist," July and August	in Exchange.
"Proceedings of the Royal Society," Nos. 153 and 154	from the Society.

The thanks of the Club were voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. E. W. Barnett, Mr. W. B. Haynes, and Mr. James Love.

The Secretary stated that Mr. Curties had handed him a further letter from Mr. Staniforth Green, of Colombo, and read the following extracts from it bearing upon the subject of "Insect mounting in Hot Climates," and supplementing the account previously given of the methods employed :—"As I have received such encouragement I am going on mounting insects in their natural state. * * * I do not care to look at a 'pressed' preparation now. The insect, in its natural shape, is a beautiful object. You see its plump thorax in which you can clearly trace the insertion of the wings. I do not now dry insects in the sun, nor were many of those that you presented to the Quekett Club so treated. I find spirits of wine the best drier. * * * My opinion is that insects can be mounted in England successfully under the process I adopt." The usual plan was as follows :—

"1st. I drop the insects alive into gin. 2nd. When they are dead I take them out of the gin, and try to put them into position, but my endeavours are not always successful, as some insects will crumple up their legs in a most uncompromising way. 3rd. I drop them in strong spirits of wine, where I leave them for a week or two, until I think all the watery matter has been extracted from them. 4th. Taking them out of the spirits of wine I immerse them in spirits of turpentime, in which I allow them to remain until symptoms of transparency set in. 5th. If the insect is a pretty thick one, I take a slide to which a glass ring has been cemented to serve as a cell; I then put the insect in the cell with as little turpentine adhering to it as possible, after that I take on the point of a very big needle a lump of very stiff and thick Canada balsam, and with the help of a similar needle I drop it on the insect. If the first lump is not sufficient to fill the cell to overflowing, I take another, and when the balsam is heaped up beyond the level or rather the rim of the cell, I hold the slide for a second or two over a spirit lamp, and when the balsam softens a little, I put a thin cover over it, but do not press it close down upon the glass ring. I leave it tilted on one side for the escape of air bubbles, which are very numerous when thick balsam is used. I then put the slide away, and do not operate upon it again until all the air bubbles have disappeared, when I subject the thin covering glass to slight pressure, which can be nicely done with the assistance of Smith's mounting machine. Sometimes a lot of balsam is pressed out of the cell in this way, which can be easily removed."

The President remarked upon the difficulties attendant upon the mounting of insects whole, owing to the breaking of their bodies. Another difficulty was that of getting rid of the air and moisture of the insect. A third difficulty was the tilting of the cover, which would produce refraction. A cell would obviate this if not over-filled.

The Secretary explained that Mr. Green referred to the tilting of the whole slide to expel air bubbles. The tilting of the cover in the slides presented to the Club might have occurred during transit to England, but the viscid state of the balsam rendered it nearly impossible to correct this. It was very difficult to account for the fact of the fatty matter being so thoroughly got rid of. The climate probably had much to do with this, but the amount of fat varied greatly in different specimens.

In the absence of a paper Mr. Ingpen made some remarks upon a gathering of *Volvox globator* collected on the 1st of January last in two bottles, one quite clean, the other with the admixture of a little conferva. Each bottle contained about 100 specimens. They were placed in an east window, and at the end of the month shewed no diminution in numbers. On the 9th of February the water in the bottle containing conferva froze slightly—not at the top, but in thin plates stretching obliquely across the middle of the bottle. Next day all the *Volvox* in this bottle had assumed the winter state, while those in the other, which had not frozen, remained unchanged. The latter continued to develop till about the middle of March, from which time they gradually diminished in number, the last disappearing on the 8th of April. Shortly after which the water became turbid and dried up. *No* specimens in the winter stage were found in this bottle, but they continued in that which was frozen till the middle of April, when that bottle also began to dry up, no water having been added to either. At the end of February *Closterium lunula* made its appearance in great numbers in both bottles, giving place, a few days afterwards, to a much smaller variety, apparently produced from sporangia, and not subsequently increasing by fission. In the middle of April water was added, after which conferva greatly increased in the bottle which had been frozen. On the 1st of June no *Volvox* in any stage was found in either bottle. The points considered worthy of note were—the continuance of *Volvox* in a small quantity (3oz.) of water, for three months, and the rapid transition to the winter state upon the occurrence of a slight frost.

The President remarked that much still remained undiscovered respecting *Volvox*. He thought that the attention of the members might well be directed to clearing similar points of life history in well-known objects.

Announcements of meetings, &c., were made by the President, and the proceedings closed as usual with a conversazione, at which the following objects were exhibited:—

Section of *Alveolina*	by Mr. Hailes.
Plates and anchors of *Synapta* symmetrically arranged	Mr. Sigsworth.
A fine specimen of the Sea Holly *(Eryngium maritimum)*	Mr. Smith.

Attendance—Members, 44; visitors, 2.

September 11th, 1874.—Conversational Meeting.

The following objects were exhibited:—

Exuvia of pupa of *Cercoptes*	by Mr. Freeman.
Wings of various Lepidoptera	Mr. Groves.
Dactylopora (Foraminifera)	Mr. Hailes.
Varieties of *Lepralia* (a vacation gathering)	Dr. Matthews.
Potato starch, polarized	Mr. Sigsworth.
Section of stem of *Sparganium*	Mr. Slade.
Salivary glands of Cockroach	Mr. T. C. White.
Stellate hairs on Ivy *(Hedera helix) in situ*, polarized	Mr. G. Williams.

Attendance—Members, 29; visitors, 3; total, 32.

September 25th, 1874.—Dr. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	„
"The American Naturalist	in Exchange.
"Grove on Arranging and Cataloguing Microscopical Specimens" ...	from the Author.
Six Slides of Wood Sections	from Mr. Geo. Williams.

The thanks of the Club were voted to the donors.

Mr. Alfred Allen was balloted for and duly elected a member of the Club.

The President said that having an intimate friend in Barbadoes he had written to him to send home some of the earth which contains the well-known Polycistina, and which was commonly known as Barbadoes Earth. After several failures, owing probably to the specimens sent having been taken from the surface of the ground, he had at length received a quantity which appeared to be rich in them. The earth which he had thus obtained was from four different localities, viz., Cambridge, Springfield, Chimborazo, and Seeley Hall Estate, and he had brought samples of each to the meeting for distribution amongst the members. He had been in correspondence with a gentleman who had asked if "Davies on Mounting" was right in stating that these objects usually came from "the rocky parts of Bermuda?" He believed that the part referred to was a place situated at the confluence of the James River, U.S., but it was, of course, possible that Bermuda might be as good for this purpose as Barbadoes.

Mr. T. C. White read a paper "On the Salivary Glands of the Cockroach," illustrating the subject by coloured diagrams, and by prepared specimens shown under the microscope.

The President, in proposing a vote of thanks to Mr. White for his paper, said he thought the subject was just now a most delicate one to express opinions upon. No doubt it was well-known that quite recently in "Nature" great doubt had been cast upon this organ being a gland at all.

A vote of thanks to Mr. White was carried unanimously.

Mr. Curties said he had brought with him to the meeting, and exhibited under his microscope a slide of the same object, prepared by Mr. Tatem, of Reading, and presented by him to the Cabinet of the Club. It was accompanied by the following letter: "I send you three preparations of the Salivary Glands of the Cockroach. They show satisfactorily enough the lobules, sacs and ducts, the latter held open, as in all other insect salivary glands, by spiral filaments, those of the lobes coated with the yellowish epitheleæ, glandular structure of Pflüger. *Apropos* of these slides is a letter in last week's number of 'Nature,' in which the writer (Mr. Hollis) questions the salivary character of these organs. Certainly as regards the secreting nature of their lobular portions I think there can be no doubt, but I quite concur in his opinion that the sacs are not reservoirs for saliva, as is commonly believed, but for the same reasons advanced by him, I have ever considered them as air sacs only, which, when the adult condition is attained, and the wings fully developed, the insect may possibly inflate, and so effect its migrations by such aids to flight. It is an assured fact that during life, or rather immediately after death, when the dissection is made, they are always found empty, flattened, and folded on themselves on either side of the æsophagus, having to be drawn out and spread as in the preparations. Seeing, however, that the common duct opens by a longitudinal slit a little in advance of the base of the tongue, I do not see in what way they can be filled with air from without. Can they possibly be inflated from time to time according to the exigencies of the insect, with *secreted air*, as is the case in the bladders, having no ducts, of some fishes? But this is mere speculation."*

Mr. B. T. Lowne said that some years ago Dr. Pflüger made some very interesting observations on the salivary glands, and he was, if not the first, certainly one of the first who discovered the ultimate nerve fibres, and who showed that the epithelial cells contained the termination of the nerves. The subject was one which required extreme delicacy in working out, but to his own mind it appeared that the evidence in favour of what Pflüger said is extremely strong. He had been for a long time engaged upon other matters, and had been unable to give to this subject the attention which he desired. Pflüger had not demonstrated his points sufficiently to others, but he had long thought that they might be demonstrated, and that this might be done as Pflüger had done it, by means of chloride of gold, and he trusted that if Mr. White would just try this process he might be able to demonstrate it. The process is an extremely troublesome one, because it was always so very uncertain whether or not the preparations would be successful. It is as follows:—A very weak solution of Ter-chloride of gold—about a ½ per cent. solution—should be used to soak the perfectly fresh glands in for a longer or shorter period. How long they should

* Since the discussion upon this subject Mr. Tatem has communicated the following:—"I can neither abandon or modify my opinions, based as they are on my own observations and dissections. I have ever found these sacs empty and flaccid, and most commonly folded on themselves—so that they have to be drawn out and spread. If proved to be salivary sacs. I shall conclude that the condition in which I always found them was brought about by the mode of killing the insect by drowning—the sacs becoming emptied and intussuscepted."

be soaked it is impossible to say—it depended upon temperature and other circumstances, and it might be perhaps from five minutes to as many hours, no one could tell beforehand how long a time would be required. The glands must be taken from the insect and put immediately into the solution, which must be kept in the dark; when sufficiently soaked they must be well washed in distilled water, and after that they should be put into more distilled water and exposed to strong daylight until they acquired a beautiful purple colour. If such a preparation were then examined with a high power—nothing less than a good ¼ would be of any use—there would be seen a fine network of nerves (diagram drawn on the black board representing what would be seen if the observer were lucky). He considered that it was extremely probable that all the nerves of special sense end in modified epithelial cells. In the ear it is well known that there are great numbers of hairs—four or five thousand of them—all tuned to receive and transmit different sounds to the nerves with which they are connected, and which nerves all end in epithelial cells. In the nose and in the tongue the same kind of thing occurs, and in the eye there are found what might be regarded as a modified epithelial structure in the rods and cones of the retina. Now when they had all this evidence of the termination of nerves in cells, the one seemed to substantiate the other, whereas if they had no instances of the kind to refer to there might perhaps have been room for doubt with regard to Plüger's statements; when they thought of the extreme delicacy of the investigation, and that the few persons who had followed it out had confirmed Plüger's view, he thought there was very good ground indeed for believing it to be the correct one. He thought that if Mr. White would try the process he had suggested (and he knew that he liked working in gold), he would no doubt be able to demonstrate the fact. He might say that he had never seen better specimens of the glands than those which were exhibited by Mr. White and Mr. Tatem. Referring to the portions coloured red in Mr. White's diagram, Mr. Lowne explained that these were certainly absent in the fly, which possessed what was known as the tubular form of salivary gland, one which was common to all suctorial insects. The beetles and gnawing insects have another form of gland; and in the cockroach and the hemiptera two pairs of glands are found. In the human subject there were three kinds of salivary glands, one of which supplies a quantity of viscid saliva, another produces large quantities of a more watery kind, and the 3rd, or sublingual glands, furnish a small quantity of very viscid saliva—and as it was quite clear that in vertebrates there are three kinds of saliva, he thought there was nothing improbable in the idea that there might be two kinds of saliva in insects. The ringing of the tubes was no proof whatever that they are tracheal tubes, because all, or nearly all, the tubular structures in insects exhibit rings. He had never seen the air sac of any insect collapsed after death—they were all made of elastic material—the insect had the power of compressing them, but they were naturally kept open by their own elasticity. In our own cases the air is forced out of the lungs by their elasticity, but in insects the opposite condition occurs. When the insect is dead these sacs are said to be always found empty, and no one has ever found them either before or after the death of the insect filled with air. He asked where is the evidence that they are air sacs? And when they had before them such very conclusive evidence that they are not, he should certainly continue so to regard them until very convincing proof to the contrary is produced.

The President, after announcing that the Club was that evening honoured by the presence of a distinguished visitor, Dr. Barker, of Dublin, said he thought it might be well to read the letter by Dr. Hollis, in the last number of "Nature," bearing upon the subject of Professor Pflüger's observations. (The President then read the letter referred to.) He confessed that he was not convinced even before Mr. Lowne had spoken. Certainly he did not regard the presence of tracheæ as conclusive, for he had a specimen of the eye of a drone fly which was full of tracheæ, and no one would doubt that it was an eye because of these tracheal tubes! He thought that, on the whole, the reasoning was quite inconclusive.

Mr. T. C. White said that he had dissected many of these insects, and had found the tubes in every case collapsed. He had, in some cases, sealed up the mouths of the insects before killing them, and still had found them collapsed. He had also kept the insects for two days in a carmine solution placed under the air pump, but with the same result.

Mr. Loy said he had had some practice in dissecting these insects, and, from what had come under his own observations, he certainly agreed with Mr. Lowne. He believed that these organs were secretory vessels, and he had never found the slightest evidence of air in them; and although they were found closed, it was by no means impossible that there might have been something in them. He felt quite sure that they were not tracheal tubes, because these were at all times easily recognised by their silvery appearance. His own idea was that they were merely reservoirs in which the saliva was stored until pumped by the tube to the stomach. He differed from Mr. Tatem in regarding them as assistants to flight. In a large number of insects examined he had never found any evidence of tracheal or air sacs forming part of their salivary glands.

Mr. T. C. White said that in the cockroach there were two enormous tracheal ducts, but there was no connection whatever between the tracheal system and these salivary sacs.

Mr. Loy said that this could be seen in the specimens.

Mr. Lowne said Mr. Loy had observed that there was a difference in the colour of the two sets of glands, and this would seem to confirm the idea that there were different kinds of saliva. In *Catypsa*, and also in the silkworm, it was quite evident there were two kinds.

The President inquired if any peculiarity had been observed in the saliva of insects which inflicted poisonous bites?

Mr. Lowne referred the question to Mr. Loy.

Mr. Loy said that all those fluids were very irritating, but he was not aware of their precise nature. He had noticed that in the case of the caterpillar of the *Dicranura*, a small globule was thrown out immediately the creature was irritated, and that it came from an orifice situated just below the mouth. In action he thought that in the process of feeding the caterpillar pressed this gland upon the edge of the leaf, and lubricated it as it proceeded. He had killed them immediately after the discharge of the fluid, and had then found the bag empty.

The President asked if there was any truth in the idea that the saliva had the effect of thinning the blood, so as to enable the insect to draw it in more easily?

Mr. Loy could not speak positively upon this point.

Mr. Hailes could not see in what way these glands could assist in flight, even if they were filled with air—seeing that the insect flew in air. The analogy to the fish would hardly hold good, because if the fish filled its air bladder with water, it would make no difference whatever in its specific gravity.

Mr. Lowne thought they should not concern themselves about what "might be," they had only to find out what *was*. If anyone thought that these bodies were air sacs, let him prove it.

Mr. Hailes said he had mentioned the matter because he understood it to be stated that there was an analogy to the air bladder of the fish.

Mr Lowne said many insects have air chambers; the cockchafer and stag beetle have hundreds of them.

Mr. T. C. White said he had been asked how these insects were dissected, and he proposed to answer this by bringing up some cockroaches to the next gossip meeting, and giving a demonstration.

Mr. Loy suggested that if Mr. White did this it would be well to bring several of the insects and kill them in different ways—say one in methylated spirit, another with ammonia fumes, and a third in boiling water—possibly it might be found that during the slower processes the sacs would be emptied.

The President remarked that they had had a most interesting discussion. With reference to the Barbadoes earth, he wished to explain, in reply to questions, that the portions marked "Chimborazo" were not from the South American Volcanic district, but from an estate in Barbadoes bearing the same name.

After the announcements of meetings, &c., the meeting terminated with a conversazione, at which the following objects were exhibited:—

Section of Stem of *Potamogeton natans*	by Mr. W. J. Brown.
Lacinularia Sultana	Mr. W. G. Cocks.
Salivary glands of the Cockroach (prepared by Mr. Tatem)	Mr. Curties.
Fredericella Sultana	Mr. Hainworth.
Aulacodiscus Solittanus	Mr. E. Hinton.
Section of Eye of *Sphinx ligustri*...	Mr. McIntire.
Cyclosis in *Vallisneria spiralis*	Mr. Martinelli.
Microphotographs, and a new miniature portable lamp	Mr. Moginie.
Wing of *Culex pipiens*	Mr. Sigsworth.
Salivary glands of Cockroach (four preparations) ...	Mr. T. C. White.

Attendance—Members, 73; visitors, 5; total, 78.

October 9th, 1874.—Conversational Meeting.

The following objects were exhibited:—

Formica Sp.	by Mr. Andrew.
Rotifera, Vorticella, &c., alive	Mr. Badcock.
Section of Rush *(Juncus communis)*	Mr. F. Coles.
House ant	Mr. Goodinge.
Batrachospermum moniliforme, from Cæsar's well, Keston	Mr. F. H. P. Hind.
Globular Silex	Mr. Ingpen.
Plates and spicules of *Synapta* (to show difference in refractive indices)	Mr. Ingpen.
Palate of *Trochus striatus*	Mr. B. W. Priest.
Antennæ of Carrion beetle (polar)	Mr. Sigsworth.
Chlorate of Potash (polar)	Mr. G. Williams.

Attendance—Members, 58; visitors, 7; total, 65.

October 23rd, 1874.—Dr. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced :—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	,,
"The Popular Science Review"	,,
"Proceedings of the Literary and Philosophical Society of Manchester" ...	from the Society.
"Proceedings of the Geologists' Association"...	the Association.
"The Protoplasmic theory of Life, being the President's address to the Liverpool Microscopical Society"	from the Society.
"The American Naturalist"	in Exchange.
"The Quarterly Journal of Microscopical Science"	by Purchase.

The thanks of the Club were unanimously voted to the donors.

Mr. Frederick Haydon was balloted for and duly elected a member of the Club.

The President announced that arrangements had been made for the re-opening of the slide cabinet, which had been for some time past closed in consequence of the continued absence of Mr. Ruffle through severe domestic affliction. The Commitee had thought it desirable that the slides should again be available for distribution, but that they should be issued, not as formerly on the ordinary meeting nights, but on the "Gossip nights." They had asked Mr. Marks to act as Mr. Ruffle's deputy by giving out the slides during his absence, and Mr. Hailes had also kindly offered to assist in the matter.

The Secretary reminded the members that the task of giving out the slides was no easy matter, and that it would be greatly facilitated if they would put down in paper a list of the slides they required before they applied for them. Mr. Ruffle had often said that members frequently did not make up their minds what they wanted until they came to the cabinet, and that this led to delay, and to a great increase in the trouble of distribution. Mr. Smith, their librarian, reminded him that he had a number of copies of the catalogue of slides which he would be happy to supply at 1s. each.

Mr. R. P. Williams read a paper "On cutting sections of the eyes of insects, and on a new instrument for the purpose." The machine was exhibited in the room, and was deservedly admired by those who had the opportunity of a close inspection.

The President said that it had been his lot to see many machines for cutting sections, but he had never seen one so beautiful or so exquisitely made as the one which Mr. Williams had brought before them. All its motions seemed absolutely perfect; he had never seen anything to compare with it; indeed it was, he thought, beyond praise. The whole of its arrangements seemed to be of the most perfect kind, and every motion and requirement seemed to have been provided for. He had not done much himself in such minute objects, but he knew that some gentlemen present had made this a study, and he hoped they would have something to say upon the subject.

Mr. Ingpen inquired if Mr. Williams had made any provision for tilting the object in either direction, in such a way as could be done by a ball and socket joint, so that it might be shifted to a different plane if required?

Mr. R. P. Williams said he had made provision for adjusting the object in any vertical plane, by means of the ebonite block described in the paper; if any other alteration were required it would be necessary to soften the wax and tilt the head.

The President suggested that Mr. Ingpen meant to inquire whether, supposing the head were found to be embedded in such a position that the plane of cutting did not coincide with the horizontal axis of the eye, it could be shifted into such a plane of coincidence without the necessity of remelting the wax.

Mr. R. P. Williams said he could not do that, but he thought it might be done, and he would endeavour to do it.

Mr. E. T. Newton asked for information upon one point which he did not quite see was provided for. In cutting sections he had found it to be absolutely necessary that they should be cut in fluid in order to get them off the knife. The machine itself was beautifully true in all its parts, and seemed perfectly to meet wants often felt, but he should like to know how he was to get the section off the knife, to which it would certainly adhere after being cut?

Mr. R. P. Williams said he had mentioned in his paper that the knife must be moistened before using with oil of turpentine, otherwise the section would cling to it. When the section was cut, it would be found upon the cutter, but by placing a piece of paper upon the edge, and then easing the section off the cutter with a piece of wood cut to a thin edge, it could be easily transferred to the paper, and thence to the fluid.

Mr. Newton was doubtful whether so thin a section would bear to be pushed off in this way without injury.

Mr. R. P. Williams said of course it must not be pushed.

The President inquired if there would be the same degree of adhesion to a revolving cutter as to an ordinary shaped one?

Mr. R. P. Williams thought there would be about the same, but was quite sure that if oil of turpentine was used, it would effectually prevent the wax from adhering to the knife. He had formerly used oil for the purpose, but found this softened the wax, and would, therefore, not do; oil of turpentine did not dissolve the wax, but prevented it from adhering, and enabled it to be easily removed in the manner described.

The President did not know how far the oil of turpentine would affect the after process—such as staining—and asked if Mr. Williams stained his sections.

Mr. Williams said he had not done so; he did not know that it was necessary.

The President said he had seen some very nice sections of eyes cut by Mr. McIntire, and hoped that gentleman would give them the results of his experience.

Mr. McIntire said that in cutting sections of insects' eyes he depended entirely upon luck. He had seen some very beautiful sections cut by Mr. Stewart, and thought he should like to try his hand at them. He accordingly got one of Topping's machines, and embedded the heads in a mixture of bee's wax and oil. He first tried upon the heads of flies, soaking them in spirit to harden them—from six to 24 hours. Great care was required in sharpening the razor. He found in practice that it was impossible to get a section of both eyes at the same time. The eyes having been hardened as described, must then be put into the wax, after which the sections could be pared away, taking care always to keep the razor thoroughly moistened with spirit, and to float the sections off the blade into a watch glass of spirit—they must on no account be touched or they would come apart. They should be lifted out of the spirit on a piece of tin foil, and put into the staining fluid—either hematoxylin or carmine very much diluted—and after this they should be transferred to methylated spirit. If the specimen was successful, it might then be put into clean alcohol, and, when all the water was gone, it could be lifted out and placed in a drop of oil of cloves upon a clean glass slide; it should then be slightly warmed, and having teazed away the wax with a fine needle, and got rid of it by a sudden tilt, the section would be ready for mounting in balsam. This should be done directly, but the cover must on no account be touched for fear of disturbing the object. He had found the eyes of flies to be the easiest to prepare—those of beetles were more difficult because of the harder and more horny nature of the outside covering, and he found that it was necessary to know the proper angle at which to cut each different insect's eye. Mr. Stewart was of opinion that the brittleness complained of might be got rid of by soaking in glycerine.

The President thought that a machine with a revolving cutter would be peculiarly applicable to the horny eyes of the Coleoptera. He felt sure that all present must have heard the paper with pleasure, and no one could examine the machine without admiring it—there was only one thing wanted to make it complete, and this was so easily added that he was sure Mr. Williams would soon do it.

A vote of thanks to Mr. Williams for his paper was then unanimously passed.

Dr. Daniel Moore read a paper "On the Generative processes of the Oyster, Mussel, and Cockle," and illustrated the subject by numerous coloured diagrams, and by preparations exhibited under microscopes in the room.

The President thought that the Club was peculiarly fortunate in having two such papers brought before them in one evening as those they had just listened to. It was not everyone who had the opportunity of so carefully going into this subject as Dr. Moore had done. He would like to ask whether Dr. Moore had ever observed the spermatozoa gain access to the ovum, and, if so, what change resulted.

Dr. Moore said he had not actually seen this take place.

The thanks of the Club were then voted to Dr. Moore for his interesting paper.

The President called attention to a side reflector for illuminating opaque objects; it was merely the substage reflector mounted upon a separate stand. He had proposed the idea to Mr. Wenham some time ago, but found that he had already carried it out. He mentioned it, and had brought it with him to the meeting, because he thought it would suggest the idea that by utilizing their own apparatus they might often save it from being unnecessarily multiplied.

The President announced that he had brought with him to the meeting a further supply of Barbadoes earth for distribution amongst the members. He had also some mounted specimens prepared by himself, and some which had been prepared by Mr. Topping.

The proceedings then terminated with a conversazione, at which the following objects were exhibited:—

Lung of Boa Constrictor (injected)	by Mr. J. W. Goodinge.
Larva of Bot-fly *(Œstrus)* in the egg	Mr. Hainworth.
Volvox Globator (alive)	Mr. Martinelli.
A Series of preparations illustrating the generative process of the Oyster, Mussel, and Cockle	Dr. Moore.
Raphiodesma lingua—showing clusters of anchorate spicula	Mr. B. W. Priest.
Feather of a Foreign duck (polar)	Mr. J. C. Sigsworth.

Mildew from Cuticle of Apple	Mr. J. F. Tafe.
Section of the eye of a Moth	Mr. Topping.
Parasite of Beetle	Mr. Underwood.

Attendance—Members, 97; visitors, 18; total, 115.

November 13th, 1874.—Conversational Meeting.

The following objects were exhibited:—

Crystals of silver forming on lead and brass filings ...	Mr. E. Bartlett.
Skin of Eel, showing scales and pigment cells ...	Mr. F. Coles.
New form of portable lamp by Swift	Mr. Dunning.
Spinnerets, web and calemistrum of *Ciniflo atrox* ...	Mr. H. E. Freeman.
Perryia pulcherrima (a new Diatom)	Mr. H. F. Hailes.
Wing of a Mauritian Butterfly	Mr. Ingpen.
Crystals of Stearic acid	Mr. S. Israel.
Cyclosis in *Vallisneria*	Mr. Martinelli.
Foot of Wasp (*Vespa vulgaris*)	Mr. Sigsworth.
Section of pad of Dog's foot, the vessels injected with carmine, and tissue stained with hematoxylin	Mr. Topping.
Foraminifera from the river Dee	Mr. C. C. Underwood.
Demonstration of Insect dissection	Mr. T. C. White.
Vertical section of pad of Kitten's foot	,,
Spiral vessels of *Banana*	Mr. G. Williams.

Attendance—Members, 62; visitors, 6; total, 68.

November 27th, 1874.—Dr. Jno. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	,,
"Proceedings of the Geologists' Association"...	the Association.
"The American Naturalist"	in Exchange.
"Richardson on the value of high powers in the diagnosis of blood stains" ...	from the Author.
Two Reprints from the "Canadian Naturalist"	from Mr. G. M. Dawson.
Two Photographs	Mr. C. White.
Fourteen Slides of Foraminifera	Mr M. C. Cooke.
Four Slides of Moss—collected on the excursion to Weybridge	Mr. W. G. Cocks.
Baird's "British Entomostraca" was added to the Library	by purchase.

The thanks of the Club were voted to the donors.

The Secretary called attention to the paper by Dr. Richardson on the use of high powers in the diagnosis of blood stains—the rules of the Club would not permit of its being read to the meeting on account of its having been already published in the "American Journal of Medical Sciences," and an abstract of it had also appeared in the "Monthly Microscopical Journal." It was of interest as pointing out the constancy of the relative sizes of the blood discs of the Mammalia, for the examination and accurate measurement of which the use of high powers was necessary.

The President said that cards of admission to the Soirée of the West London Entomological Society had been placed upon the table, and he had also been requested to ask for the co-operation of any members of the Club who might be willing to assist the Society upon that occasion.

The President referred to the excursions of the Club, and called upon those members who took part in them to communicate the results to the meeting, They often heard of excursions to be made, and supposed that they were made, but they hardly ever heard anything more of them. No doubt they were of value, and bore abundant fruit to those who took part in them, but he must say that, so far as the Society was concerned, they were fruitless. They always happened upon a day when he could not possibly join them, but he should be profoundly glad to hear of the results from those who did.

Mr. Cocks having presented to the Club four slides of mosses collected during the excursion to Weybridge.

The President admitted that he had been a little premature in some of his observations, and was very glad to find it so. The slides which Mr. Cocks had presented showed what had resulted from one excursion, they were beautifully finished, and quite models of mounting; and he should be very glad to see them under the microscope in the course of the evening.

The President reminded the members that at their last meeting two very interesting papers had been brought before them, which he thought might form the subject of some further observations from gentlemen present, who had pursued similar studies, and invite remarks upon either subject.

Mr. Ingpen communicated some notes on "Personal Equation," with reference to Microscopy, illustrating his remarks on the black board.

The President, in proposing a vote of thanks to Mr. Ingpen for his communication, observed that as they were essentially a Microscopical Society, nothing could be more useful to them than the discussions of such questions as those contained in the paper, which directly bore upon the subject of accuracy of observation.

Mr. J. G. Waller said that one or two points in the paper touched him professionally, and he should like just to say with regard to the paintings of Mulready, that he thought the gentleman who had made the observations quoted by Mr. Ingpen must have been in error. When a painting was painted it was always begun on the blue side of the scale, and finished on the yellow side. Now Mulready was a very slow painter, and as he painted at times under pressure from his patrons, it might happen that some of the pictures were not quite finished and hence the blueness. He knew Mulready quite well, and could therefore speak from knowledge in the matter. With regard to Turner he did not believe that the peculiarities adverted to were at all due to defects of vision, and quoted an anecdote to prove that Turner had on one occasion, when expressly requested to do so, painted a picture in which his accustomed extravagancies did not appear. Titian painted up to the last—he believed to the age of 93. He had seen some of his pictures which were painted at an advanced age, and certainly they were anything but blue, and he had never seen an instance of this in the case of a great artist.

The President said that the paper suggested many considerations of much interest. With regard to astigmatism it most fortunately happened that it generally existed in one eye only, and it was due to the fact of there being some alteration in the curves of the front or back part of the line, making it more or less elliptical—the effect was as if it were pressed laterally and so made elliptical. A necessary consequence of this was that dots which were very near to each other would be seen in one direction as a line, from their being converted into ovals and overlapping each other. Another frequent error of interpretation was as to whether a thing was within or outside the focus, and no two persons seemed to agree as to what was exactly the focus. A blood disc for instance, on one side of the focus appeared to be concave, whilst it did not appear so on the other side, and it was a question with many which was the reality. Then again there were the markings on *Pleurosigma formosum*. Some persons saw them as convex hemispheres and others thought them concave, and they were frequently seen to be more or less coloured for reasons which were entirely personal. Another question arose with regard to Micrometry—a long and a short sighted person would use the Micrometer, and their observations would not agree on account of their differences of focus; whilst some persons see shadows and cannot tell accurately which is the margin of the object. As regarded the question of fluorescence, it was a very curious fact that when a person had been saturated with quinine (given not in small quantities as a tonic, but in large quantities in cases of ague, as an antiperiodic medicine) the effect was generally headache and a confusion of vision, and they were able to see much farther towards the violet end of the Spectrum than under normal conditions. But in such cases it was found that vision was impaired in exactly the same proportion towards the red end, so that their range was not really increased. It should be borne in mind in connection with the subject of colour that all their microscopes were corrected for white light, but they were for the most part used in very yellow light, and they could not suppose that the effects under these conditions would be the same as in day light, and it was not possible to get by ordinary means within the reach of every one monochromatic light, strong enough for microscopical purposes. Irradiation, also, must not be overlooked, as being a frequent source of personal error; for even in landscape photography there was found to be an irradiation effect produced, which became less marked when the back of the plate was smeared over with yellow. Its common effect was that 999 people out of 1000 could see light lines upon a dark ground better than they could see dark lines upon a light ground, and this would account for the better definition commonly produced by dark ground illumination—either by the paraboloid, or by oblique illumination from the mirror. The former of these methods was, however, much preferred, owing to the diffraction which was frequently caused when the other was adopted. If a person were temporarily ill he could not see things in the same way as when in health and it was quite certain that the presence of bile where it should not be must tend to a disturbance of vision. He had at that moment a person under his care who was dying from cancer of the liver, all of whose tissues and fluids were so saturated (and coloured) with bile that even the saliva was much tinged, and very bitter. In this case there was much confusion of vision, accompanied by spectra—probably owing to alteration in the density and colour of the humors of the eyes. It had even been asserted by some observers that objects seemed yellow to such sufferers, and the same had been observed by those who had taken Santonica medicinally.

Mr. Ingpen said, in reply to Mr. Waller's remarks, that probably Professor Liebreich knew nothing of the special circumstances with regard to Mulready, but simply drew his conclusions from observation of the paintings themselves The fact of yellow cornea was very pertinent to the subject, and it was also quite possible that some artists might not have been affected in that way. With regard to Turner, he believed that all that was said had reference to the possibility of reducing the vertical streaks to a natural effect, by looking at the pictures through a cylindrical lens.

Six gentlemen were proposed for membership. Meetings for the ensuing month were announced, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Sertularia argentea	by Mr. E. Bartlett.
Capsules of Moss (*Bryum capillare*)	Mr. W. G. Cocks.
Upper Wing of fly from Brazil	Mr. A. L. Corbett.
Aleyrodes Chelidonii	Mr. H. G. Glasspoole
Collection of Ferns from the Cape	Mr. Golding.
Micro-photograph " The Song of a Shirt"	Mr. Moginie.
Lace fern	Mr. F. Reeve.
Sections of Echinus Spines	Mr. C. Sigsworth.
Transverse Sections of jaw and teeth of young rabbit	Mr. A. Topping.

Attendance—Members, 84; visitors, 13; total, 97.

December 11th, 1874.—Conversational Meeting.

The following objects were exhibited :—

Tracheal system of larva of *Dytiscus*	by Mr. F. H. P. Hind.
Mymar taprobanicus—minute parasitic Hymenopteron, from Mr. Staniforth Green, of Colombo	Mr. Ingpen.
Salivary gland and tongue of Cockroach showing their connection	Mr. W. W. Jones.
Pleurosigma angulatum under Beck's $\frac{1}{10}$th Immersion, with Dr. Matthew's oblique illuminator... ...	Dr. Matthews.
Head of *Tænia solium*	Mr. B. W. Priest.
Haematopinus Asini (louse of the ass)...	Mr. J. A. Smith.
Skin of Dog Fish (*Scyllium canicula*)	Mr. Topping.
Agläasphæria from Africa	Mr. Underwood.

Attendance—Members, 39; visitors, 2; total, 41.

January 8th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Foraminifera from the London clay	by Mr. H. F. Hailes.
Cuticle of *Onosma taurica* (polar)	Mr. Ingpen.
Tongue and Salivary gland of Cockroach...	Mr. W. W. Jones.
Cirri of Barnacle (polar)	Dr. Matthews.
Section of Nose of Cat (injected)	Mr. Topping.
Lepralia Brougmartii, Red Sea	Mr. C. C. Underwood
Deep Sea Dredgings, 1680 Fathoms	Mr. T. C. White.
Photomicrograph of Diatoms, &c., attached to Atlantic Cable	Mr. C. C. Wyatt.

Attendance—Members, 73; Visitors, 7; total, 80.

January 22nd, 1875.—Dr. J. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"...	,,
"The Popular Science Review"	,,
"Proceedings of the Royal Society"	the Society.
"Proceedings of the Literary and Philosophical Society of Manchester" ...	,,
"The American Naturalist"	in exchange.
"The Natural History of the Diatomaceæ, by Dr. Arthur Meade Edwards ...	the Author.
A Photomicrograph	Mr. C. C. White.
1 Slide	Mr Underwood.
3 Slides	Mr Wm. McVean.
Bowerbank's "British Spongidæ," Ray Society	by purchase.
"The Quarterly Journal of Microscopical Science"	,,
Part I. of "Atlas der Diatomaceen. Kund von Adolf Schmidt"	,,

The thanks of the Club were voted to the donors.

The Secretary said he had received a letter announcing the formation of a new Natural History Society at Watford, and asking him to bring it before the notice of the members of the Club, in order that any residing in that neighbourhood might avail themselves of the opportunity of joining.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. Thomas Bolton, Mr. Edward Dadswell, Mr. F. W. Howard, Mr. Henry Power, Mr. A. Tinney, the Hon. J. C. Vivian.

The Secretary said he had received a letter from Mr. R. Sedgwick, Hon. Sec. of the Tower Hill Microscopical Club, intimating that their Annual Soirée was arranged to take place on Wednesday, February 17th, and asking for the co-operation of the members of the Q. M. C. on that occasion.

The Secretary called the attention of the members to a new Portable Microscope exhibited in the room, which had recently been designed and made by Mr. Moginie; it was specially adapted for use with low powers. He always thought that the 4-in. objective of Ross had not been done full justice to on account of the small field of the A eyepiece. The new instrument had a large Huyghenian eyepiece of a very low power, giving a splendid field of view, and the lenses of the eyepiece were made to slide into the tube, instead of screwing in the usual way, so that they could be readily removed for wiping. The focussing was effected by a rackwork arrangement attached to the stage instead of to the body of the instrument, which was fixed to the stand; thus adding greatly to the steadiness of the whole, and the rackwork was sufficiently delicate for use with $\frac{1}{2}$ or even $\frac{1}{4}$ inch objective. If required for use in the vertical position, the instrument could be screwed into a plate provided for the purpose on the lid of the wooden case, into which the microscope and apparatus were arranged to pack in a very small compass (12in. $\times$ 5 $\times$ $3\frac{1}{2}$).

The President said he had the pleasure of seeing an instrument of this kind shewn by Mr. Moginie a short time ago at the Royal Microscopical Society, and was much pleased with it ; it could be used very well with a 4in. or even a 5in. objective, and showed a very much larger field than that of the ordinary eye-piece. He thought that if the diaphragm was removed from an A or B eyepiece, it would be much more useful with low powers, and he commended the practice of making the diaphragms moveable in such eyepieces to enable them to be easily adapted to show a larger field when a low power object glass was used. He could strongly recommend Mr. Moginie's new instrument for the use of students and for botanical purposes.

Mr. T. C. White read a paper "On the Aquarium as a field for microscopical research," in which he minutely described the method of constructing, stocking, and maintaining a marine aquarium in a London home.

The President said that Mr. White had in his paper spoken of his laziness, but he did not himself think that the paper was an evidence of it. The interest attached to the subject was boundless, and he should be very glad to hear the remark of any of the members upon it. Two or three minor points occurred to him in connection with it—first, he believed that the habits of the creatures kept in aquaria were, for the most part, nocturnal, or at least that they often preferred a subdued light ; even amongst fishes, he believed this was largely the case, and yet he often went into rooms and saw great tanks of clear glass without a particle of shade provided for the creatures to take shelter in, and he could only call this gratuitous cruelty. Then all these creatures were expected to live for an indefinite time without any means being taken to aërate the water duly, no attempt being in many cases made to supply it, and then people said "they don't know how it is, but they can't get their fishes to live." The question of aëration was one of great importance, and required study. A friend of his made it a condition that everyone who went to look at his aquarium should give it three charges of the water from a syringe, and another fixed a bellows to the door of the room, by means of which a change of air was forced into the water whenever the door was opened. With respect to the difference between natural and artificial sea water, he believed that iodides and bromides of magnesium and sodium entered into the composition of sea water in its natural condition, and he should like to ask Mr. White if he found it necessary to supply them.

Mr. T. C. White said that with regard to the iodides and bromides, their proportion was so extremely small that he thought their absence made no difference. Mr. Lloyd, of the Crystal Palace Aquarium, told him that they were not really necessary, but they would in the course of time be developed, especially if sea-weeds were washed in the water. The sea water in his own aquarium had been unchanged for three years ; it was given to him in the first instance by Mr. Lloyd and he believed it came from Brighton. During the last summer *Oscillatoriæ* were developed in it in such numbers that the water became foul, and many of the creatures, including the *Serpulæ*, died. He exposed it, however, to strong sunlight, and this caused oxygen to be given off in such large quantities that the water became quite purified, and it was now quite "looking up" again. It was an excellent plan to occasionally wash fresh seaweed in the water, as this supplied quantities of germs and other matters which were beneficial. He quite agreed with the President as to some people's ideas regarding an aquarium. Some of his patients having seen his aquarium went away delighted, and forthwith set up one for themselves ; they went to Brighton or Weymouth and brought home things to put into it, but very soon after there was no more heard of it, and they would say, "Oh, it was no good keeping it, for all the things died." In giving instructions as to how to start an aquarium, he always laid particular stress upon getting the tank ready, and letting the plants grow in it for some days before the living inmates were introduced. The trouble would be amply repaid, for there were many developmental stages in the life-history of the creatures which were most interesting; and one need not even go as far as the seaside to seek objects, [for Mr Lloyd had told him that he used at one time to go round in the neighbourhood of Smithfield, and when he came to a large oyster stall, he examined the shells, and often found beautiful little specimens upon them, and he had found even *Crassicornis* upon shells, as well as algæ. He recommended an examination of shells dredged up from a great depth as being very likely to yield specimens of much interest.

The President suggested that there was a way of keeping water a long time from putrescence by putting into it a mass of charcoal (by preference animal charcoal). And with respect to objects found upon the oyster shells, he might mention that he had recently found many excellent specimens upon the shell of the *Pecten maximus*, which was very abundant in London at the present time.

Mr. W. W. Jones thought that the best way to add the iodides and bromides to artificial sea water would be to put seaweeds into it.

Mr. Russell inquired what was the best mode of feeding?

Dr. Foulerton asked if Mr. White had found any inconvenience from the great alterations in temperature which must occur in an aquarium. The deep sea was not subject to any great range of temperature, but water kept in a room in small quantities must get hot or cold according to the temperature of the air.

Mr. White, in reply, said that with regard to feeding, the creatures might be allowed to go a month without food, the only thing being that they would in that case be found to diminish somewhat in size. He had found in practice that it was best to feed them once a fortnight, and the best food was an oyster well washed and cut up into small pieces; if the creatures did not take it directly it was a sign they were not hungry, and the food should be removed at once to prevent it from polluting the water. As regarded temperature, some persons thought this an important matter, and recommended a thermometer, but this to others appeared to make the thing complicated. He had himself only a specific gravity ball, and had not "gone in" for a thermometer, because he found that the aquarium flourished very well without it.

Mr. Russell had not done much with marine aquaria, but could speak from experience as to fresh water, and he found that variation of temperature was necessary, and that in a confined room it was necessary also to aërate the water constantly, and he did this by bringing down a small pipe from the cistern so as to discharge a fine jet with some force through the water. He found also that the weed would not grow properly until he put it out of doors. The variation of temperature between day and night he believed to be necessary, and certainly he had never found it to act prejudicially upon the animals. Overstocking was a very great evil. He had found that it was of great advantage to put in odd pieces of rock for shelter. The study of an aquarium was one of so much interest, that he strongly recommended those who had not done so to launch out in that direction.

Mr. White said he did not intend at all to discountenance the use of rock-work, but he did very much deprecate the fanciful erections one often saw, giving a tea-garden appearance to some aquaria. Rockwork itself he liked very much; it not only gave shelter, but it also increased the superficial surface of the bottom, and helped the growth of vegetation, which was so necessary for aëration.

A vote of thanks to Mr. White for his interesting paper was unanimously carried.

The proceedings then terminated with a conversazione, at which the following objects were exhibited :—

Æcidium Ranunculi	by Mr. W. H. Golding.
Sections of Human Scalp ... ... ; Salivary Glands and Tongue of Cockroach	Mr. W. W. Jones.
Cyclops	Mr. Martinelli.
Fungoid growth on leg of Water Beetle.	Mr. Rolfe.
Foraminifera, from Mr. T. C. White's Aquarium	Mr. J. Russell.
Naviculæ (selected)	Mr. J. C. Sigsworth.
Brain of Mouse (injected)	Mr. Topping.
Eggs of *Chiton*	Mr. T. C. White.
Young *Asterias*	,,
Sphæraphides in stem of *Viscum album*.	Mr. R. P. Williams.

Attendance—Members, 94 ; visitors, 11 ; total, 105.

February 12th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Leaf of *Alyssum. Sp.*	Mr. G. D. Brown.
Lituola (Foraminifer), the test formed of Sponge spicules	Mr. Hailes.
Intestine of Cat, injected	Mr. W. W. Jones.
Section of Tail of Horse—stained two colours... ...	,, ,,
Marchantia polymorpha	Mr. Martinelli.
Spicules of Gorgonia	Mr. B. W. Priest.
Section of Agate, polarlsed	Mr. Sigsworth.
Transverse section of Human Tooth, polarised ...	Mr. Topping.
Demodex folliculorum (alive)	Mr. T. C. White.
Eozöon Canadense	,, ,,
American Aloe, transverse section	Mr. Geo. Williams.
Clematis ,, ,, ...	,, ,,

Attendance—Members, 69 ; visitors, 3 ; total, 72.

DONATION TO THE CLUB.

REPORT OF COMMITTEE.

The Committee have great pleasure in reporting that Mr. Frank Crisp, one of the members of the Club, has made a donation, by which the sum of £20 annually is secured to the Club for five years, upon the condition that the same shall be applied in such a mode as will be calculated to promote its interests and welfare.

Your Committee, in furtherance of the above purpose, and considering that it will be beneficial to the interests of the Club to offer an honorarium to any member who may distinguish himself in Microscopical work, have framed the following rules for the application of the fund thus placed at their disposal:—

I.—That such honorarium be given, not in money, but in books or scientific instruments.

II.—That the work for which such honorarium shall be awarded shall have been originally communicated to, or brought before the Club.

III.—That the Committee shall decide to whom such honorarium shall be awarded, and that its members shall be excluded *ex-officio* from receiving the same.

IV.—That the Committee shall communicate their decision to the Club at the Annual Meeting in July of each year.

V.—That no one shall be eligible to receive an honorarium until he has been more than one year a member of the Club at the date of the Annual Meeting at which the same is awarded.

VI.—That no member shall be eligible to receive an honorarium more than once in three years.

VII.—That the Committee shall be at liberty to make their first award at the Annual Meeting, in July, 1875, if they shall so think fit.

VIII.—That if the Committee shall decide not to make any award, or shall not award the whole sum of £20 in any one year, such sum as shall remain shall be used for an award or awards in the sixth or some succeeding year, and that no greater sum than £20 shall be awarded in any one year.

Your Committee hope that this mode of applying the fund so liberally presented to the Club will meet with the approbation of the members. It is designed to promote original research, and to give a stimulus to the performance of good and useful work, at the same time avoiding the evils consequent upon direct competition, the introduction of which might possibly diminish the cordiality which has hitherto existed in the Club, and which forms one of its most attractive features.

On an Instrument for Cleaning Thin Covering Glass.

By W. W. Jones.

(*Read April* 23, 1875.)

A very common complaint amongst working Microscopists is of the trouble they have in cleaning very thin glass covers without breaking them; in fact, I know that with many the annoyance is so great that they use the thicker glass for all specimens, and so render them utterly useless for examination with high powers. Now, I think you will hold with me when I say that nearly if not all transparent specimens would be of infinitely greater value if they were capable of being examined with the higher powers, and as the thinnest glass is just as cheap as the thick when you consider that you get about twice the number to the ounce, the only drawback to its more general use that I can see is the great breakage that occurs in cleaning, to obviate which I wish to bring before your notice a small and simple apparatus, which I find answers exceedingly well, having used it for the last 12 or 18 months. It consists of a small tube of brass or steel, of about an inch in diameter and the same in height, into which fits loosely a weighted plug. To the lower end of this plug is cemented a piece of chamois leather. Another piece of leather is stretched upon a flat piece of wood or plate glass to form a pad, which completes the apparatus.

The mode of using it is this. You place the tube on the pad, breathe on the glass, drop it into the tube, put in the plug, and then holding the tube well down on the pad you can rub as much as you like with perfect safety, the weight of the plug giving sufficient pressure. With this simple arrangement you will find it almost as difficult to break the glass as many have hitherto found it easy. I hope that this may be the means, not only of saving time and trouble, but also of adding materially to the value of many good specimens which are now often half spoilt by the use of thick covers.

On *Bucephalus Haimeanus* and another Allied Organism.

By Daniel Moore, M.D.

(*Read April 23rd*, 1875.)

Before introducing the special subject to which I am to draw your attention to-night, I must state that the final corrections of my paper, which appeared in the last issue of our Journal, were, through some mistake, not attended to; they are, however, unimportant, except in one particular. The second paragraph at the commencement of the Explanation of the Plate ought to have appeared without its last clause, and, to prevent misunderstanding, ought to be as follows:—"The necessity of getting many objects into a small space has obliged me to alter the figures from the original camera lucida drawings, so that although in certain of them there is some approach to micrometric exactness, the magnification may be taken rather as an indication as to what may be seen with certain magnifying powers, than as exact measurements." In the report, also, a mistake has arisen. I am there represented as saying that I never saw the entrance of spermatozoa into ova, whereas my paper is based on the fact that I thought I had seen the entrance of spermatozoa into early stages of ova. Last Friday I was informed that Mr. W. Fell Woods intends to read a paper after me to-night, "On the Relation of *Bucephalus Haimeanus* to the Cockle." I have, therefore, made my paper as brief as possible, leaving out matter that I feared might lead to needless repetition.

In October last I read a short paper before this Club, giving the results of some observations on the Generative Processes of the Oyster, Marine Mussel, and Cockle, which observations had led me to the conclusion that these lamellibranchs were truly monœcious, and I detailed my reasons for so thinking. In the plate, accompanying that paper, I figured what, I supposed, were the larval forms of the young of these molluscs, giving, however, no reason for that opinion, beyond such as might be gathered from the plate itself, hoping that, if a discussion had followed my paper, some facts might have been elicited in relation to them. I found shortly after that the organism I had figured as the young of the Cockle had been very fully described by M. Lacaze-Duthiers, in the "French Annals of Natural History" (4th series, vol. 1), under the name of *Bucephalus Haimeanus*, and although the organism I figured as the young of the Marine Mussel has, as far as I know, never been named, it is evidently closely allied to *Bucephalus Haimeanus*, and, in all essential particulars, has the same life history as far as I have observed. When I promised to give a paper on these two organisms, I intended to bring before you previous observations and conclusions in reference to them, but since the Secretary of "The Royal Microscopical Society" has in their Journal for the current month given an able *resumé* of the subject, I feel it would be merely wasting time to go over the same ground. It will suffice here to say that M. Lacaze-Duthiers considers *B. Haimeanus* the cercarian form of some unknown *Distoma*, and describes the tubular structure in which it is found as a collection of sporocysts or nurses which he mentions as filling the abdominal glands of oysters and cockles, and rendering them sterile, his opinion being based on the likeness of this organism to the *B. polymorphus*, described by Von Baer, supported by his own observations, last autumn. M. A. Giard announced, in a note to the *Comptes Rendus*, a translation of which appeared in the December number of "The Royal Microscopical Journal," that he had discovered this organism encysted in the common Garfish, *Belone vulgaris*, which, as you know, visits our shores annually, and in some parts is known as the mackerel guide. I have no intention, gentlemen, of disputing these statements; efficient observers consider them facts, and I am thankful for the light they bring. My experience, however, of these organisms has been somewhat different, and as I wish, as far as possible, to avoid giving a controversial tone to my paper, I think it best merely to relate in detail the reasons which led me to a different conclusion, feeling sure that arguments about opinions tend rather to confirm in error, if a mistake has been made, than to settle a question which requires for its elucidation fresh facts or confirmation of facts already recorded. And it is my hope to induce members of the Quekett to examine the subject for themselves, so that the life-history of these organisms may be fully settled. When I first saw M. Lacaze-Duthiers' paper it was a great pleasure to me to read his account of an organism which had occupied a good deal of my attention, and to recognise, in the description of so good an observer, much with which I was familiar; and you will see that the facts I have observed have been much the same as those recorded by him. I have, however, never found *B. Haimeanus* in the oyster, although receiving both oysters and cockles from the Hayling oyster beds, where, as they are in juxtaposition, it would appear probable that this organism might be found in both, if parasitic. I have also never found it in cockles containing spermatozoa, but only in those containing eggs, and never before the eggs were fully formed. These statements represent the examination of a large number of these molluscs, and although the explanation of this limitation may be of a local character, yet it had a decided effect in forming my opinion. Before going further, I think it may make the subject clearer to some here if I give a very brief outline of the facts (for which we are indebted to the observations of Nitzch, Siebold, Bojanus, and Steenstrup) concerning one of the *Cercariæ*, whose life-histories have been the most clearly traced. Eliminating minor details, about which differences in opinion exist, it appears to be briefly as follows:—The perfect sexual form of fluke, found in certain water snails, lays eggs which are supposed to develope into a small vermiform organism of a yellowish colour, about two lines in length, which may be found adhering in large numbers to various parts of the snail, in which the *distoma* is parasitic. After a time the interior of these small vermiform organisms is observed to be occupied with a numerous progeny, which, being set free from this *nurse*, or *sporocyst*, and also from the host, appear as freely moving *Cercariæ* in the water; in this state they have a movable tail, a head furnished with hooklets and a sucking mouth; these *Cercariæ* may be seen attaching themselves to the skin of the snail into which, their tails being cast off, they penetrate more or less deeply, and become encysted in a case of hardened mucus—after a time undergoing a further development into a well-formed *Distoma*, and then becoming distributed to their appropriate parasitical habitat. Siebold, however, thinks that the free *Cercariæ* may penetrate insect *larvæ*, and await their transference to higher organisms. So that we get first the *ova* from the Distoma, supposed to develope in a way not clearly traced into a sporocyst containing a large number of *cercariæ*, sometimes all well formed, sometimes found in various stages of growth; these are set free from the nurse and the host in a way not clearly made out, and are then found as freely moving organisms which attach themselves to the outside of a snail, become encysted, and ultimately develope into sexual *Trematodes*, whose eggs start in the same round again, thus forming a complete case of alternation of generation.

Such a history as I have sketched was supposed to apply to *B. polymorphus* somewhat modified, differences of opinion, however, existed on some points, and M. Lacaze-Duthiers, after alluding to them, goes on to say "that it is still permissible to employ the name *Bucephalus*, given by Baer, while waiting for clearer light as to the transformations of this being;" he accordingly names one of the organisms I bring before you to-night, *Bucephalus Haimeanus*, after his friend M. Haime, and describes the tubular structure in which they are found as sporocysts or nurses. This structure I have always found branched, as shown in the diagram. M. Lacaze-Duthiers says of it, "Taken out of the organs they unwound in long white filaments, which were very fragile, so that it was very difficult, I might say almost impossible, to obtain an entire one, so as to be able to examine its extremities." They are doubtless very fragile. I have never seen them unwind as described, but have found it necessary to teaze a portion out with needles in water, to get any good idea of its nature, and it was in this way that I found the bifurcations so evident, and in certain cockles where there were egg sacs these appeared attached as in the diagram; when examining these under the microscope I came to the conclusion that the sacs were anatomically united to the tubular structure. On the supposition that we are dealing with *cercarian sporocysts*, this appearance may doubtless have arisen from such sporocysts being contained in the genital ducts.

The striation perpendicular to the axis, as described by M. Duthiers, is evident in well developed portions of the tube, such portions when ruptured expel their contents with considerable vigour, but I have never observed any other kind of movement.

M. Duthiers gives an account of an appearance of budding, which is figured in the diagram, this I have often seen, and interpreted it from my point of view as the remains of a short branch where an egg sac had been attached, which, when emptied of its contents, shrivelled to this form. The process of development of this structure, which M. Duthiers somewhat obscurely describes, I think I have also observed, and have thought it indicated the rapid growth of a temporary structure fitted to receive its contents; nucleated cells sometimes alone, sometimes in groups, may be seen in certain stages with a $\frac{1}{4}$ inch objective; such cells evidently running more or less in lines. Occasionally I have seen strings of these cells connected together by an indefinite membranous structure. One other point is mentioned by M. Duthiers, namely, an occasional appearance of beading which he compares to a *rosary*, and, if I understand what he alludes to, it has appeared to me to be produced by the stretching of imperfectly developed tubes during their removal from the animal; partial tearing of the structure, in my experience, invariably leads to irregular contraction in fully formed portions from the expulsion of some of the contents. This description applies with equal truth to the similar structure found in the mussel, which, however, has appeared to me somewhat less branched, and less pronounced in its striation. The contents of this tubular structure, about which I will now say a few words, are, first, a number of granular balls, which I have called yelk balls; next the organism named *Bucephalus Haimeanus*, in all stages of growth, beginning, as described by M. Duthiers, as a flattened cone, and progressing through the stages figured in the diagram to this, the most perfectly developed I have seen. It is a rare occurrence to find a cockle exhibiting all these stages, and I have invariably found that the most perfectly developed forms existed when the whole structure was considerably diminished in bulk, which, as I thought, indicated the gradual extrusion of these organism on reaching that stage. M. Duthiers' figure appears to me to have been drawn from a specimen not fully developed. He describes and figures a mouth surrounded with a true sucker; this I have not been able to see as drawn by him. To me it has appeared that the oral aperture was almost identical in all points with such as may be seen in an *Anguillula*, and the only appearance at all resembling a sucking disc in relation to it has been when the creature is strongly contracted, then the oral lips appear somewhat withdrawn within the termination of the body. But as M. Duthiers says that when the animal is strongly contracted the sucking disc disappears, I am unable to say that

I have seen what he describes. He also draws and gives an account of a protuberance about midway in the length of the body, "at the top of which another orifice opens in a transverse direction in the shape of a button-hole." He continues, "I have never been able certainly to ascertain, although all my attention has been fixed on this point, whether this slit communicated with the central cavity. I cannot, therefore, say whether it ought to be considered an anus." I have never made out this protuberance, as clearly as M. Duthiers appears to have done, and think that the slit described may possibly be an optical illusion, produced by seeing somewhat askew the central organ, which I have drawn on an enlarged scale, from a favourable specimen which I took special care in examining. This organ had puzzled me much, and it is the only portion of the *Bucephalus* which has given me the impression of its being a sucker. It is usually seen tilted in relation to the long axis of the body, and I have fancied the œsophageal tube, which is easily traced to this point in well developed specimens, passed through the centre. His description of a central digestive cavity, which M. Giard calls in question, I have also never recognised, but have often seen what appeared like a vacant space of considerable extent in the centre of the body at a comparatively early stage of its development. The long filamentous appendages, which are finely striated throughout their length, much like voluntary muscular fibre, always vary in calibre when extended, being thickest at their attachment, and diminishing toward their free end, the striation varying in closeness with the amount of extension. It is only in an early stage that these arms appear of equal calibre throughout, and then they are very obscurely striated. Beyond the origin of these filaments there is a peculiar structure, darker in colour, and looking like two pads, uniting in the long axis of the body. This is only seen, as in the diagram, when the organism is as fully matured as I have ever observed it. M. Duthiers appears to me to have drawn this portion from an immature specimen. These pads, when examined by polarized light, exhibited appearances which made me think that here might be the beginning of rudimentary shells. The organism found in the mussel is, as you see, chiefly different from *B. Haimeanus*, in the form of its lamellar appendages, but here the difference is very great in all stages of its development, and when matured the contrast is very remarkable, the filaments, instead of ending abruptly in the general structure, are here attached to a large lamellar portion with its striation running in a different direction. The diagram explains this better than any description can; beyond, it exhibits a triangular marking when seen directly in front, but when seen sideways, the appearance is as shown in the diagram, and which I have thought indicated the presence of rudimentary shells of a more defined character than in *B. Haimeanus*. The integuments of both these organisms are finely striated. The only trace of internal structure I have detected is an œsophagus leading from the mouth, and which I thought passed through the central organ. In early stages two vacuoles are generally seen, one at the oral, and the other at the lamellar extremity, and a much larger one I have often seen in the centre, which, however, as it is not invariable, may have been accidently produced. The general contents appear cellular, with only slight differences as to size and colour, when the organism has reached the most perfect stage at which I have seen it. I have now come to the end of all I need at present say about these organisms, and I will only add that if *B. Haimeanus* has been found in the oyster, the interpretation I was led to put on the facts observed must be wrong. The statement that it is so found has, as far as I know, never been confirmed, although it has been repeated. It is contrary to my experience of English oysters, a large number of which I have examined. I need not mention the supposed encystment further than to say, that if it is confirmed in the future, we should be introduced to a life history of a remarkable character, and of great interest. That the ova produced by the perfect Trematode, presumed to develop its sexual character in some voracious devourer of the common Garfish, should be so abundantly deposited on our coasts as to supply cockles with sporocysts, in the number we find them, is such a wonderful phenomenon that we may well hesitate before at once accepting it as fact, seeing that at present nothing is known of the life-history of this supposed fluke, beyond the recorded presence of its sporocysts in certain molluscs, and the encystment of its cercarian form in the Garfish. How the eggs enter the cockle, and then follow their life-history, has not as yet been indicated, and, indeed, nothing is known as to the origin of the structure containing these organisms in the cockle if this hypothesis be true. If a sporocyst, it is an anomalous one, and furnishes a subject for good work in tracing its parentage.

DESCRIPTION OF PLATE III.

Fig. 1.—A nurse of *Cercaria ephemera* provided with a prolonged digestive canal. *a*, mouth cavity; *b*, intestinal canal; *c*, a *Cercaria ephemera* already developed in its interior; *d*, germinative bodies which have not yet become *Cercariæ*. After Siebold. This nurse is found living on *Planorbis corneus*.

Fig. 2.—A portion of the structure in which *Bucephalus Haimeanus* is found, magnified about 12 diameters. *a* is a blind extremity—these are abundant in certain stages; *b* is a peculiar looking nodular termination, perhaps caused by the everted edges of a ruptured portion, a different example of which may be seen at *c*.

Fig 3.—A diagrammatic representation of what looks like the attachment of egg sacs to the structure containing *Bucephalus Haimeanus*. A portion thus teazed out in water, when examined with a high power, exhibits, I think, an anatomical connection between the egg sacs and the tubular structure. The appearance, however, may be caused by the presence of the structure in the genital ducts.

Fig. 4.—*Cercaria ephemera*, after Siebold; it is half the size of his drawing. *a*, mouth cavity; *b*, intestinal canal; *c*, *d*, urinary organ; *e*, queue; *f*, three spots of pigment.

Fig. 5.—*Bucephalus Haimeanus*. *a*, mouth; *b*, lamellar appendages; *c*, pad; *d*, central organ.

Fig. 6.—*Bucephalus*, from *Mytilus edulis*. *a*, mouth; *b*, lamellar appendages *c*, pad; *d*, central organ.

Fig. 7.—Stages of development of *Bucephalus Haimeanus*.

Fig. 8.—Stages of development of *Bucephalus* from *Mytilis*.

Fig. 9.—Granular masses found in abundance in the tubular structure in which *Bucephalus Haimeanus*. and the other *Bucephalus* is found.

Fig. 10.—Diagrammatic figure showing the appearance of the central organ when viewed in the long axis of the body.

Fig. 11.—Diagram of the pad of the *Bucephalus* from *Mytilis edulis*.

Fig. 12.—*Cercaria ephemera* encysted; after Siebold. In the three figures from Siebold I have merely given the outline.

On the Relation of *Bucephalus* to the Cockle.

By W. Fell Woods, Esq.

(*Read April 23rd,* 1875.)

It will be in the recollection of the Club that when Dr. Moore read his paper on the 23rd October opportunity could not be found for its discussion. In referring to it now I shall not touch upon the Mussel, of which I really know nothing. The Oyster has been long studied by me, and Dr. Moore will remember that I read a paper "On the Reproductive and Larval States of the Oyster" at our local Society at Forest Hill, in 1872. But I do not propose saying anything to-night concerning either the Oyster, or Dr. Moore's remarks thereon, save that I am glad to find he now supports many of my observations, though I do not think that he carries his evidence of its hermaphrodism, or, more strictly speaking, of its self-fertilising power, so far as I have done. Of his drawings, I think Figures 5 A and B (*Ostrea edulis*) are not altogether happy illustrations of the stages they are supposed to represent.

I turn now to "the Relation of the *Bucephalus* to the Cockle;" and I ought, perhaps, at once to state that, in reference to the views which may be expressed, Dr. Moore and myself have not acted in concert, but with complete independence. When, however, both had offered papers on some branch of the subject, he suggested that, as I had proposed treating it in reference to the Cockle, he should deal with the Mussel.

As Dr. Moore's drawings (*Cardium edule*) in the last number of the "Quekett Journal" (No. 28) sufficiently resemble and confirm my own, and the April No. (76) of the "Monthly Microscopical Journal" contains copies of some of the drawings of *B. Haimeanus* by M. Lacaze-Duthiers, I have thought it needful to trouble you only with such rough outlines of my own as were absolutely needful by way of supplement.

The recorded notes of my observations extend to nine only of the months of the year. In neither year do I appear to have made any examinations in September, October, or January.

Each statement now advanced I have verified by extracting from my note books the date of at least one of the observations on which it is founded.

It was during my investigations into the development of the eggs in the Oyster that, for purposes of comparison, I opened a Cockle on the 14th June, 1872. I therefrom obtained a mass of seemingly orange-coloured tubing, which lay amongst the muscles and around the liver and other organs of the mollusc. It was seen to be occasionally branched, to be distended in some places, and constricted in others.[1] When severed there were poured forth, in various stages, then roughly sketched, the forms of the creature now believed to be *Bucephalus Haimeanus*.[2] I exhibited it at our local Society, and subsequently, in the spring of 1873, at the Annual Soirée of the Quekett, as a "Marine Parasite," that having been my first impression of its character. I thought I observed a motion of severed parts of the tube,[3] indicating its separate existence as a mother or nurse of this progeny, but, from other observations, it seemed more likely that the movements were only due to the constriction or collapse of the tube upon its evacuation by the bodies contained near the fracture, and by the subsequent passage of those higher up, for whom room was thus made. Moreover the tube appeared to be continuous and of immense length ;[4] portions of the stem were sometimes frequently branched, and I think also the branch was sometimes bifurcated. No one seemed to know anything about it, and possibly through not being shown in my capacity as a member of the Quekett, but only as one of the visitors from a local society, who, I think, formerly did not fare so well in the arrangements made as they now do, it was the less prominent, and scarcely attracted notice. Referring to Diesing, I was thrown off the scent by his making no mention of any parasite in the Cockle. I continued my observations on a large number of Cockles in various conditions during different months, constantly strengthening the idea which soon presented itself, that, instead of

[1] Fig. A.

[2] Fig. H. Only the earlier stages are here shown; the specimen contained all stages from spheres to well-developed *Bucephalus*.

[3] June 14, 1872. February 28, 1873. May 20, 1873.

[4] June 14, 1872.

being parasitic, the creature was a larval form of the Cockle; and, accordingly, from time to time, I exhibited it under that designation. Of course I may be altogether wrong in my interpretations, and may but exemplify the truth of the proverbial expression that "first impressions are always the best;" but if so, I may probably by this paper assist in guarding some other observer against similar error.

The reasons for my opinion were these: I found five prominent states of the area occupied by the reproductive gland; the *first* revealed bunches of lobules containing spermatozoa[5] and *possibly* ovules; the *second*, similar bunches of lobules filled with well-defined eggs,[6] which exhibited each its capsule affording a *zona pellucida* around a membrane containing a mass of vitellus, within which was a germinal vesicle with so-called spot. There might be indications sometimes of a change in the latter, and also in the vitellus, but I never found in the sacs an egg *segmented*. This being so, and further never seeing any appearance of emptied sacs, pointing to a discharge of the eggs, the *third* state of the Cockle was now examined as to its possible connection with the two former. This third state was that which displayed the developed tube, sometimes containing only or mainly spherical masses of cellular structure in a membrane, at others several or all of the stages up to the fully developed *Bucephalus*.[7] It must, however, be noted that, whilst many of the masses answered in size to what the eggs of a Cockle should be when segmented, yet they were frequently so much less opaque than I should expect that others could be seen through them.[8] Yet a *fourth* state there was,[9] in which, besides the tube with its contents, there were co-existent—sometimes, perhaps, in the tube, but certainly in the ovisacs—full-sized eggs of the Cockle. As a *fifth* state, I believe that on one occasion,[10] I found in the tube, together with early forms of *Bucephalus*, the same eggs as in the second state of the gland. Hence it seemed highly probable that the spheres usually found in the tube might be the segmented eggs,[11] whose continuous development up

[5] April 19, 1873. April 25, 1873 (No. 5). May 2, 1873. April 18, 1874.
[6] April 14, 1873. April 16, 1873.
[7] June 14, 1872. February 18, 1873. March 21, 1873. April 29, 1873. May 20, 1873. May 27, 1873.
[8] February 18, 1873. April 29, 1873. December 9, 1874. Fig. B 2.
[9] July 4, 1872. April 16, 1873 (No. 2). April 29, 1873 (No. 3). May 9, 1873. May 17, 1873 (No. 4). May 20, 1873.
[10] April 16, 1873.
[11] March 21, 1873. May 9, 1873. May 12, 1873. Figs. H, J, and K.

to a larval form was henceforth so easily traced. One objection to my hypothesis suggested itself, viz., the fact that many of the spheres seemed too small to be developing eggs.[12] But there is considerable variety in the size of the eggs of the Cockle whilst in the sacs,[13] and I have seen similar variety of size in the *segmented* eggs of the Oyster when discharged into the mantle for incubation. Moreover, there is an advanced stage in the Bucephalus in which the embryonic buddings of its limbs become almost invariably detached whilst in the tube,[14] owing partly to the struggles of the most advanced specimens, or to the rough usage sustained in their exit from the broken tube, and these portions appear to correspond thoroughly to the small spheres; the different stages of the creature being so often contemporaneous in one or other part of the tube,[15] that under any of the conditions my difficulty was met, and the objection vanished.[16] For several seasons I had offered rewards for Cockles in spawn, meaning thereby such as had eggs incubating in the mantle, as in the Oyster, on the supposition that the statements of the fishermen that they had seen them might be correct. But though very anxious to obtain the reward, the "cocklers" never succeeded, and many now believe they were mistaken.

Although I observed the co-existence of, I did not trace any direct connection between, the ovisacs and the supposed uterine tube,[17] yet it seemed possible that the latter might be either the development or the prolongation of the tube into which the ovisacs all led; it appears impossible to disentangle the latter from the former so as to trace either. Seeing, moreover, that when the tube was present, it always exhibited, except when evidently just emptied,[18] some stages of the same contents; whilst no other development of the ovisacs themselves, nor of the unsegmented eggs in the ovary, either in the presence or the absence of the tube, was ever traceable; and when, lastly, the same eggs were

[12] February 18, 1873. April 29, 1873 (No. 3). Fig. H 1.

[13] April 14, 1873 (No. 2). May 20, 1873. July 9, 1873 (No. 2). March 5, 1874. Figs. E 1 to 5; F 1 to 3; G 1, 2.

[14] April 12, 1873 (No. 4). May 20, 1873. Figs. J 1 to 3.

[15] June 14, 1872.

[16] Since this paper was read, I have found a Cockle (April 29, 1875) in which none of the spheres equalled in bulk the vitellus of the eggs then present in the sacs, whilst the number of *small* spheres seemed so great, and they appeared so situated in the tube, as to be incompatible with the theory of detached members.

[17] April 29, 1873 (No. 3).

[18] April 16, 1873. Fig. C.

found, sometimes in the ovary and sometimes in the tube, I seemed shut up to discard the idea that this frequently branched and extremely lengthy tube could be other than a legitimate organ of the Cockle, and to suggest the theory I still advanced on the 4th November last, at a meeting of the Royal Microscopical Society, that this *Bucephalus* might be the *larval form of the Cockle.* There is another consideration which may strengthen my position (though its contrary would not necessarily invalidate it), viz., that if this be a parasite we ought certainly to find it when the male element of the Cockle is visible in the gland, and, though I cannot of course affirm that it may not be so found, I doubt if I have observed it.[19]

Moreover, when in May, 1873, Dr. Moore became interested in this creature, his examination of Cockles, which I sent him from time to time, led him to the same conclusions.

The observations which I have now laid before you are all taken from notes made, from time to time, by me prior to the last mentioned date; and the two series of observations are therefore independent and corroborative.

But I must now adduce two recent observations of great interest, inasmuch as not only do they confirm the fourth and fifth states, but one of them offers a *sixth* still more valuable. The first was on the 6th and 7th of the present month. The tube was most distinctly branched, composed of two layers, and in other ways as usual; in removing a portion I obtained also a large piece of racemose structure, quite unlike the tube,[20] and which it was not possible either to disentangle from it, or positively to trace to a junction with it. With lens or under microscope, it proved to be two or three of the usual bunches of lobules. Both tubes and sacs contained similar eggs variable in size,[21] the tube seemingly having a larger proportion of the larger size. The eggs differed somewhat from those usually seen in the sacs, in that their capsules, if they had them, were contracted, or not yet enlarged, so as scarcely to show any zona pellucida. They had but little yelk, and in fact were in an early stage.[22] Lifting a portion of the tube

[19] This argument must be abandoned, as on May 3rd I found a Cockle having both the tube with sundry stages of *Bucephalus* and sacs containing spermatozoa.

[20] Figs. D 1 and 2.

[21] April 6 and 7, 1875. Figs. F 1 to 3.

[22] Compare Cockle eggs, no tube, April 7, 1875. Fig. E 5.

with a needle, the eggs, having considerable space available, shifted easily to and fro in the tube.

The second case was noted on the 14th and 16th. Here there was a tube which gave the impression of having been recently emptied. The Cockle was not very fresh, and may have been delivered in the fresh water in which it had been placed. Bunches of sacs were found in every part; they were filled with eggs like those just described, and noted as precisely the same as previously seen in the tubes.[23]

The bearing of these cases I shall presently indicate. Meanwhile I must revert for a moment to the true character of the ovisacs of the Cockle. I doubt whether they are really composed, as Dr. Moore suggests, of *two* membranous sacs, one within the other; if so, the outer seems to have disappeared when the eggs have begun to develop; and differing from him, I suppose the tube to be continuous, at least by its inner layer, not with the outer sac, if such exists, but with that which contains the eggs and answers to the inner sac of Dr. Moore. Some of the characteristics of the sperm sacs and ovisacs make me still doubtful of the hermaphrodism of the Cockle.

The discovery by Mr. Badcock of some free specimens of *B. polymorphus* in his aquarium was the means of calling my attention, last December, to existing descriptions of the *Bucephalus*, and upon these I wish to make a few comments. Of course the existence of *Bucephalus* in creatures whose own progeny has been traced would settle the question of its parasitic nature; if, therefore, the observations of M. Lacaze-Duthiers as to its presence in the Oyster be reliable, the Bucephalus found in our Cockle is a parasite. But, then, as I shall show, some interesting facts disclose themselves; for if the observations made by me are correct, it follows that the statements of M. Lacaze-Duthiers will not altogether hold good—at least they will not apply to the Cockles of our harbours. It is certainly curious that, whilst among those of the locality in which my observations are made the *Bucephalus* is found in so large a proportion, I have never seen it in a single Oyster from the same place.

With regard to the development of *Bucephalus* described by Lacaze-Duthiers some differences have been noted by me. He says that from a perfectly transparent spherical globe, without

[23] April 14 and 16, 1875.

vesicle, germinal spot, or vitelline granulations, its first step is elongation, it then becomes oval, after which nipples appear, which also elongate, &c. Whereas I have shown eggs to be contained in the tube, and spheres, not perfectly clear, but of the same structure as that which the embryo continues to exhibit until it approaches its full development.[24] These spheres become oblate, and then follow the course described by our author. He omits, however, to state that this development is made, until near the final stage, within an elastic membrane, in which I have seen the embryonic tentacular filaments uncoil and re-coil.[25] The well-developed creature seems to me to display not one but three cavities,[26] or if that in rear of the mouth is really one with the central cavity, I find another near the base, which no doubt also communicates with the latter. Both are so variously distended and contracted that their apparent size and position are very changeful, but when they approach each other most nearly they appear to be separated by a very well-defined partition. A rough outline may serve to indicate this.[27] I am not sure that the basal filaments are attached precisely in the manner shown by the French writer. He also evidently considers them as cylindrical, which they may be: but I once watched one of a pair which had been detached in the tube, and it continued its contortions for a long time, as when well-developed they always do, allowing its base end especially to be very fairly seen through the tube. The filament appeared more like an eel cut open than a cylinder, the edges being curved inwards; this was caused, I think, by a groove or channel along its centre.[28] It is questionable whether the basal appendages are a necessary feature of every *Bucephalus*; whilst many partially developed are only mutilated by accident,[29] there are many very well advanced which appear fairly perfect without them, and I doubt if sufficient detached limbs could be found to match them. Is it possible there can be a difference of sex with which these are connected? Since, also, I have never seen any *Bucephalus* which exhibited a contour exactly corresponding to either of the French drawings of *Haimeanus*, there may be a slight difference in the English kind.

[24] June 14, 1872. February 18, 1873. March 12, 1874. Fig. H.
[25] April 11, 1873. April 29, 1873. May 20, 1873. Figs J 1 to 5.
[26] April 29, 1873. May 20, 1873. May 27, 1873.
[27] June 16, 1874. November 25, 1874. December 9, 1874 (No. 6). Figs. K 1 to 3.
[28] November 25, 1874. Fig. L.
[29] February 18, 1873.

I have mentioned these features chiefly to invite the comparison of other observers.

In conclusion: there are two points upon which I do not feel quite certain that I understand M. Lacaze-Duthiers' views. I think he indicates his belief that a tube is a sporocyst, a mother, a larva; and he speaks of the tubes as "unrolling themselves." I do not find this. Neither, if the eggs are found both in the ovisacs and in the tube, can I disconnect the two, nor think of the tube otherwise than as a continuation of the genital canal. Again, he speaks of the Helminth as occupying principally the conduits of the genital glands and even the interlobular spaces, and thus rendering the mollusc sterile. If he refers to *Bucephalus* itself, I find it only in the tube, whatever that tube may be; whilst the indubitable presence contemporaneously of eggs in the ovisacs disproves the alleged sterility.

The co-existence of lobules of eggs with the tube, supposing the eggs to be those of the Cockle, and the tube a trematode or sporocyst, disproves the sterility which Lacaze-Duthiers asserts to be caused by the presence of the latter. If the eggs found in the ovisacs be those of the parasite, then, not only has it eggs, which our author denies, but, the tube ceases to be a sporocyst, and is a normal uterine organ developed in connection with the ovary.

The results yielded by this inquiry seem to be these:—

Either *first*—The *Bucephalus* is the larva of the Cockle (and if not, it remains an interesting question for solution, what is ?).

Or *second*—The *Bucephalus* is a parasite; but if so, it does not render the Cockle sterile, as asserted by Lacaze-Duthiers.

And *third*—The connection of the tube with the ovisacs, as established by the presence of eggs in both, proves that it is not an independent sporocyst, as asserted, but an organ of the Cockle.

Whilst *fourth*—If this connection be denied, though the case of the 6th April seems to render it certain, the *Bucephalus* must still be developed from eggs seen in the tube, in contradiction of a third assertion by Lacaze-Duthiers.

EXPLANATION OF PLATES IV. V.

These drawings are not made to scale, save when so indicated. The magnifying powers employed were generally 60, 170, and 310 diameters.

A. Piece of tube (sporocyst of von Baer and Lacaze-Duthiers) showing branched structure, taken from Cockle, June 14, 1872. 1 and 2 branches severed in removal.

B 1. Tube with constrictions. 2. Piece more largely magnified, showing semi-transparency of spheres.

C. Tube showing contraction of the inner membrane when emptied.

D 1. Tube. 2. Ovisacs (showing their relative proportions) containing the same eggs, taken from Cockle, April 6th, 1875. All the ovisacs were filled with eggs.

Figures E, F, and G are to scale, being rendered about 150 times their natural diameters.

E 1, 2, 3, 4, 5. Eggs of various sizes taken from ovisacs of Cockles.

F 1, 2, 3. Eggs taken from both ovisacs and tube in Cockle, April 6, 1875.

G 1, 2. Eggs taken from ovisacs, April 14, 1875. Tube present, but none found therein.

Figure H 2 is about 150 times its natural diameter.

H 1, 2, 3, 4, 5, 6, 7. Spheres and subsequent developments of the embryos taken from a Cockle.

J 1, 2, 3, 4, 5. Embryos developing ; the dotted line shows the enveloping membrane. 4 and 5. Instances of the extension and retraction, &c., of rudimentary filaments.

K 1, 2, 3. Outlines of the cavities in *Bucephalus* (? *Haimeanus*).

L. Root end of filament.

On the Organic Structure of Flint and of Meerschaum.

By M. Hawkins Johnson, F.G.S.

(*Read* May 28, 1875.)

Given a sufficient amount of earnest investigation, and, I imagine, there is no object in nature that will not prove a mine of delightful surprises. At all events I have found it so with a series of bodies which at first sight appeared most unpromising. I allude to the nodules found in sedimentary strata, and which Geologists have generally dismissed from further consideration by calling them concretionary.

To two different species of these nodules I wish now to call your attention :—To Flints, which occur in the Chalk, not only in nodules but also in tabular sheets, and to Meerschaum, the substance of which the bowls of tobacco pipes are sometimes made, and which also occurs in nodules and in sheets.

I have two facts to announce which, I believe, have not been previously noticed. The first is, that the organic structure of Flint may easily be made visible by staining thin splinters with acetate of rosaniline. The second is, that Meerschaum is a fossil sponge.

The diagram No. 1 represents a piece of Flint thus stained as seen with a 1-in. obj. glass, when illuminated by means of a parabolic condenser beneath the stage, so as to give a dark background. The upper part of the object being thicker than the lower, the colour is more striking, while the lower part, being thin, the meshes of the net-work are transparent and therefore dark. It is mounted in a dry cell.

The diagram No. 2 represents the structure of Meerschaum. To render this structure visible requires a little care, for a slice of Meerschaum mounted in Canada balsam is transparent, and in appearance almost structureless.

The method I have adopted is to take a slice $\frac{1}{8}$in. thick, to boil it in water to expel the air, and then to boil it in solution of acetate of rosaniline, dry it, saturate it with balsam, harden the balsam by heat, grind one side smooth, fix it on a glass slide with hard balsam, grind it thin, and wash slightly with oil of turpentine. Do not put a glass cover over the object. Illuminate by means of a parabolic condenser beneath the stage, and examine with a 1-in. obj. glass, and you will see what I have depicted.

This adds one more to the list of nodular bodies, the minute structure of which I have found to have a decidedly organic character. They are as follows:—

1.—Meerschaum.
2.—The Kunkur of the Doab in India.
3.—The Phosphatic Nodules of the Crag of Suffolk.
4.—Menilite from Ménil-Montant, near Paris.
5.—Septaria of the London Clay.
6.—Race of the Woolwich Beds.
7.—Flints of the Chalk.
8.—Iron Pyrites of the Chalk.
9.—Green-coated Nodules of the Chalk Rock.
10.—Phosphatic Nodules of the Cambridge deposit.
11.—Phosphatic Nodules of the Gault.
12.—The Oolitic Bodies.
13.—Ironstone in Coal Measure Sandstones.
14.—Chert of the Mountain Limestone.
15.—Phosphatic Nodules of the Lower Silurian strata of North Wales.

As a note to the foregoing remarks, I wish to add, that, by the aid of acetate of rosaniline, the pale green substance in the green marble from Connemara may be shown to be a very beautiful fossil sponge.* This is especially interesting, as, on account of its being in age and appearance not unlike the Eozoönal Limestone, the Connemara marble has been carefully searched, I believe hitherto without result, for organic remains. Perhaps this method may now lead to their detection, not only here, but also in other places where their existence was not even suspected.

In the same way I have found the soluble-silica rock from the neighbourhood of Farnham, in Surrey, to be a silicified sponge.

Those who wish to study the chemical action of silica on the aniline bases will find some interesting matter in an article by Wm. Skey, "Chem. News," vol. xxx., p. 45; also in one by M. Reimann, "Chem. News," vol. xxii., p. 83, and "Journ. Chem. Soc.," vol. xxiv., p. 452.

The development of fossil structures to which I have alluded appears to be due to the fact that one portion of the mass is in such a condition that it is more readily acted on by the reagent than the other.

The acetate of rosaniline is by no means the only substance that I have found useful in discovering these hidden structures; nitrate of silver is sometimes even more efficacious, and the acetate of iron will often answer the purpose. The object to be effected is to render one portion opaque or strongly coloured relatively to the other, so that the difference between them may be detected, which, while they are both of the same colour and equally transparent is impossible.

* Also that the serpentinous rock, largely quarried in the Isle of Anglesea, about 50 years ago, and used in London for ornamental purposes under the name of Mona marble, contains a considerable amount and a considerable variety of similar structures.

PROCEEDINGS.

FEBRUARY 26TH, 1875.—DR. MATTHEWS, F.R.M.S., PRESIDENT, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following additions to the Library were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	"
"Proceedings of the Royal Society"	the Society.
"Proceedings of the Literary and Philosophical Society of Manchester" ...	"
"Seventeenth Report of the East Kent Natural History Society" ...	"
"The American Naturalist"	in exchange.
"Carpenter on the Microscope"	by purchase.
Six Ordnance Maps of Districts round London for the use of the Excursionists	Mr. T. C. White.
Lewis's Hæmatoid Entozoa	the Author.
Lewis and Cunningham's report on Cholera ...	the Authors.

The thanks of the Club were voted to the donors.

The Secretary read a letter which had been addressed to him by the Secretary of the Tower Hill Microscopical Society, conveying the thanks of that Society to those members of the Club who had rendered their services at the Society's recent Soirée.

A letter was also read from Mr. Robson intimating that the usual rooms in University College would be placed at the disposal of the Club for the purpose of their Soirée on Friday, April 16th, by permission of the Council of the College.

A letter from Colonel Horsley to Mr. Curties with reference to a possibly new *Vaginicola* was also read to the meeting.

The Secretary stated that the letter was accompanied by a very nice drawing by Mr. Fullagar, and though it bore some resemblance to one drawn by Pritchard (*Vaginicola decumbens*) there appeared to be some differentiation from it, and the opinions of those members of the Club who were acquainted with these organisms were requested upon the subject. The drawing was pinned upon the black board for their inspection at the close of the proceedings. The Secretary said that as he had mentioned Mr. Fullagar by name he would take the opportunity of calling attention to an article by that gentleman which appeared in "Science Gossip" for that month—"On the Development of *Lophopus crystallinus* from the Statoblasts"—because he thought that this was one of the best kinds of work that a microscopist could take up, and that every opportunity ought to be taken to bring such work under the notice of the members in order, if possible, to induce them to go and do likewise.

The following gentlemen were ballotted for, and duly elected members of the Club:—Mr. Edmund Gardner, Mr. Christopher Holford, and Mr. W. J. Scofield.

The President said he had a very pleasing duty to perform in making the announcement to the Club that a gentleman who was well known to them had given the sum of £20 annually for five years for the purpose of promoting the interests and welfare of the Club. This gift was not offered under any conditions or restrictions, but it was left to the deliberations of the committee to decide in what manner it should be appropriated. This being the case he had summoned a special meeting of the committee to meet at his house to consider the question, and they had arrived at some conclusions which were embodied in a report which he held in his hand, and would presently read. In considering the matter the committee had studiously avoided one aspect of it; it was thought by them that any process leading to a spirit of undue competition should be avoided. They also thought that it was very undesirable that if a member was doing work of any kind, he should be incited to leave it in order to embark in any other kind for the sake of emulation or competition, but that good work in any way should be recognised. Work itself, he felt sure, needed no reward, for truth was the end to which it was the way. There was, however, always a spice of ambition in every human breast, and to be recognised amongst their fellows was a distinction which all might aim at. Gentlemen were, therefore, not asked to leave their own particular work, but by steadily pursuing it they might rest assured that it would unfailingly be recognised. The President then read the report of the special committee, and the rules which they had drawn up for the award of the sums placed at their disposal (printed page 47).

The President said that a most pleasing duty devolved upon him in connection with this matter, namely, that of proposing a vote of thanks to Mr. Frank Crisp for his munificent donation.

The vote of thanks was then put from the chair, and carried by acclamation.

Mr. Lowne delivered a lecture on the "Histology of the Eye."

The President said he was greatly interested in the subject which had been brought before them by Mr. Lowne, and he hoped they should be able to prevail upon that gentleman to give them his further remarks upon it. He had in his possession a little book which related to the question of seeing in various ways the different parts of the eye for oneself; it was entitled "Entoptics," by Dr. Jago, and it showed how anyone might get views of these parts. It was a very curious and interesting little work, and he should be happy to show or to lend it to anyone who felt interested in such matters. With regard to the question of relative estimate of light, they all knew that the light given forth by the moon was invariable, because it was derived from an invariable source. When it was seen in the sky in the day time its brilliancy was no greater than that of a white cloud of equal area, but at night its light appeared very great.

Certificates in favour of gentlemen proposed for membership were read, announcements of meetings, &c., were made, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Melicerta, *Floscularia*, *Vorticella*, and *Plumatella* (from Statoblasts) ...		by Mr. Badcock.
Desmidiaceæ (collected at Southall) ...	...	Mr. Bartlett.
Polyxenus lagurus (alive)	...	Mr. W. G. Cocks.

Pteris aquilina	Mr. Goodinge.
Tongue of Blow Fly	Mr. Richards.
Atropos pulsatorius	Mr. J. A. Smith.
Tooth of *Miliobates* (transverse sectiou) ...	Mr. Topping.
Membrane from head of Earwig	Mr. R. P. Williams.

Attendance—Members, 91; Visitors, 11. Total, 102.

March 12th, 1875.—Conversational Meeting.

The following objects were exhibited:—

Carchesium and *Epistylis*	Mr. Thos. Bolton.
Lophopus crystallinus	Mr. W. G. Cocks.
Micro-photograph—Conference of Engineers —Menai Straits...	Mr. F. Coles.
Aulacodiscus formosus	Mr. Dunning.
Phyllobius Alneti	Mr. Enock.
Polystomella, from Baldjik Marl	Mr. Glasspoole.
Section of hand—Seven weeks' human fœtus ...	Mr. W. W. Jones.
Section of Retina of Sheep	Mr. E. T. Newton.
Batrachosper um moniliforme	Mr. Sigsworth.
Section of Bramble Stem	Mr. Slade.
Larva of *Dytiscus*	Mr. J. A. Smith.
Astromma Aristotelis	Mr. Topping.
Balanus balanöides, in various stages of development	Mr. T. C. White.
Alveolated surface of Cæcum (injected) ...	Mr. G. Williams.

Melicerta, *Carchesium*, &c., were distributed by Mr. Thomas Bolton, and *Lophopus* by Mr. Fullagar, of Canterbury.

Attendance—Members, 70; Visitors, 9. Total, 79.

April 9th, 1875.—Conversational Meeting.

The following objects were exhibited:—

Section of Palm leaf (polarised)	Mr. M. Burgess.
Corethra plumicornis	Mr. Enock.
Fragment of Derbyshire Spar	Mr. Golding.
Hydractinia (alive)...	Mr. Goodinge.
Transverse section, Spinal Cord of Frog (injected)	Mr. Grayling.
Section of Human Ovary, showing ova, *in situ* (under $\frac{1}{20}$ objective)	Mr. W. W. Jones.
Raphides from inner bark of *Quillaya saponaria*	Mr. T. Terry.
Human Spermatozoa	Mr. Topping.
Laomedea flexuosa (alive)	Mr. T. C. Whlte.

Attendance—Members, 65; Visitors, 2. Total, 67.

ANNUAL SOIRÉE.

April 16th, 1875.

The Annual Soirée was held, by permission of the Council, in the Library and Museum of University College. About 100 microscopes were exhibited by members, and about 50 by members of the South London, the Croydon, the Sydenham, and Forest Hill, and the Tower Hill Microscopical Clubs. The attendance was large, and the meeting highly successful.

The following objects were exhibited by our members, and those of the above-named clubs:—

Circulation in leg of Spider	Mr. W. Adkins.
Tongue of Bee	,,
"Lady bird," shown in a curious old microscope, with very large field of view ...	Mr. Alfred Allen.
Vertical section—bud of Plum	Mr. J. Alstone.
Pupa of Earwig (*Forficula auricularia*) ...	Mr. A. R. Andrew.
Section—Spur hoof of Ram (injected)	Mr. F. W. Andrew.
Drum of ear of Frog (injected)	,,
Ecchinococci	Mr. H. Ashby.
Tongue and foot of Blow-fly, &c....	Mr. A. Atkinson.
Melicerta, *Plumatella*, &c.	Mr. J. Badcock.
Arachnoidiscus on sea-weed	Mr. E. Bartlett.
Bicellaria ciliata, &c.	,,
Foraminifera, &c., with Erecting Binocular, by two objectives 3in. and 2in.... ...	Dr. G. P. Bate.
Scale of Sole...	Mr. Thos. Bevington.
Head of Vaporer Moth	Mr. W. A. Bevington.
Vallisneria spiralis	Mr. G. Bird.
Wing of *Uranium* Butterfly	Mr. W. Bishop.
Ophrydium pediculum	Mr. Thos. Bolton.
Brachionus urceolaris	,,
Elytra of Weevil	Mr. A. Brown.
Fossil Polyzoa from Suffolk Crag	Mr. G. D. Brown.
Decolorized leaves (polarized), &c.	,,
Hydra vulgaris and *H. viridis*, &c.	Mr. W. J. Brown.
Feather of Humming Bird, &c.	Mr. G. Browne.
Young Oysters	Mr. R. Catchpole.
Cristatella, *Stephanoceros*, &c.	Mr. W. G. Cocks.
Specimens of Insect Anatomy	Mr. W. Cole.
Asparagin, Salicin, Santonin (polar)	Mr. F. Coles.
Palate of *Haliotis tuberculata*	Mr. A. L. Corbett.
Transverse section—Tongue of Cat	Mr. A. Cottam.
Echinus spines, and antennæ of Emperor Moth	Mr. C. Creer.
Silky earth Mite, shown by Nachet's "Grand Microscope renversé"	Mr. F. Crisp.
"A dip from a Hampstead Pond"	Mr. J. S. Crisp.
Eggs of Currant Moth	Mr. J. D. Crosfield.
Ptilota elegans	Mr. Ph. Crowley.
Polysiphonia fastigiata	,,

Cingalese flea, *Sarcopsyllus gallinaccus* (n. sp. Westwood)	Mr. T. Curties.
Circulation in *Daphnia*	Mr. E. Dadswell.
Conochilus, *Hydra*, &c.	Mr. G. C. Drew.
Larva and pupa of straw-coloured gnat... ...	Mr. C. G. Dunning.
Gemmules of sponge	,,
Möller's Diatom Type slide, &c.	Mr. J. Everett.
Some beautiful forms of Pond life	Mr. F. Fitch.
Section of Carrara Marble	Mr. H. E. Freeman.
Eggs of *Tetranychus lapidum*	,,
Hydra viridis	Mr. C. J. Fricker.
Hydra viridis, and *H. vulgaris*	Mr. G. Gardiner.
Corethra plumicornis (alive, polar)	Mr F. W. Gay.
Orthotrichum leiocarpum	Mr. E. George.
Pogonatum nanum	,,
Partridge Wood, *Heisteria coccinea*, &c. ...	Mr. E. Gibson.
Thorax of Beetle (*Cyphus germari*)	Mr. W. H. Golding.
Weevil (*Phyllobius maculicornis*)	,,
Section of human kidney	Mr. A. Goode.
Parasite of Canary (*Dermanyssus avium*), living	Mr. J. W. Goodinge.
Larva and egg of Bot-Fly, &c	Mr. C. A. Gould.
Lung of Frog, &c.	Mr. F. J. Grayling.
Triceratium, with seven angles	Mr. G. Green.
Spring flowers	Mr. W. Gregory.
Leaf of *Deutzia scabra*	Mr. J. H. Hadland.
Tingis, new sp. from N. America	Mr. F. H. Hailes.
Aulacodiscus formosus	,,
Conochilus volvox, *Cyclops*, &c.	Mr. W. Hainworth.
Illustrations of the anatomy of the Crane Fly...	Mr. A. Hammond.
Mignonette, &c.	Mr. G. Hardess.
Larva of May Fly	Mr. J. Harrod.
Scale of Sole, &c.	Mr. F. W. Hembry.
Egg of House-fly	Mr. D. W. Hill.
Parasite of Ground Hornbill, &c.	,,
Vorticella, *Daphnia*, *Hydra*, &c.	Mr. G. Hind.
Apple Aphis, &c.	Mr. C. W. Hovenden.
Feathers of Humming Bird	Mr. C. How.
Clava squamata, from the Mediterranean ...	Mr. Ingpen.
Conochilus, *Hydra*, *Cyclops*, &c.	Mr. S. Israel.
Volvox globator	Mr. B. D. Jackson.
Alga, *Ptilota plumosa* in fruit	Mr. E. Jaques.
"Only a Flea"—Pond Life	Mr. E. F. Jones.
Dental plates of *Ophiocoma rosula*	Mr. W. W. Jones.
Eggs and larva of Tiger Moth	,,
Seed of *Adysitum*, polar	Mr. E. Kiddle.
Hoof of Horse	,,
Selected Diatoms	Mr. T. W. Kilsby.
Pernadaris apetas (Australia)	Mr. C. J. Kindon.
Sting of Hornet, &c.	Mr. F. J. Kitsell.
Eggs of Moth—Oak spangles	Mr. H. H. Lake.

Eggs of House-fly	Mr. Le Pelley.
Mud from Cuxhaven	,,
The absorption of coloured glass...	Mr. Jas. Love.
Wing of *Papilio Polyctor*—Exotic Butterfly ...	Mr S. J. Mc Intire.
Foot of Comb-footed Ichneumon fly	Mr. K. Mc Kean.
Section, Foot pad of Elephant	Dr. Mk kechnie.
,, Horn of Bison	,,
Elytron of *Pachyrhynchus orbifer*	Mr. E. Marks.
Diaptomus castor, alive	Mr. Martinelli.
Thallium under the Electric Spark	,,
Canadian Lichens (5 in. objective and sub-stage mirror)	Dr. Matthews.
Sections of Wood	Mr. A. F. Mayhew.
Wing of *Morpho cypris*	Mr. J. Menzies.
Circulation in Tail of Tadpole	Mr. Nelson.
Skin of Camel (polarized)	,,
Parkeria, a gigantic foraminifer from the Chlorite Marl, Cambridge	Mr. E. T. Newton.
Wing of *Morpho Menelaüs*	Mr. M. D. Northey.
Conochilus volvox, &c	Mr. F. Oxley.
Blight on young Shoots of Apple	Mr. T. Palmer.
Hydra...	Mr. W. J Parks.
Dental plates of *Ophiocoma*, &c....	Mr. G. Pearce.
Cirrhi of Acorn Barnacle	Mr. G. Perry.
Gill of Scallop	,,
Spicules of *Synapta*, &c.	Mr. T. Purdie, jun.
Clava squamata, from the Aquarium of Mr. G. H. King...	Q. M. C. Microscope.
Tongue and lancets of Gad-fly, &c.	Mr. G. E. Quick.
Atlantic cable ooze	Mr. E. D. Ram.
Drum of ear of Frog (injected)	Mr. F. Reeve.
Parasites of Long-eared Bat, &c.	Mr. W. W. Reeves.
Section of Human tongue	Mr. E. Richards.
Bristles of Sea-mouse (*Aphrodite aculeata*) ...	Mr. E. Robins.
Skin of Spotted Dog-fish (*Scyllium canicula*)...	Mr. T. Rogers.
Grey Human Hair, &c.	Mr. J. Rowlett.
Cyclosis in *Anacharis*, &c.	Mr. Jas. Russell.
Section of Stag's Horn	Mr. C. S. Rolfe.
Daphnia pulex and *Floscularia*	Mr. Jos. Russell.
Tracheæ of Centipede	Mr. T. D. Russell.
Eggs of Blue Butterfly	Mr. J. Salmon.
Wing of *Morpho cypris*, &c.	Mr. R. Sedgwick.
Antennæ of *Pygara bucephalus*	Mr. J. C. Sigsworth.
Small Feather of the Goldfinch	Mr. J. E. Simmonds.
Circulation of blood in Newt, &c.	Mr. E. Simpson.
Sections of Chalk, Atlantic ooze, &c.	Mr. J. Slade.
Actinophrys, &c.	Mr. W. Smart.
Platino-cyanide of Magnesium	Mr. Alphs. Smith.
Section of Bamboo Cane	,,
Flowering Currant	Mr. Jas. Smith.
Mantle of *Terebratula*, &c.	,,

Lophopus crystallinus	Mr. J. A. Smith.
Nummulina from Pyramid of Egypt	,,
Trichina spiralis	Mr. B. Smith.
Gizzard of Cricket	,,
Section of Jasper and Amethyst	Mr. W. S. Smith.
Marine Life	Mr. C. W. Stidstone.
Phyllobius argentatus	Mr. D. J. Stuart.
Anthers and Pollen of *Hibiscus Africanus* ...	,,
Colorado Potato beetle (*Doryphora decemlineata*)	Mr. J. F. Tafe.
Pencil Hairs of Larva of *Orgyia antiqua* ...	Mr. A. D. Taylor.
Salivary glands and ovaries of Cockroach ...	Mr. T. Terry.
Section of spine of Echinus	Mr. A. Topping.
Injected drum of ear of Frog, &c.	,,
Chaunosea hurtissima (Mozambique), &c. ...	Mr. C. C. Underwood.
Asplenium ruta muraria	Mr. J. S. Walker.
Dysidea fragilis (British sponge)	Mr. J. G. Waller.
Eggs of Lace-wing Fly, &c.	Mr. S. Warburton.
Section of stem of Dog-rose	Mr. H. R. Warrington.
Lunar Crater, in pure silver	Mr. J. Watkins.
Circulation in tail of Gold-fish, &c.	Mr. T. E. Way.
Vorticellæ	Mr. W. West.
Stellate hairs from *Fremontia Californica* ...	Mr. C. E. White.
Spiral vessels of *Collomia* seed	Mr. F. W. White.
Terebella, a Marine Annelid	Mr. T. C. White.
Plates and anchors from *Synapta*, *Chirodota*, &c.	Mr. G. Williams.
Parasite of Irish Bat	,,
Section of Retina of the Sheep	Mr. R. P. Williams.
Mites found in Irish Moss	,,
Brine Shrimp (*Artemia salina*)	Mr. W. Fell Woods.
Daphnia pulex, &c.	Mr. J. W. Worster.

The bays of the Library were well filled with the contributions of the leading London Opticians, who made a brilliant and interesting display of instruments, apparatus, and objects, amongst which the following were well worthy of notice :—

Mr. Bailey—Microscopes; Student's Microscope, with solid tripod and rotating concentric stage; Freezing Microtome; sections of Limestone, &c.

Mr. Baker—New Medical and College Microscopes; series of Objectives with reduced angles of aperture, for histological purposes; collections of Botanical Preparations, by Rodig, of Hamburgh.

Messrs. R. and J. Beck—Microscopes; Popular and small Travelling Microscopes; New $\frac{1}{6}$ and $\frac{1}{10}$ inch immersion objectives; *Pleurosigma formosum*, opaque with $\frac{4}{10}$ and lieberkuhn; series of stained Vegetable Preparations, &c.

Mr. Browning—Universal Automatic Spectroscope, showing spectrum of Indium; Micro Spectroscope, showing absorption spectrum of Cantharides; new Rotating Microscopes, &c.

Mr. Crouch—New Binocular Stand, with improved detached substage; Student's Microscope, with thin concentric mechanical stage; Low-angled $\frac{1}{2}$ inch Objective for Binocular, &c.

Mr. Enock—Collection of Mounted Insects, &c.

Messrs. Horne and Thornthwaite—Microscopes; Table Polariscope; specimens of unannealed glass; sections of Crystals, showing uni-axial and bi-axial systems, &c.

Mr. Moginie—Microscopes. Portable Travelling Microscopes; Portable Lamps; Revolving Stereoscope, with 36 glass stereographs of British, Continental, and American scenery.

Messrs. Murray and Heath—Students' Microscopes; Sea-side Microscopes, &c.

Messrs. Powell and Lealand—New Immersion $\frac{1}{8}$-inch Objective, showing cyclosis in *Vallisneria*.

Messrs. Ross and Co.—Large Microscopes of the Wenham-Ross form; new Portable Microscopes; new large-angled $\frac{1}{2}$-inch Objective; new Diffusion-film Condenser; series of Injections.

Mr. G. J. Smith, for Mr. How—Large Binocular Microscope; Students' and popular Binocular Microscopes; transparent Anatomical preparations, &c.

Mr. Steward—Large Microscope, with very thin goniometer stage; new form of Botanical Microscope, for viewing portions of large objects; series of Transparent Injections.

Mr. Swift—Microscopes; new Portable Microscopes; new low-angled Objectives; new Achromatic Condenser; Portable Lamps, &c.

In the Museum Mr. G. H. King exhibited a large Marine Aquarium, with *Balanophyllum verrucosa*, and *Clava squamata*, from the Mediterranean; another containing *Hippocampi*, &c.; also a Fresh-water Aquarium, with *Triton marmoratus*; cases of Stuffed Fish, &c., &c.

Mr. Lloyd, of the Crystal Palace Aquarium, exhibited some fine living specimens of the Neapolitan Coral, *Astroides calycularis*.

Messrs. Murray and Heath exhibited their New Patent Combination Graphoscope, for transparent and opaque objects; several Stereoscopes, &c., &c.

Mr. Parkes, of Birmingham, lent a number of his Patent Parallel-ray Lamps for the use of exhibitors.

Mr. William R. May delivered, in the Mathematical Theatre, an interesting lecture "On the Extinct Animal Life of the World," illustrated by a large number of photographs and drawings shown by the oxy-hydrogen light.

Mr. G. J. Smith, for Mr. How, displayed views, statuary, microphotographs, &c., by oxy-hydrogen light, at intervals during the evening.

April 23rd, 1875.—Dr. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following additions to the Library were announced:—

"The Monthly Microscopical Journal"	... from the Publisher.
"The Popular Science Review"	,,
"Science Gossip"	,,
"Proceedings of the Royal Society," No. 159	the Society.
"Proceedings of the Literary and Philosophical Society of Manchester"	the Society.
"Annual Report of the Geologists' Association"	the Association.
"Transactions of the Botanical Society of Edinburgh"	the Society.

"Annual Report of the Brighton and Sussex Natural History Society"	from the Society.
"Annual Report of the East London Naturalist's Society"	the Society.
"Microscopical examination of certain mineral waters," by D Campbell and Jabez Hogg	the Authors.
"The American Naturalist"	in exchange.
"The Quarterly Journal of Microscopical Science"	by purchase.

The thanks of the Club were voted to the Donors.

The President then said that it had become his mournful duty to communicate to the Club officially an event of grave and peculiar significance which had occurred since their last meeting, of which the members were doubtless well aware privately, and would understand that he thus intended to inform them of the death of their Treasurer, Mr. Robert Hardwicke. The relations of this gentleman to the Club were so many and so various, and he fulfilled them all with such ability, that the loss to the Society might truly be said to be irreparable. He was one of the founders of their Society, and was always ready to promote its objects, and his great tact and talent in doing so would be acknowledged by all. As their Treasurer, he discharged his duties with uprightness, and in a manner which gave offence to none. As a member of Committee he was never absent from his place unless from unavoidable cause, and greatly would they miss from the accustomed seat his pleasant face and portly form. As their publisher, his services to the Society were very great, for in all times of difficulty his valuable technical experience was readily placed at their service, and his loss to them in this respect could hardly be over-rated. As a man of intellect, his acquirements were far above the average, and it was ever his pleasure to collect around him men of science, by whom it might fairly be said he was held in high appreciation. As a publisher of scientific works he showed great discrimination, and to his judgment many valuable and popular books of this class owed their existence. He (the President) could personally testify to the geniality and evenness of temper ever displayed by Mr. Hardwicke, and he felt sure that all who knew him were able to bear similar testimony to his worth. Another way in which Mr. Hardwicke had been of invaluable service to the Club arose from the circumstance that he had placed his office at all times at their disposal, he received their letters, transacted their business with diligence and propriety, and whilst his assistants were ever ready to afford help or give information to inquirers with cheerful courtesy, his rooms were always at the service of the Society, when special meetings or special business required. For any one of these kindly offices and traits, he would have deserved their thankful remembrance, but when they were all united in one man, they might well honour his memory! A cynic of old had said that gratitude was a feeling largely composed of memory of past and expectation of future benefits, and even on this principle they might surely be grateful to one who had given them so much, and who always led them to expect that he would do still more for them upon future opportunities. Certainly no one regretted his loss more deeply than those members of the Committee with whom he so harmoniously worked. Several of the leading members of the Club, Mr. Bywater, Mr. Cooke, and the Secretary, together with himself, had attended Mr. Hardwicke's funeral, and upon no occasion could it be said that there gathered around a grave more real mourners. He would ask them, therefore, as members of the club to unite with the Committee in endeavouring in some way to express their sympathy with the widow; nothing could console her, that must be left to a Higher Power, but human sympathy was never thrown away, and it had a real value in a time like that. The Committee had passed a vote of sympathy with Mrs. Hardwicke, and he thought it would be fitting that a similar expression of their feelings should be made by the general body of the members themselves.

Dr. Braithwaite said that as a friend of the late Mr. Hardwicke, and as one who had been much in contact with him, he should have much pleasure in moving the following resolutions:—1st. "That the Committee and Members of the Quekett Microscopical Club desire to express their sense of the loss they have sustained in the death of Mr. Robert Hardwicke, the Treasurer and one of the Founders of their Society, and to bear testimony to the great value of the services rendered by him for nearly ten years, not only in adequately filling the office of Treasurer, but also in furthering in all ways that lay in his power the welfare and best interests of the Club. His amiability of disposition, and readiness of resource will ever live in the memories of those who have been associated with him:" and 2nd, "That a copy of this resolution and expression of condolence and sympathy on the part of the Club, be forwarded to Mrs. Hardwicke."

The resolutions having been respectively seconded by Mr T. C. White, and Mr C. F. White,

Mr Golding said that the remarks of the President, and the words of the resolutions would meet with such a real and hearty response from every member of the club that he felt sure no remarks in support would be in any way needed.

The President then put them to the meeting, when they were unanimously carried.

On the motion of the President it was resolved that "these expressions of sympathy on the part of the members be entered on the minutes of the Club."

The following gentlemen were then balloted for, and duly elected members of the club: Mr James Harrison, Mr Charles Nathaniel Peal, and Mr. Henry Williams.

Mr. Hind gave notice that at the next meeting, he would move the following alterations in rule III.:—1st, to omit the words, "That in the event of such nominations exceeding one half more than the number of vacant offices, the candidates be reduced by show of hands to such proportion." 2nd, in line eight, after the word "President" to add "Vice-Presidents." 3rd, in line fifteen, after the word "President" to add "Vice-Presidents." The effect of the first of these proposed alterations would be that the names of *all* the persons nominated as members of committee would go to the ballot, instead of the reduced number; the other proposal would place the nominations of Vice-Presidents in the hands of the committee, in common with those of the President, Treasurer, and Secretaries.

Mr. Hind also moved that the next ordinary meeting of the Club be made special to consider the foregoing propositions.

The motion was seconded by Dr. Foulerton, and carried unanimously.

Mr. W. W. Jones read a short paper describing a contrivance for cleaning thin glass covers, which he exhibited.

The President said he could speak in high terms of this little apparatus; it was very simple, and perfectly answered its purpose.

A vote of thanks to Mr. Jones, for his communication, was passed.

Mr. T. C. White said that it would be remembered that a short time ago he had brought under the notice of the Club a slide of the salivary glands of the cockroach, and that a discussion took place upon the subject. In the course of that discussion some differences of opinion were expressed, but all agreed that the salivary glands were always found collapsed, and the investigations which he had made to that time seemed to confirm the observations. Some weeks ago, however, he had killed a cockroach, and upon dissecting the thorax a bright clear bead of something came out, which he at once snipped off, and put under the microscope, and found it to be composed of fluid containing salivary corpuscles. He then operated upon the other side of the insect, and found that the other sac was filled also with fluid of the same kind. He exhibited the specimen which he had preserved in alcohol.

Mr. W. Carr observed that the salivary sacs could always be found fully inflated if the animals were kept a few days without food and were supplied with only a little water. They used this saliva for the purpose of moistening the food, and after feeding there would be very little of it found in the glands. By adopting the plan named, he had no difficulty in finding the sacs full, and had kept them in this condition preserved in fluid.

Mr. W. W. Jones believed that these observations were quite correct.

The President thought that if these sacs were preserved in fluid, endosmosis would take place to some extent. He enquired if Mr Carr could tell him what was the nature of the fluid.

Mr. Carr was unable to say; but it was something thicker than water.

The President explained that the difficulty of preserving them in fluid arose from the fact that fluids of different densities could not usually be kept separate from each other merely by an animal membrane.

Dr. Moore read a paper "On *Bucephalus Haimeanus*, and another allied organism."

The President thought the subject was a most interesting one, and as on a former occasion they were debarred from discussing it from want of time, he hoped there would be nothing to prevent a discussion on the present one. As, however, Mr. W. Fell Woods had prepared a paper on the same subject, he would call upon him to read it, and the two papers could then be discussed together.

Mr. W. Fell Woods then read his paper "On the Relation of *Bucephalus* to the Cockle."

The President said that having heard these two interesting papers, he should be very glad to hear some further remarks upon the subject from gentlemen in the room. He had seen a paper bearing upon the subject which was written by Van Beneden, a Belgian naturalist who had given much attention to these animals, and who there described a creature which he said was parasitic upon the cockle, and which he called *Mnestra parasites*. He thought that this rather added to the difficulty. He should like to ask Mr. Woods if he thought that the existence of these organisms had any influence upon the diminished supply of oysters in this country?

Mr. Woods, in reply, said that seeing it had never been found in the oyster in England, he thought it could not have any such effect. It had been found in oysters from the Mediterranean.

Mr. Charles Stewart said he was not acquainted with *Bucephalus*, nor was he very well acquainted with the *Lamellibranchiata*, but he had seen this organism exhibited, and he certainly thought it some species allied to a Trematoid worm, for the reason that in the earlier stages of all the *Lamellibranchiata* there is found a locomotive apparatus known as the *Veliga*; it might be described as consisting of a small round mass provided with these sail-like floats, richly ciliated, whereas in the present instance the organism was perfectly without cilia, and therefore not at all like what they knew to be the general characteristic of the young of the *Mollusca*. Another reason why he thought it to be more likely a Trematoid than a Mollusc, was, that if the latter, there would be no difficulty in getting it to develop into its mature condition and this, it would seem, could not at present be done. But if it were a Trematoid they could of course understand the difficulty, inasmuch as it would probably require to be developed in the body of some other "host."

Votes of thanks were unanimously passed to Dr. Moore, and Mr. W. Fell Woods for their papers.

Dr. Moore said he should much like to induce some of the members to take up this subject; at the present time it could be done without difficulty, a pennyworth of cockles would furnish any number of specimens. He thought that the remarks of Mr. Stewart were rather general; he should like to hear of some particular instances.

Mr. Stewart inquired if Dr. Moore wished him to give some instances of the development of some *Lamellibranchiate?*

Dr: Moore said he had developed them himself many times, and did not ask for that; what he meant was that one could not very well argue from single forms when the same kinds often presented so many peculiarities. He had observed many differences in oysters, one from Lisbon showed a large *Zona pellucida*, and in an American oyster a kind of shell was formed in the gland itself; so that he did not think they could argue from any individual species.

Mr. Stewart quite agreed with Dr. Moore as to the latter part of his observations, but with regard to the question before them, he thought that where it was shown that in certain known forms, one uniform character was always present and specially developed, it was more probable that an unknown organism which possessed no trace of that character belonged to some other class rather than to the same.

The President announced that at the next ordinary meeting a paper would be read by Mr. M. Hawkins Johnson, "On the Organic Structure of Flint and Meerschaum."

The Proceedings then terminated wish a conversazione, at which the following objects were exhibited:—

Collection of Australian Polyzoa...	by Mr. E. Bartlett.
Hairs of larva of *Tiresias serra*	Mr. W. G. Cocks.
Pleurosigma angulatum (under $\frac{1}{8}$in. immersion lens)	Mr. Crouch.
Larva of Moth (*Orgyia antiqua*)	Mr. Enock.
Algæ, *Fungi*, and other objects collected in Hackney marshes	Mr. Glasspoole.
Pyrites containing gold	Mr. Golding.
Argulus foliaceus	Mr. Goodinge.
Hydra viridis (with parasites)	Mr. Hainworth.
Transverse section of Penis of Squirrel ...	Mr. W. W. Jones.
Trachea of Centipede	Mr. C. S. Rolfe.
Transverse section of Hoof of Horse (injected)...	Mr. A. Topping.
Spongilla fluviatilis (early development of) ...	Mr. J. G Waller.
Clava squamata (alive)	Mr. T. C. White.

Attendance—Members, 79; Visitors, 8; total, 87.

May 14th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Buccphalus polymorphus	Mr. Badcock.
Leaf of *Eleagnus*...	Mr. G. D. Brown.
,, *Galium aparine*	,,
Argulus foliaceus...	Mr. W. G. Cocks.
Leg of Devil's Coach-horse	Mr. A. L. Corbett.
Walckenaëra acuminata...	Mr. Enock.
Cristatella mucedo	Mr. H. E. Freeman.
Melicerta ringens	,,
Onosma tauricum...	Mr. Glaspoole.
Preparations of Flint	Mr. M. H. Johnson.
Section of great sciatic nerve of human fœtus (five months)	Mr. W. W. Jones.
Petal of Geranium	Mr. F. Reeve.
Phytocasis Tiliæ	Mr. Sigsworth.
Proboscis of *Chærocampa Elpenor*	Mr. F. H. Ward.
Scales of *Lepidocyrtus curvicollis*	Mr. G. Williams.

Attendance :—Members, 56; Visitors, 8. Total, 64.

May 28th, 1875.—Dr. J. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The meeting was then made "special" for the consideration of the alterations in the rules proposed by Mr. Hind, of which notice had been given at the ordinary meeting in April.

Mr. Hind explained that the effect of the first of the alterations, of which he had given notice, would be to enable them to place upon the balloting papers the names of *all* the gentlemen who might be proposed as members of committee, instead of reducing, by show of hands, the number of those proposed to one half more than the number of vacancies to be filled up. This portion of the rule was introduced at the general alteration of the rules which took place in 1869, for what purpose he was unable to say. Its effect was to waste a great deal of time, and he thought that its removal would relieve them from some annoyances which had been felt by the striking out of names which members had proposed.

Mr. Hailes seconded the proposed alterations.

Mr. Curties said that as the proposal was one to alter the rules, he should be glad to know if it had received the consideration of the committee?

The President said it had received their careful consideration, and met with their entire approval.

A member inquired whether any practical difficulty had arisen with regard to the carrying out of the rule, or whether the alteration was merely to meet some imaginary difficulty which it was thought might arise? It was, after all, an alteration of their rules which was proposed, and he thought it was always well to look twice before altering a rule.

Mr. Hind did not think any practical difficulty had arisen beyond the loss of time—for instance, at the meeting in last June there were six gentlemen to be elected, 10 were proposed, and the number had, according to the rule, to be reduced to nine. This involved the taking of 10 shows of hands, which occupied quite 20 minutes. Further than this, he would suggest that it was not in accordance with the principle of the ballot to decide any part of an election by show of hands.

The President thought they were bound to carry out the principle of the ballot in its entirety.

The Secretary said there had been several instances in former years in which members had been nominated, and had afterwards felt annoyed by the small number of hands held up for them ; whereas if their names had been put into the list a larger number might have voted for them at the annual meeting.

Mr. Hailes said that, as an old member of the committee who was present when this rule was framed, it might be well for him to explain why this clause was originally introduced. It was thought at that time that a great number of members might like to propose friends as members of committee, and would thus give them a very large number of names to print on the lists ; and the provision was made in order to reduce the number within a reasonable limit. Practically it was electing some of them twice over ; but at all events the difficulty provided against had never arisen, showing that there was really no necessity for retaining the clause.

The alteration proposed was then put to the meeting, and carried unanimously.

The other alteration proposed by Mr. Hind was then explained by him to be the partial revival of the rule as it stood in 1868, and its effect would be to place the nominations of *Vice-Presidents* in the hands of the committee, instead of in those of the members. He believed that only on one occasion had a member of the club exercised the privilege of nominating a Vice-President ; and although no doubt there might be occasions when members would like to elect some particular person in order to do him special honour, this alteration would really place no actual difficulty in the way of this being done.

This alteration was seconded by Mr. George Williams.

Mr. James Smith believed it was quite the practice in the Royal, Linnean, and other Scientific Societies, for the Vice-Presidents to be nominated by the Council, and therefore they would only be following the usual course in leaving these nominations with the committee.

Mr. Hailes said that at the time the rule was made, placing the appointment both of Vice-Presidents and committee in the hands of the club, it was felt that the club generally took no active part in the nomination of its officers, and the committee were desirous of abandoning the principle of the house list. In their anxiety to force the club to elect their committee themselves, the nominations of the Vice-Presidents were also put upon them. The office of the Vice-President was really the only honour they had to bestow, because in all the other offices the amount of work and time to be given rendered it rather a favour to the club for any one to accept them. This being so he thought the nominations were much better placed in the hands of the committee, who could form a better judgment than individual members as to who were, in consideration of their work or services, most worthy of the honour at their disposal.

The President said he was cognizant of at least one instance in which a gentleman was proposed and elected a Vice-President without his consent having been previously asked, and that gentleman never attended the meetings of the committee.

The alteration was then put to the meeting, and carried unanimously.

The Secretary explained that the adoption of this alteration would not prevent any member from exercising the right of introducing any other names upon the lists at the annual meeting; that right was still reserved to members by rule III., so that if at any time it should happen that any large section of the club should think proper to do so, they could still procure the election of a Vice-President. The Secretary reminded the members generally that at their next ordinary meeting the nominations for members of committee, would have to be made, and he hoped that those who knew suitable persons would come prepared to nominate them on that occasion.

Mr. Curties inquired how many vacancies on the committee there would be to fill up?

The Secretary was not quite sure at that moment, but he thought there would be four.

The President said that Mr. Hailes had just handed him a bottle containing a quantity of diatoms, accompanied by a letter from Mr. C. C. Capel. These were a free gift, and if any person wished for any of the diatoms they should apply to Mr. Hailes. The diatoms were obtained from the river Cray.

Mr. Hailes said the diatoms in question were all cleaned and ready for mounting.

The ordinary business of the meeting was then proceeded with.

The following donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	... from the Publisher.
"Science Gossip"	,,
"Proceedings of the Geologists' Association" ...	the Association.
"Proceedings of the Royal Society," Nos. 160, 161	the Society.
"The American Naturalist"	... in Exchange.
Parts 2 and 3 of Schmidt's Diatom Atlas...	... by Purchase.
Two Slides of Diatomaceæ	... from Mr. C. F. White.

The thanks of the meeting were voted to the donors.

The following gentlemen were balloted for and duly elected members of the club:—Mr. G. M. Amner, Mr. Arrowsmith, Mr. J. W. Browne, Mr. Chas. Cooper, Mr. Arthur Dean, Mr. Joseph G. Defries, Mr. Francis J. Hamley, Mr. John Larkin, Mr. J. C. Laws, Mr. G. W. Saul, and Mr. J. R. Thomson.

A letter from Mrs. Hardwicke, thanking the club for the vote of condolence passed at the preceding meeting, was read.

Mr. Curties said he had laid upon the table for the inspection of the members a number of photographs taken by Mr. L. Huggins, of Liverpool. There were some features of the process which were new, and which he hoped he should be in a better position to lay before the members at an early meeting.

Mr. M. Hawkins Johnson then read a paper "On the Organic Structure of Flint and of Meerschaum," illustrating it by coloured diagrams.

The President proposed a vote of thanks to Mr. Johnson for his paper, and expressed a hope that those who were conversant with the subject would favour the meeting with their opinions. He was himself not very much acquainted with it.

Mr. Lowne said he should like to know what evidence there was that the structure described and figured was sponge? He wanted something more than the fact that a reticulated structure was shown by grinding, to convince him that such was the case.

Mr. Waller said he was very much interested in the subject of sponges, and his belief was that sponge had a great deal to do with flint structure, although he might say that his opinion was formed in a somewhat rough and ready manner.

The President asked if Mr. Johnson thought it was the animal matter in his specimens which was affected by the staining fluid, and asked if he had brought any slides for exhibition ?

Mr. Johnson thought it was the silica which was stained. He had not brought any slides with him, but would do so at the next gossip night.

The President could hardly, for his own part, see how flint could receive a stain from such a substance as the die employed.

Dr. Foulerton thought it was very interesting to find a definite structure in these substances, but he was of opinion that what Mr. Johnson had to do was to give them a reason why this structure was a sponge.

Mr. Lowne said that if sufficient time were given anything would stain. Flints were constantly met with stained with oxide of iron, and sections of these had very much the appearance of containing pieces of sea-weed – moss agates were instances well known. He knew of no mineral which stained more readily than silica. He thought they ought, before deciding, to have some definite characteristic of sponge shown. He saw some resemblance to sponge structure in the drawings, but did not recognise any character which he considered conclusive.

Mr. Johnson said that he did not know that he had ever stated *positively* that the structure he found was sponge. All he had affirmed was that it was an organic structure.

Dr. Foulerton asked if Mr. Johnson could give them a specimen about which there was no doubt as to whether it were a sponge or not ?

Mr. Johnson said he could not. He thought it was clear that a substance might be organic, and yet not be a sponge at all.

Dr. Foulerton suggested the resemblance to those organisms which were found in fossil teeth.

Mr. Johnson said fossil teeth might be filled with other organic substances ; it was quite clear that a dental foramen would afford a passage into the tooth, and where fungi could go a sponge might go. With regard to the facility of staining flint, if Mr. Lowne did not know of any mineral which stained more easily, he could tell him of a good many.

Mr. Lowne said he meant any mineral of equal hardness or compactness. The fact that sponge gemmules had been found in flint, and had not been found in other minerals was, he thought, rather a cause for hesitating before pronouncing an opinion.

Mr. Waller said he had examined a great number of sponges, in which he could not find any gemmules at all—to find them the sponge must be examined at a particular period of its existence.

Mr. Johnson thought it would be rather hasty for any one to come to a conclusion at all upon a thing which he had not seen ; he would therefore endeavour, at the next meeting, to bring some specimens, which he hoped would throw some light upon the matter. He himself thought that if a substance, apparently homogeneous, was found to reveal structure when carefully examined, there was a great probability that it was of organic structure, but he did not mean to say that all these structures were sponge. Some flints were naturally found with an outer crust stained with oxide of iron, and if a section was taken of one of them it would be found to look very much like a sponge, and certainly appeared to be organic.

Mr. Lowne said he must strongly demur to the assertion that any structure found in an inorganic substance, and not of a crystalline nature, was therefore organic; and also that they were to draw a line and say that all crystalline substances were inorganic, and all others which showed any apparent structure were organic. It was not any one who had not worked at these subjects who must see them, but they must be seen and examined by an adept in the subject, and it must be pointed out by him why they were to be regarded as organic.

The President said he went to a certain extent with Mr. Johnson in regarding it as a high probability that these structures were organic; it was, however, a pity that he had not fortified his case by bringing his specimens. He thought it must not be overlooked that silica deposited in a coloured state sometimes bore the closest resemblance to organic structure; nor that silica existed in nature in solution, and that there were agencies in nature other than organic by which it was deposited. He would refer them for further illustration of this subject to the Cantor lectures by Dr. Calvert.

Mr. Lowne said what he wanted to know was, *why* were these structures organic?

Mr. Johnson said he should like to refer to some experiments which he had been making with silica in solution. First of all he took some tadpoles and put them into nitric acid—in half-an-hour they were completely disintegrated, and in an hour there was very little tadpole left. He then put some more tadpoles into a solution of silicate of soda, and left them there for three or four days; he then took them out and washed them to remove all superfluous solution of silicate, and then placed them in a vessel with a small quantity of water. To this he added a drop or two of nitric acid, and generally increased the quantity until it was entirely acid. The tadpoles were left in this for weeks, and they remained all the time in just the same condition as when first put in, and from this he argued that some very important change must have taken place. They knew, as a fact, that there was a large class of bodies in which silicon occupied an analogous place, and it seemed to him highly probable that there might be some process by which the one substance was exchanged for the other.

Mr. Lowne said he should much like to have the subject cleared up. He thought that in the tadpole case there would be found a source of ultimate error in the dilution of the nitric acid. For a very small quantity of water in nitric acid when brought into connection with soda would cause nitrate of soda to be formed, and this was really non-corrosive. If, however, there was really a substitution of silicon for carbon, a most important discovery had been made. He hoped this could be clearly shown.

Mr. Johnson said the acid was diluted in the one case exactly the same as it was in the other.

The President considered that Mr. Johnson had made out a very strong *prima facie* case. He quite believed in the possibility of these substances having an organic structure, but until they had some opportunities of further examination they could do very little more in the way of coming to a conclusion.

Six gentlemen were then proposed for membership, the meetings and excursions for the ensuing month were announced, and the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Arachnoidiscus, in situ—sent from Shanghai by Mr. F. Quekett	by Mr. E. Bartlett.
Carchesium polyperium; Salivary Glands of Flea (prepared by Mr. Tatem), and a series of Photographs by Mr. Huggins, of Liverpool...	Mr. Curties.
Epidermis of Holly	Mr. Drew.
Eyes of *Chrysops relictus*	Mr. Enock.
Obisium orthodactylum	Mr. H. E. Freeman.
Section of *Orbiculina*	Mr. Hainworth.
Section of Cochlea of Kitten	Mr. E. T. Newton.
Cyclosis in stem of *Nitella flexilis*	Mr. Topping.

Attendance:—Members, 73; Visitors, 13. Total, 86.

June 11th, 1875.—Conversational Meeting.

The following objects were exhibited:—

Alcyonella fungosa	Mr. Badcock.
Siphonia pyriformis—Fossil Sponge from the Upper Green Sand	Mr. D. Brown.
Sphærularia bombi—a parasite of the Humble-bee	Mr. W. Cole.
Tadpole of Smooth Newt	Mr. Dunning.
Cristatella mucedo	,,
Bombylius major—Humble bee fly	Mr. Enock.
Sections of flint	Mr. Hailes.
Potato starch	Mr. F. H. P. Hind.
Bowerbankia imbricata	Mr. Ingpen.
Flint stained by nitrate of silver	Mr. M. H. Johnson.
Meerschaum stained by acetate of rosanaline ...	,,
Section of Conemara Serpentine, cut and stained by Mr. M. H. Johnson	Mr. Sigsworth.
Xanthidia from flint	Mr. Slade.
Striated human muscle	Mr. Topping.
Sections of flint...	Mr. J. G. Waller.
Sections of vegetable ivory	Mr. Geo. Williams.

Attendance:—Members, 53; Visitors 6. Total, 59.

EXCURSIONISTS' ANNUAL DINNER.

One of the most successful of these always pleasant gatherings took place on the 16th of June, at the Swan Hotel, Leatherhead. Fifty-nine members and their friends attended, and the chair was taken by the President, Dr. Matthews. The weather was delightful, and those who were able to spend the day in the neighbourhood enjoyed an extremely pleasant ramble. Mr. Thos. Rogers and some of his friends added greatly to the pleasure of the evening by some excellent part-singing. The whole of the arrangements, which were under the care of Mr. W. W. Reeves, were highly satisfactory.

June 25th, 1875.—Dr. J. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following additions to the Library and Cabinet were announced:—

"The Monthly Microscopical Journal" ...	... from the Publisher.
"Science Gossip"	"
"Proceedings of the Literary and Philosophical Society of Manchester" ...	the Society.
"The American Naturalist"	in exchange.
Twelve Sections of Horn	Mr. J. R. Williams.
One Slide	Mr. Tatem.
A number of Copies of Engraved Scales for the Measurement of Angular Aperture	Mr. J. W. Stephenson.

A vote of thanks to the Donors was proposed by the President, and duly carried.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. Theodore Arnold, Mr. Henry Faulkner, jun., Mr. J. B. Jones, Dr. W. S. Radford, Mr. Sydney Turner, and Mr. Edward U. Whitney.

The Secretary reminded the members that the next meeting would be their anniversary, at which a ballot would be taken for the election of officers and committee for the ensuing year, and that according to the bye laws nominations for members of committee must be made that evening. There were four vacancies caused by the retirement of Messrs. Crisp, Jackson, Oxley, and Rogers. The following officers had been nominated by the committee:—

As President ...	... Dr. Matthews.
As Vice-Presidents	Mr. F. Crisp. Mr. R. T. Lewis. Mr. B. T. Lowne. Mr. T. C. White.
As Treasurer ...	... Mr. F. W. Gay.
As Hon. Secretary	... Mr. J. E. Ingpen.
As Hon. Secretary for Foreign Correspondence ...	Dr. M. C. Cooke.

The following gentlemen were then nominated to fill vacancies on the committee:—

Mr. M. Hawkins Johnson	Proposed by	Dr. Foulerton,	Seconded by	Mr. Sigsworth.
Mr. Oxley	"	Mr. Hainworth	"	Mr. McIntire.
Mr. Thos. Rogers	"	Mr. C. W. Hovenden	"	Dr. Foulerton.
Mr. Joseph A. Smith	"	Mr. Curties	"	Mr. Nelson.

Mr. F. H. Ward was also nominated, but declined to serve.

Mr. Hainworth having been appointed auditor of the accounts on the part of the committee, the members were requested to elect another gentleman to act in that capacity on their behalf; and Mr. Dobson having been proposed by Mr. Curties, and seconded by Mr. Golding, was declared, upon show of hands, to be duly elected auditor on behalf of the Club.

The Secretary explained, by means of a diagram drawn upon the black board, the method of using the scale designed by Mr. Stephenson for measuring the angular apertures of objectives. A scale of cotangents of half the required angles (from 35° to 175°) was laid down upon a line drawn on a sheet of paper. At two points at right angles to this line small flames, such as that of a night light, or strips of white paper could be placed. By advancing the objective along the scale, the images of the flames or other objects employed were separated, until each was seen on the opposite margins of the posterior lens of the combination, when the angle of the objective was indicated directly beneath its front lens. A second scale was provided for measuring angles from 18° to 40°. A holder for carrying the objective was also exhibited.

The President pointed out that in using the scale it was of importance that the mount which carried the objective should be kept fairly at right angles with the engraved line, and it would be also found desirable when using high power glasses to amplify the images produced by them by means of a magnifying lens held at the back.

A question asked by Mr. Hainworth as to the issue of slides from the cabinet gave rise to some discussion upon the subject, in the course of which it was stated that during the absence of Mr. Ruffle (Curator)—who was prevented by severe domestic affliction from attending to his duties—Mr. Hailes had kindly attended on the gossip nights for the issue and exchange of slides. The cabinet had not been open on the evenings of the ordinary meetings from want of time and pressure of other business, but if any gentlemen wished for slides on those occasions, and would apply to Mr. Hailes, he would be happy to oblige them in the matter as far as practicable.

The Secretary called the attention of the meeting to two lamps which had been sent for their inspection by Mr. Parkes, of Birmingham. They were similar in construction, and both burnt mineral oil, but one had a flat wick and the other a round one; the reflector—by which the flame was partially enclosed—was intended to throw a beam of parallel rays, and a tinted glass cover to the opening of the reflector served to correct the yellowness of the flame.

The President observed that the flame was not quite in the focus of the reflector, and that the latter was rather conical than parabolic. If it were made a true paraboloid, and the flame was placed in the proper position, still better effects might be obtained from it.

Dr. Foulerton gave notice that at the annual meeting he would move as an addition to the bye-laws "That the ordinary meetings of the Club be suspended during the months of August and September." He thought it would be found convenient to do this, and to follow in this respect the course adopted by all the other scientific societies. This alteration was not intended to suspend the gossip nights, and there might be additional gossip nights on the fourth Fridays in those two months instead of the ordinary meetings.

The notice of motion was seconded by Mr. F. H. P. Hind, who thought the proposition very proper and desirable.

Mr. B. T. Lowne gave a second address upon the histology of the eye, in which, after recalling the substance of his former communication, he proceeded to illustrate and explain the minute structure of the retina, the rods and cones, &c., and gave the most approved methods of hardening, cutting, and mounting sections for microscopic examination.

Announcements of meetings and excursions for the ensuing month were made, and the meeting terminated with a conversazione, at which the following objects were exhibited :—

Ant carrying its pupæ	Mr. Curties.
Artemia salina (Brine-shrimp)	Mr. Enock.
Parasite of turkey	Mr. Freeman.
Cristatella mucedo	Mr. Golding.
Odontophore of *Cyclostoma*	Mr. Slade.
Skin of Sole	Mr. Swift.
Transverse Section Spine of *Acrocladia* ...	Mr. Topping.

Attendauce—Members, 68; Visitors, 9. Total, 77.

July 9th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Stylops Spencii, Parasite of Bee...	Mr. Enock.
Culex, with parasite...	Mr. Ingpen.
Conemara Serpentine, stained by Acetate of Rosanaline	Mr. M. H. Johnson.
Flint, stained by Nitrate of Silver	,,
Flint, etched by Hydrofluoric Acid	,,
Agate, etched by Hydrofluoric Acid	,,
Basalt, from Staffa	,,
Fossil Conifeious Wood (polarized)	Dr. Matthews.
Liver of Fly	Mr. Rolfe.
Larvæ of *Œstrus Equi* in the Egg	Mr. Sigsworth.
Aulacodiscus Petersii (six processes)	Mr. G. Williams.
Navicula splendida	,,

Attendance—Members, 29; Visitors, 1. Total, 30.

ANNUAL MEETING.—July 23rd, 1875.

Dr. J. Matthews, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The Secretary read the tenth Annual Report, also the Treasurer's annual statement of accounts, duly audited.

The President said the members had no doubt listened to these reports with much satisfaction, as showing the continued prosperity and progress of their Society. He then formally moved, "That the reports now read be received and adopted, and that they be printed and circulated in the usual way."

The motion having been seconded by Mr Goodinge, was put to the meeting and carried unanimously.

The President said that the next business upon the paper was a notice of motion given at the last meeting by Dr. Foulerton, which if carried would have the effect of suspending the ordinary meetings during the next two months, or rather of converting them into gossip nights. Unfortunately for the proposal, Dr. Foulerton was not present to lay it before them, and as its seconder, Mr. Hind, did not feel inclined to take it up on his own responsibility, it must therefore, of necessity fall to the ground.

The President then delivered the Annual Address.*

Dr. Gray proposed a vote of thanks to the President for the admirable address to which they had just had the pleasure of listening, and moved that it be printed and circulated with the reports.

Mr. Hind having seconded the motion, it was put to the meeting by Mr. Ingpen and unanimously carried.

Mr. Reeves and Mr. Moginie were then appointed to act as scrutineers, and the ballot for the election of officers and committee was proceeded with.

Mr McIntire proposed a vote of thanks to the President, Committee, and Officers of the Club for their valuable services during the past year. He knew what it was to be on the Committee, and was aware that it took up a great deal of time, and that attendance frequently involved personal inconvenience. Their President had been constant in his attendance, and their Secretary had given them several papers during the year, the preparation of which must have greatly augmented his labours. In this vote of thanks he wished to include all their officers, their Librarian, and especially the Excursion Committee, to whom they were greatly indebted, and he would also mention Mr Lewis, the Hon. Reporter, who did them such good service in taking the notes of their meetings.

The vote of thanks having been seconded by Mr Loy, was put to the meeting by Dr. Gray, and carried by acclamation.

Mr. Ingpen said that although Mr. McIntire's motion very properly included all the officers of the Club, he nevertheless wished to propose a special vote of thanks to Mr. R. T. Lewis, their Hon. Reporter, and "Silent Member." He knew that many amongst them were doing hard routine work for the Club, but he thought that no one worked under such circumstances of self-restraint as Mr. Lewis, for though competent to speak upon all points, and able to give valuable opinions and advice, he felt himself obliged to keep silence, in order to record the utterances of others. He had given them a series of most admirable reports, and should he feel obliged at any time to give up his duties as Reporter (as he had sometimes hinted might be the case), the Club would find great difficulty in supplying his place. The Committee had been able on that occasion to pay Mr. Lewis the compliment of nominating him for the office of Vice-President, and he (Mr. Ingpen) felt sure the Club would regard that nomination with great satisfaction, and unanimously elect him.

The vote of thanks having been seconded by Mr. Reeves, was put to the meeting by the President, and unanimously carried.

Mr. T. C. White proposed a vote of thanks to Mr. Dobson and Mr. Hainworth for their services as Auditors. The looking well after their expenditure, and to the correctness of their accounts was a very important branch of the service, and the gentlemen who performed it were entirely independent of any action on behalf of the Committee.

Mr. George Williams seconded the vote, which was thereupon put to the meeting by the President, and carried unanimously.

While the scrutineers were occupied in examining the balloting papers, Mr. Ingpen made a short communication with reference to the last Excursion, which was one to Weybridge, thence by the side of the Canal to Woking, returning by train. They had a fine afternoon, and a very pleasant ramble. Those who were botanists were able to collect many wild flowers, and the "puddlers" were rewarded by finding several fine species of desmids, some beautiful free

* Printed with the Reports and List of Members.

swimming rotifers, &c., &c. He described a curious spined *Difflugia*, and read a list, prepared by Mr. W. G. Cocks, of the desmids gathered. Mr. Ingpen considered the Excursion highly successful, and hoped to be able to give some account of others from time to time.

The President announced that the gentlemen whose names appeared upon the balloting lists were all unanimously elected; he was glad to be able to say this, because it showed the amount of confidence placed by the members in the judgment of their committee.

A vote of thanks to the Scrutineers, proposed by the President and seconded by the Secretary, was carried unanimously.

The President said there was one more office which he had to perform, and that was a most pleasant one. They were all aware by whose permission they met there, and could highly appreciate the comfort they had so long enjoyed, as well as the countenance and support which they received from being privileged to assemble in that building. He had therefore the greatest pleasure in asking them for a cordial vote of thanks to the Council of University College for their continued kindness, and the courtesy with which they had renewed the permission for the meetings of the club to be held in the Library of that Institution.

Mr T. C. White having seconded the motion, it was put to the meeting, and carried by acclamation.

The following donations to the Club were announced, viz. :—

"The Monthly Microscopical Journal"	from the Publisher.
"The Popular Science Review"	,,
"Science Gossip"	,,
"Proceedings of the Bristol Naturalists' Society"...	from the Society.
"Third annual report of the Zoological Society of Philadelphia"	,,
"Report of the Smithsonian Institution"	from the Institution.
"The American Naturalist"	in exchange.
"The Quarterly Journal of Microscopical Science and Schmidt's Atlas of the Diatomaceæ"	by purchase.

The thanks of the Club were voted to the Donors.

A donation of twenty-four slides from Mr C. F. White was announced by the President, and acknowledged by a special vote of thanks.

The President said he had another pleasant duty to undertake that evening. A short time ago, Dr. Lionel Beale, one of their former Presidents, sent an intimation of the withdrawal of his name from their list of members, for the reason that he did not wish to seem to undertake duties which his other engagements rendered him unable to perform. Feeling that they would all greatly regret Dr. Beale's withdrawal from the Club, he had taken the liberty of calling upon him, and finding that the Doctor's only reason was his inability to attend the meetings regularly, and that his sympathy was as much as ever with them, he had the pleasure, on behalf of the Committee, of nominating Dr. Lionel S. Beale, F.R.S., &c., for election as an honorary member of the Club.

The nomination having been seconded, a ballot took place, and it was announced that Dr. Beale had been unanimously elected.

Mr. J. J. Ayling and Mr. M. J. Hallett were balloted for, and duly elected members of the Club.

The Secretary announced that in consequence of the death of their late treasurer, Mr. Hardwicke, it would not be possible for them to continue the offices of the Club at 192, Piccadilly. From that time, therefore, all communications of a financial character should be addressed to the Treasurer, Mr. F. W. Gay, and all others to the Secretary, *at their private residences*, instead of at 192, Piccadilly, as heretofore.

Meetings for the ensuing month were then announced, and the proceedings terminated with a conversazione, at which the following object was exhibited:—

Chrysopa perla, showing pygidium ... ... by Mr. Enock.

Attendance—Members, 58; Visitor, 1. Total, 59.

Remarks on a Parasite of Humble Bees.

Sphærularia Bombi, Léon Dufour.

By W. Cole, M.E.S.

Read August 27th, 1875.

The parasites of insects form a most interesting and varied subject of investigation for the entomologist and microscopist, but it is a branch of natural history very little attended to in this country; probably on account of the scanty and scattered character of the information on the subject contained in English books on entomology. Those who are in search of a profitable employment for their observing powers, may find a wide field for exertion in this direction; one less hackneyed, perhaps, and more likely to lead to remarkable, if not new results, than many others which are in fashion with amateur naturalists. No one need here fear of lack of worlds to conquer; the subject would appear to be well nigh inexhaustible. Judging from the data furnished by my own rather limited experience, I am disposed to think that not only does every species of insect suffer from the attacks of some endemic parasite, but almost every individual affords nourishment to a guest either internally or externally; and many insects examined this year were found to be playing the part of hosts to four or five different species of parasites.

Partly from their social habits, and partly, perhaps, from the fact that their life-histories have been more closely watched than those of some other orders of insects, the *Hymenoptera* have been found to be the especial victims of these unwelcome guests. Some of the parasites of bees are so strange in appearance, and so anomalous in their mode of life, that they long formed a puzzle to naturalists, and may still be considered as amongst the most wonderful creatures in the whole range of entomology. We have only to call to mind the genus *Stylops* and its allies, or the transformations of the species of *Meloë*, in confirmation of this statement; and I propose to bring under the notice of the Society to-night a parasite which may vie in interest with any of these, and one that forms a very instructive object for microscopical study.

I must, at the outset, plead for your kind indulgence, inasmuch as I have scarcely any observations of a novel character to bring forward. My apprenticeship to the use of the microscope has been so short, and my experience in this kind of investigation so limited, that it was hardly possible I should be able to do more than repeat some of the observations of the learned and skilful entomologist who had previously worked at the subject. I was encouraged, however, by what passed at our previous meeting, and I hope others of our diffident members may be so likewise. Most of us will agree with the purport of our President's remarks in his Annual Address, that papers read before this Club need not necessarily be of an original character. I am afraid a paper of that description every month must long remain a thing to be desired, rather than expected. But if each member, who has been studying an interesting subject, were to give an account of his labours, even though they had led him to the discovery of no fresh facts, or to the elaboration of no startling theories, we should hear fewer complaints of the paucity of papers; no attempts would be necessary to diminish the number of meetings; and the discussions so promoted would, by calling forth the latent knowledge and experience of our colleagues, do much to increase the pleasure and profit to be derived from the assemblies of the Club. Having this object in view, I trust the few remarks I propose to make will be taken as they are intended, rather for the purpose of attracting attention to an interesting subject, about which I hope to have more to say in the future, than as constituting a scientific memoir.

As regards its systematic position, *Sphærularia* may be placed in the old class *Entozoa*, which comprises so many strange animals within its rather loose and indefinite confines. The parasite's nearest allies would appear to be the genera *Mermis* and *Gordius*, although it differs from both in several important particulars, and Dr. Cobbold places it with them in the family *Gordiidæ*. The two first named genera are well known to be parasitic in insects, at least in one stage of their existence. At other times, *Gordius* and *Mermis* are found in water and damp places; and several instances are on record of their appearance in great numbers under circumstances so mysterious as to lend some colour to the popular idea that they had been precipitated from the clouds in a shower of rain. In June, 1867, such an eruption of *Mermis nigrescens* occurred, which occasioned much discussion and speculation, and furnished materials for a paper read by Mr. R. T. Lewis before this Society. In that paper (which is printed in "Science Gossip" for 1867) may be found some valuable details as to the minute structure of *Mermis*, which are interesting from our present point of view, this "hair-worm" being probably the nearest known relative of *Sphærularia*.

The merit of discovering this extraordinary creature belongs to the celebrated insect anatomist Leon Dufour, who described it in the "Annales des Sciences Naturelles" for 1836. He at first supposed it to be a dipterous larva, many of which infest insects; but on further consideration of its structure he perceived that he had before him a new genus of *Entozoa*, and he accordingly brought it before the scientific world under the name of *Sphærularia Bombi*. In 1838, Von Siebold published a few remarks on the animal, and pointed out the position it should occupy in systems of classification; but the naturalist who made the first thorough attempt to work out its development and anatomy was Sir John Lubbock, in the "Natural History Review" for 1861. The same Journal for 1864 contains the results of some further investigations made by him; and in these two memoirs will be found nearly all the information we at present possess on the subject. I need hardly say how much I am indebted to these admirable papers.

Finally, I understand Schneider has made some observations on the morphology of *Sphærularia* in his work on the Nematodes, and has therein expressed an opinion as to its structure, to which I can more conveniently refer presently, after we have considered the details of its anatomy.

Nothing is easier than to obtain specimens of the parasite from an infected bee. The insect should be killed by some mode of suffocation, such as being placed in the vapour of sulphurous or hydrocyanic acids, and carefully dissected under water. The *Sphærulariæ* are not found, as is commonly the case with the mature *Entozoa*, in the interior of the alimentary canal. They lie perfectly free among the viscera in the upper portion of the abdominal cavity, and are bathed on all sides with the nutritive fluids of the bee. They are occasionally entangled with one of the tracheæ, but this seems to be a purely accidental circumstance. They are generally more or less coiled up, and are absolutely without motion. One very noteworthy fact is that the worms have hitherto only been found in large *female* bees; so far as present observation goes, the male and worker humble-bees are entirely free from their attacks. This predilection for one sex is by no means a solitary instance amongst the Entozoic parasites of the *Hymenoptera*; Siebold describes a species of *Gordius* which affects the drones of the honey-bee, and *Mermis albicans* is said to have similar habits.

Leon Dufour's original specimens of *Sphærularia* were found in the large and handsome humble-bees known to entomologists as *Bombus terrestris*, and *Bombus hortorum*. Sir John Lubbock and myself have found it by far the most commonly in *B. terrestris*; but from six to eight species of *Bombus* are more or less liable to attack. The spring of the present year seemed to be peculiarly favourable for the increase and well-being of the parasite; and I think I am quite correct in saying that from the middle of May until the beginning of June I never examined a single female *B. terrestris* without meeting with some specimens. On May 31st they reached a climax in point of numbers, one bee containing no less than 33 mature *Sphærulariæ* of about half the normal size, in addition to myriads of eggs and young. All these *Bombi* were caught quite indiscriminately, as they frequented the luxuriant blossoms of a plantation of rhododendrons on the confines of Epping Forest; and I narrowly watched the flight and behaviour of the females in which *Sphærulariæ* were afterwards found in plenty, but could never convince myself that they were less active than the general run of these busy creatures. It is, however, difficult to believe but that such a large number of parasites must have a very injurious effect on the life of the bee, and, perhaps, their presence or absence may be one of the determining causes of the scarcity, or otherwise, of humble bees in some years. From the end of May I had no further opportunity of examining humble bees before the wet weather set in; and either the rain or the plague of *Sphærularia* so thinned the ranks of the insects that the results of two or three excursions, made at the end of July and the beginning of August for the special purpose of searching for them, were perfectly fruitless, not a single individual of the larger *Bombi* being observed.

The mature *Sphærulariæ* vary somewhat in size; but the full grown ones are about an inch in length, of cylindrical shape, with a uniform diameter of about $\frac{1}{15}$th of an inch. They are white in colour, and more or less transparent, often so much so, that the simple internal organs can readily be traced through the skin. Their most striking peculiarity, and one which suggested the name of the genus, is the possession of a large number of round, wart-like bodies, or spherules, arranged in regular order over the entire surface of the body, giving it a very pretty appearance under a low power. On an average, there appear to be about 800 of these warts on each worm; they are about $\frac{1}{100}$th of an inch in diameter, and project $\frac{4}{1000}$ to $\frac{8}{1000}$ths of an inch from the surface of the body. Each of these spherules is filled with granular matter, with which is mixed, in some cases, larger refractive globules, apparently of fat. Some are more dense than others, and these darker spherules are found principally in the neighbourhood of the vulva. By the action of alcohol or Beale's carmine fluid, this granular matter shrinks more or less away from the transparent walls of the spherule, forming an almost opaque mass, in the centre of which is generally seen a kind of nucleolus which is always intensely tinged by the carmine. The spherules appear to have no communication with the interior of the body, and their function is entirely unknown.*

The skin of the animal is a transparent membrane in which ordinarily no indications of structure can be discerned. In some of the smaller, and less mature worms, however, I have been able to trace a division of the skin into rectilineal areas, in the centre of each of which lies a spherule. Sir John Lubbock, who had an opportunity of examining the worms during the winter, when they were very young, describes each spherule as a cell with a distinct nucleus and boundary walls. The divisions I have noticed are, in all probability, the remains of the walls of these cells, which become more and more obscure as the animal develops. I have examined the skin with and without the use of reagents, under a $\frac{1}{4}$th inch, but have not been able to discover the slightest trace of

* Dr. Matthews has suggested to me, with considerable probability, that these wart-like bodies may subserve nutrition as absorbents; in which case their hemispherical form would be of great service by presenting a much larger surface to the nutritive perivisceral fluids of the bee, than if merely on a level with the general contour of the body of the *Entozoön*.—W. C.

muscular fibre. Indeed, the habits of the creature would render such an element of structure quite superfluous. The adult leads a perfectly inert and vegetative existence, immersed in the blood of the bee, and deriving nourishment from the fluid by simple imbibition. The body may be described as an elongated sac, having only one aperture, that of the vulva; there is no mouth or intestinal canal, and, as far as present observations extend, no trace of nervous or circulatory systems. The interior of the body is almost filled with two organs only, both comparatively of enormous size—the *fat-cells* or *corpus adiposum*, and the *ovary*. The fat-cells may be considered as the homologue of the intestine in other nematoids. They form a sort of double chain, or row, which is attached to the body at the extremities, but elsewhere lies free in the general cavity. Each fat-cell is a membranous sac, sometimes as much as about $\frac{1}{11}$th of an inch in length, filled with a thick fluid, containing granules, and "six to eight transparent nuclei, which are of a tolerably even size, and about $\frac{8}{1000}$ths of an inch in diameter." In younger specimens Sir John Lubbock found the thick fluid contents of the cells replaced by an immense number of minute vesicles; in the interior of which were, in most cases, a quantity of acicular crystals. In this stage the nuclei were about $\frac{3}{400}$ths of an inch in diameter, and attached to the walls of the fat-cell; they contained a number of small irregular bodies, and were "surrounded by a sort of halo of granules." These cells probably act as reservoirs of nutriment for the use of the animal, and may also serve, in some measure, the office of an intestine by still further elaborating the organized fluid in which the worm lives.

The ovary is a simple tube more than four times the length of the body, in which it lies perfectly free, excepting in the neighbourhood of the vulva, where it is connected with the fat-cells. It commences as a fine tube at the anterior end of the body, gradually increasing in size and coiling loosely amongst the fat-cells, until it expands into a large uterus, which is generally quite extended with ovæ. It then contracts about one-half, and opens externally at the end of the body opposite to that at which it commenced.

The eggs afford excellent material for the study of yolk-segmentation and development, as from the transparency of the envelope the various processes are readily observed. They may generally be found in all stages; from the clear, simple cell at the upper end of the ovary, containing only the germinal vesicle, up to the mature egg enfolding the fully-formed embryo just preparing to wriggle into its little world, in a snug corner of the bee's body. The growth of the egg is considerably advanced before it issues from the vulva, but the embryo is not then formed; after the egg is laid, however, the development proceeds with great rapidity, and the young are soon hatched out. They are exceedingly active in their movements, thus presenting a marked contrast to their quiescent mother. They vary, of course, somewhat in size according to their age, but do not grow much in this stage of their existence; the bulk of those found in May and June are about $\frac{1}{25}$th of an inch long, with a nearly uniform diameter of about $\frac{1}{1000}$th of an inch. The end, which for the sake of distinction may be called the "head," is somewhat pointed; but the "tail" is very different, being blunt, curved, and club-like. The structure of the young *Sphærularia* is of the simplest nature possible. Under a $\frac{1}{4}$th inch glass the skin is seen to be very delicately ringed. The interior of the body is filled, excepting a short, clear space before the head, with a great number of small refractive globules, mixed with opaque granules. By careful focussing, a faint line or notch can be discerned at the anterior end of the body; but not the slightest appearance of digestive or other organs can be traced.

It is scarcely necessary to mention that all the large individuals we have been considering are females; but we now come to the most curious fact connected with the morphology of this bee-worm. Near the extremity of each female, at the end farthest from the vulva, may be noticed a minute nematoid worm, which might readily, at first sight, be passed over as one of the young, did not certain peculiarities of form and its invariable presence in the same position negative such a supposition. This little creature is very transparent,. and perfectly motionless; it is about $\frac{1}{20}$th an inch in length, and $\frac{1}{1000}$th an inch in breadth. It may easily be distinguished from the young *Sphærulariæ* by the differently-shaped "tail," which is sharply pointed, and quite unlike the clubbed extremity peculiar to them; the "head" is also somewhat more truncate, and the little notch more clearly defined. The skin is likewise ringed, but the striæ are coarser, and more easy to make out; other characters, whether histological or anatomical, are, however, equally conspicuous by their absence. The body is filled with granules and globules similar in appearance to those found in the young, but no indication of specialised organisation is discoverable. It is attached to the female near one extremity of her body at a point about one-fifth of its length. The junction is extremely firm, and the animals seem almost organically connected, as it is very difficult to separate them without rupture. The granular matter filling the interior of the smaller worm appears to branch into the female at the point of union; but I have not been able yet to obtain a preparation showing in what way this is effected. Sir John Lubbock figures the large worm as having a sac-like depression of the skin into which a corresponding projection of the small one is closely fitted; but my specimens do not show this clearly.

Startling as the supposition may at first appear, the weight of opinion is in favour of Sir J. Lubbock's view—that this minute nematoid is, in fact, the male *Sphærularia*, living an epizoic existence permanently attached to his giant consort—beside whom he shows so diminutively and cuts so sorry a figure. It is certainly a curious assertion of woman's rights and the dignity of the sex amongst the *Entozoa;* but it is not altogether without its parallel in the wide range of Zoology. In the *Crustacea* there are certain species belonging to the order *Ichthyophthira*, living attached to the eyes and gills of fish, in which the males never advance beyond the embryonic stage, but pass a life of parasitism on the bodies of their gigantic mates, which are sometimes two or three hundred times their size. Even more extraordinary instances occur among the *Cirripeda*, the females of some species having two diminutive males as permanent retainers, snugly ensconced in depressions within their shells. The disproportion of size in these instances, however, sinks into insignificance in comparison with that of the two sexes of *Sphærularia*—the males in the latter case being from twenty to thirty thousand times less than their "better halves!"

I have, as yet, had no opportunity of examining bees during the winter months, but according to Sir John Lubbock's observations, the *Entozoön* may then be found very small and immature, although in all cases in which he met with them from the middle of December until February the union of the sexes had already taken place. He states that the male was then somewhat more lively both in appearance and reality than when met with in the spring. "The female, however, far from being the comparatively gigantic creature which she afterwards becomes, was actually shorter, though thicker, than the male, being only $\frac{1}{40}$th of an inch from one end to the other."

The male, in these early stages, presented no more tangible evidence of structure than it usually does in summer, and nothing in the nature of spermatozoa were to be seen in its interior. The uterus of the female, however, contained "a very curious rod-like body, composed of a great number of minute granules, united together as if by some sticky substance. It lay with its lower end close to the vulva; and, in small specimens, seemed to distend the uterus; though, in larger ones, it lay quite free in the cavity." Sir J. Lubbock conjectures that this body consists of a collection of spermatozoa, agglutinated into a mass at the end of the ovary, so as to fertilize each egg as it is pushed forward in the tube. In the younger females he examined, the ova did not descend in the uterus as far as the rod, but in more mature specimens they had passed by it without altering its form. I believe a similar body is found in one of the annelids, and is also there regarded as a mass of spermatozoa; but as Lubbock could find nothing analogous in the male, and no evidence exists as to the mode in which it is deposited in the uterus, the exact nature of the "rod" in *Sphærularia* remains a doubtful point.

In the above brief sketch of the anatomy of the parasite, I have used Lubbock's nomenclature, in accordance with the opinions he entertained in his Memoirs as to the relations and functions of the various parts; but, as I have before hinted, Schneider has recently expressed a view as to the nature of *Sphærularia*, which differs completely from that adopted by previous writers. He considers the small nematoid, described above as an epizoic male, to be the true female, and the tuberculated worm attached thereto, to be merely a gigantic prolapsed uterus growing out of it. I am indebted to the kindness of Dr. Cobbold, our greatest English helminthologist, for this information, and he assures me that he is not disposed to accept the view advocated by Schneider, but considers Lubbock's to be the correct interpretation of the mystery. Many of the facts could be explained equally well by either hypothesis; but, of course, if Schneider's assumption is correct, the male is still unknown in its adult stage, and it must be searched for elsewhere than in the bee's body. I have not been able to refer to Schneider's work, to ascertain the reasons he gives for this opinion, but I presume it is based, in some measure, on the known habits of various other nematoids. Siebold's experiments have shown that young worms of this class are capable of living in moist earth, and there becoming sexually mature, and it has been conjectured that it is in this stage the great work of reproduction is commenced. The males are observed much more rarely than the females. Mr. Lewis, for instance, in the paper I have before referred to, says there was not one male amongst the 50 or 60 specimens of *Mermis* he possessed; I believe Van Benedin's opinion is that the males quit their hosts some time before the female, and if so, the habit furnishes a reason for the apparent scarcity of the former.

From Sir John Lubbock's and my own experiments, it is certain that young *Sphærulariæ* are capable of living for many weeks in water after removal from the body of the bee, and we can imagine, with a degree of probability, that the natural history of the bee-worm may be somewhat in this wise.—Although I have not myself observed any diminution of vital power in the infected bees, they must doubtless in time become weaker and weaker from the absorption of the vital fluids by their insidious foes, and then crawling into some grassy nook where the soil is soft and damp, quietly end their busy lives. The young worms then probably quit their victim, and take up their abode amidst the moist earth and herbage. If Schneider's theory is correct, it is here, perhaps, that the union of the sexes takes place, the young nematoids becoming mature after leaving the bee; but, if the other view of the case be the true one, this event is probably deferred until the male and female are safely lodged in the interior of a new "host." In any case, the worms would await the arrival of some wandering *Bombus*, in which case the bee, groping amongst the herbage, as is the habit of its tribe, "poking its nose into this and to that," could hardly fail to come into collision with some of the expectant nematoids; they would lose no time in taking up their local habitation in the insect's body, and then by growth during the winter, assume the form in which we find them in the spring, so once more completing the cycle of their existence.

If something like the above be their habits, their chance of life is dependent on a humble-bee accidentally blundering into their place of concealment, and thousands must inevitably perish without ever having had an opportunity of entering an insect. In Nature we often find vicissitudes of a like description in the life of a plant or animal, compensated for by great powers of increase under favourable conditions. The astonishing fecundity of many *Entozoa* is well known, but probably few animals more faithfully fulfil the command, "Increase and multiply," than *Sphœrulariœ*. The young absolutely swarmed in all the infected bees I examined, and on making the necessary incisions in the abdomen, they flowed out in myriads, rendering the surrounding water quite milky. A few drops of this fluid placed in a watch-glass, and examined under a low power, presented a very curious spectacle, the whole collection of worms being in a state of rapid motion. As the result of some experiments, Sir John Lubbock estimated that one bee contained 50,000, one 60,000, and a third over 100,000 young *Sphœrulariœ*, and my own observations fully confirm this statement. Even these figures, however, do not represent, by any means, the numbers that may possibly be developed in a single insect. At the time the young are found so numerously, the ovaries of the worms are filled with germs in every stage of growth, and I have frequently found a dozen or more full-grown *Sphœrulariœ* in one bee, each busily engaged in adding egg after egg to swell the ranks of the already teeming multitudes!

It is plain that, whatever be the economy of the parasite, the destruction of the young must bear a direct proportion to the prolificness of the species, otherwise the prodigious increase of the parasite would exterminate the humble-bees in a couple of seasons. As Sir John Lubbock observes, "It is evident that, if the sexes of a given species are equal in number, and if the species is neither increasing nor diminishing, the chances against any given young one attaining to maturity may be obtained by halving the average number of young ones produced by each female." Applying this principle to the species before us, we may calculate the chances to be about 5,000 to one against a young *Sphœrularia* finding a permanent home in the body of a bee.

Presuming the foregoing view as to their life-history to be correct, a slight consideration of the known habits of humble-bees will enable us to account for the fact I have before stated, namely, that *Sphœrulariœ* are only found in the large *females*. We cannot imagine that the young parasites would be capable of exercising any power of selection as regards the sex of their victims; they would probably crawl on to males, workers, and females quite indiscriminately. In the two former events, however, their existence would be speedily nipped in the bud. The female *Bombi* are the only individuals that survive the winter; they hybernate in stacks of wood, or dry turf, and are the sole founders of new colonies in the spring. The males and workers die long before the frosts of winter set in, and, of course, any nematoids who had effected a lodgment in their bodies, would perish likewise. Only those more fortunate ones, who had gained an entrance into a female bee, would have the least chance of existing through the winter, and so becoming full-grown, and capable of perpetuating the species.

I have thus given an imperfect *résumé* of the known facts respecting this anomalous creature, and I hope what I have said will at least have this good effect, that some of our members may be induced to make an effort towards clearing up the moot points in its history. The season is now approaching when this may be attempted, as regards one question, with some chance of success. The worms must make their entrance into the bees during the autumn, and, of course, if the two supposed sexes can be discovered in a bee before union has taken place, Lubbock's theory will be at once established. It is not to be disputed that the search would be very troublesome, from the minuteness of the young parasites, and their resemblance to some of the internal organs of the bee, as well as from the scarcity of these insects at late seasons of the year, and consequent difficulty of obtaining specimens for examination. In my own case, living, as I do, near town, the latter hindrance will, I fear, prove a very formidable one; and I need hardly say how glad I shall be to co-operate with anyone resident in the country, and familiar with the haunts of the humble-bee, in an endeavour to effect a solution of this puzzling biological problem.

Explanation of Plate. VI.

1. *Sphærularia Bombi*, L.D., mature female, rendered transparent by the action of glycerine, so as to show the internal organs, viz., the "fat cells" and ovary. A small nematoid worm, presumed to be the male, is seen attached near one extremity. × about 7 diameters.
2. Male, "head." } × about 260.
3. do. "tail." } × about 260.
4. "Head" of young *Sphærularia*. } × about 260.
5. "Tail" of ditto. } × about 260.
6. Male, × about 55.
7. Young, × about 55.

All the figures were drawn from specimens preserved in glycerine.

On the Development of Actinophrys sol.

By Mr. James Fullagar, Honorary Assistant Secretary of the East Kent Natural History Society.

Read Sept. 24th, 1875.

Having for some time past been occupied in examining *Actinophrys sol* (a number of specimens of which I found in a glass cell wherein I had been watching some rotifers), my attention was called to the manner of their taking food, and also of their reproduction by fission. This formed the subject of a paper, published, with sketches, in the May number of "Science Gossip." The present communication consists of what I afterwards observed with reference to some remarkable changes through which the *A. sol* passes. I had on several occasions witnessed what is termed "conjugation"—that is, when two or more *Actinophrys* approach each other, and at first an entanglement of their spines takes place; then, coming closer to each other, they gradually become fused into one mass. According to Prichard, in his work on the Infusoria, this was by the early observers considered a reproductive act—a sort of copulation between two individuals; but, he says, "the tendency of opinion at the present day is to deny it this nature, and to treat it as little more than an accidental phenomenon without apparent object or aim. Nevertheless, its occurrence is so frequent, and its process of so complete a character, that it is hard to believe it to be in vain, and of no purpose in the economy of the *Actinophrys*." The *Actinophrys* thus fused together may be of any number, from two to twelve, which number may be told by the outward position of the spines, as they do not entirely lose their outward or individual form, but the parts where they unite become intermingled, and are so fused with one another that they appear as one body.

The following observations were principally taken from a group of eight which had thus become amalgamated, from which state I witnessed their separation and the various changes that followed. I have given an illustration of one only, though the whole of the group underwent the same changes to the time when they arrived at the stage shown in Fig. 6. Figs. 7, 8, and 9 show the varied appearances of the same objects under a $\frac{1}{4}$-inch objective; that at Fig. 9 has a peculiar reticulated appearance. (Plates VII. VIII.)

When thus joined together in a mass, they are capable of seizing and retaining, by their united efforts, large animalcules. I have seen three large *Paramecia* enclosed at one time, and each of them in a separate circle, from which nutriment appears to be extracted and diffused through the whole number thus united in one body. They feed voraciously at this time—namely, just before their encystment commences, for which, I think, this fusion of many together to be preparatory. When fully fed, they again divide into their individual forms in the same gradual manner as in the act of fission. When completely separated, the spines are of an extraordinary length, some of them being twice the diameter of the body in length, and very brilliant; as they separate, they move a short distance from each other, so that the spines are quite clear of one another, and then remain stationary, preparatory to the next change. And now the spines begin to shorten by being slowly withdrawn into the body, and in about four hours they so far disappear as to present the appearance as shown in Fig. 1; in about two hours more they are entirely withdrawn (Fig. 2). As the spines shorten, the centre of the body is observed to become darker. The contractile vesicle (Fig. 2. a) continues to act for a short time after the spines have disappeared. But soon another change takes place in the interior, the contents of which, in about six hours, are found to be divided into two equal-sized globes, still surrounded by the original circle (Fig. 3. a), at which time a very transparent film is seen to be thrown out which entirely surrounds it (Fig. 3. b). These globes, in about twelve hours, gradually change into the form shown at Fig. 4, when the original circle loses its roundness (Fig. 4. c), and finally disappears, and they continue to alter in shape, until the two bodies take the form shown at Fig. 5, in which state the dark parts continue quite separate from each other, so that a space can be seen between them. They remain for some hours in this position, when they approach each other, and a union again takes place, commencing in the centre (Fig. 5); and in the course of an hour from the time when they are observed to touch, they again become fused into the globular form, as shown in Fig. 6, but much smaller than the original ones, and in this encysted state they continue for some time. Now, at this stage a curious phenomenon takes place; one of the group of eight that had become encysted moves about in all directions among the others—sometimes going a short distance from the rest, then returning to the group, gliding between and around them, making use of hyaline processes or pseudopodia, which are thrown out (Fig. 10). After wandering about in this way for a time it will withdraw its pseudopodia, and remain at rest for some time, then again move off in all directions, these alternate movements and rests being continued for more than forty-eight hours.

The whole group of eight also move slightly, at times being seen closer together, and then moving to a short distance. Fig. 11 shows one in particular that had left the group, putting out many processes, and moving at a quicker rate than usual, at the same time retaining hold of the gelatinous substance surrounding the whole, and so drawing them together in a heap, as though they were connected by some means, when, by a sudden snap of the connecting medium, they break away from the moving one, and fall back into their original position, the active one still pursuing its way through the water, continually changing the form of its pseudopodia, until it appears as shown at Fig. 12, when it very much resembles that figured in Prichard's Infusoria as *Amœba bilimbosa*, and, if seen by itself, without knowing it to be produced from the encysted state of *Actinophrys*, it would certainly be taken for *Amœba bilimbosa*. Also at times there is a cloudy translucent matter (Fig. 13) exuded from some of them, which does not appear to affect in any way the surrounding envelope, nor to alter the density of colour in the centre. It proceeds slowly from different parts, glides away in various directions, and then becomes stationary; and what appears most strange, and to me inexplicable, is, that out of these cloudy masses, are seen to issue minute globular bodies, which pass out of the field of the microscope, and are lost. Also out of the same cloudy matter I have seen *Amœban* bodies proceed; at one time it has been like *Amœba princeps*, beautifully clear and transparent, with its moving granules, and two contractile vesicles; at other times it has been *Amœba porrecta*, with its curious, delicate, and numerous processes, and its fine granules, moving more quickly across the field. Several of *Amœba limax* have made their appearance in the same cell, and also *Amœba actinophora.* As all of these *Amœbas* are supposed by some writers to be distinct species, it gives rise to the question—what connection have they with *Actinophrys sol.*, being found so closely mixed up with them? This is a question that will require some little application, study, and patience to answer. Dr. Wallich, in a note to his paper, "On an undescribed form of Amœba," in the "Magazine of Natural History," Vol. ii., 1863, p. 287, says that he thinks it will be found eventually that all those *Amœbas* are mere transitory phases of one and the same species; and I think so too, after what I have seen of them during four months of almost daily observation.

Fig. 3 is similar to one of the eight *Actinophrys* mentioned in the paper, in their progress towards encystment, having arrived at the stage of the formation of the two globular bodies.

Fig. 14 shows a change that took place in a number of globular bodies, that at one time appeared in the cell when *A. sol.* had passed through the encysted state. These globes were about half the size of those encysted, and not fixed like them, but moving slowly through the water, surrounded by a very delicate fringe, but without spines. In the course of an hour they were seen to change in form from Fig. 2 to Fig. 4, and then to Fig. 14, each of which, when separated, became perfectly shaped like Fig. 2, but only half the size. Each of these again divided into two, as at Fig. 15, when very fine and numerous spines were thrown out—these I believe to be young *A. sol.* I have not yet seen any of them attain the size of the original ones.

Fig. 16 is a sketch of another form of *Amœba*, seen in the same cell. The large granules at *a* were very bright, and moved about as the creature advanced in the direction indicated by the arrow.

Fig. 17 represents a globular form, of which there is a great number in the cell; they have been visible for the last month, and they move so very slowly as to appear stationary; sometimes as many as six or seven are seen at once in the field of the microscope. They have a number of vacuoles, which, at short intervals, close up, and again open at the same spot; the vacuoles are not all equal in size, some are double the size of others, and in some of the globes they are more numerous than in others. Being sure, by the action of those vacuoles, that a change would take place in them sooner or later, I watched them for a long time, when one of them was seen to open, and put forth a long process, which it waved and curled about in all directions, as though seeking for something; when the process or pseudopodium was fully extended, the body lost its globular form from being emptied of its contents, and assumed that shown at Fig. 18. After a little time the pseudopodium was again withdrawn, and the body resumed its globular form as before, and slowly moved out of the field. In the course of an hour five of them were seen to do the same. The length of the pseudopodium, when fully extended, was five times the diameter of the body.

Fig. 19 shows two of the globular bodies which, on approaching one another, became flattened, but did not actually touch, and again passed away from each other in opposite directions, returning to their globular form. They contained several Desmids.

Fig. 20 is one that was filled with exceedingly numerous, distinct, and bright granules.

Fig. 21 is one that showed a reticulated centre and vacuoles which contained food.

A very bright and translucent *Amœba* was also seen, with four vacuoles, but no granules. It was floating through the water at a quick pace.

On Mounting *Ostracoda* and Allied Genera in a Permanent Manner.

By E. Gardner.

Read October 22, 1875.

I have been trying for a long time to mount the *Ostracoda* and allied genera in a permanent manner, and having at last fancied that I have succeeded, as my slides show no alteration after some months, I beg to communicate my method, in the hope that other young microscopists will improve upon it, and give the results of their experience. I found that fluid media were of no use, as endosmose, sooner or later, destroyed the objects, which do not admit of being dried for mounting in resinous media. I therefore tried a mixture of two-thirds gum arabic and one-third syrup, made with loaf-sugar with a few drops of alcohol and creosote and a little corrosive sublimate. I found that a drop of this mixture hardened sufficiently in about two days to imbed and preserve the object, and to admit of the cell being filled up with gum dammar in benzole. I use that prepared by White, of Litcham, in collapsible tubes. Should the object show above, or project through the first coat of gum when hardened, more must be dropped in, until it is quite imbedded. The object is then covered with thin glass. My reason for mixing the syrup with the gum arabic is merely to prevent the gum from cracking or contracting too much when dry.

On the Histology of the Hard Dental Tissues.

By T. Charters White, M.R.C.S., &c.

Read Nov. 26, 1875.

About four years ago I had the honour of reading a short paper here, in which I directed your attention to the histological characters of that soft dental structure, generally known as the "nerve" of the tooth. I pointed out to you the compound nature of it, and described it as a mass of areolar connective tissue, plentifully supplied with nucleated cells, supporting the minute ramifications of the dental vessels and nerves, and having a remarkable layer of peculiar cells disposed on its external surface, in close connection with the walls of the pulp-cavity. At that time I briefly alluded to the office of these cells as dentine-forming organs, and I desire this evening to show more particularly the part these cells play in the formation of the largest and most important division of the hard dentinal structures.

In drawing your attention to these structures, I may as well acknowledge at once the source from whence I derive my information, for I need not remind you of the difficulties which beset original investigations in any branch of developmental physiology, difficulties that can only be overcome by such workers as our own Dr. Sharpey and Mr. Tomes, in this country, and by Kölliker and Stricker amongst our foreign *savans.* I shall, therefore, endeavour fairly to represent their views in this short paper, contenting myself, as far as I am able, by giving you a clear and orderly summary of all that has been done by them in this department of histological work.

In commencing this undertaking, we must bear in mind the nature and office of the teeth—they are essentially dermal structures—by which I mean that their development partakes largely of that of the skin. They are cuticular appendanges, and, although in administering to the wants of man, they are most suitably placed at the commencement of the alimentary canal, and only a few inches from the external surface of the body, yet in the lower animals, they may be found occupying a great range of positions, either studding the formidable rostrum of the saw-fish, and developed into the mighty spear of the narwhal, or found in the digestive cavity of the crustacea, and being periodically shed with the shells of these creatures.

These few instances may be quoted as proofs of their true relation to the external skeleton, proofs which I hope may be made still further clear, when we come to deal with their developmental history.

With these few words of introduction, we will proceed to an examination of these structures in the earliest periods of their existence.

The development of the teeth commences about the sixth week of fœtal life, by the formation of a ridge upon the gums of the upper and lower jaws, and may be studied most advantageously in sections taken during this and the succeeding periods of growth, when may be observed a thickening of the embryonic connective tissue and epithelium of the mucous membrane of the mouth. This epithelium, with its vascular substratum, constitutes, therefore, the matrix of the several constituents of the future tooth, the epithelium forming the enamel, and the mucous tissue the dentine and cement, while the surrounding tissues immediately investing the rudiments of the future tooth become a sacculus enclosing it during the changes which attend its formation till it is ready to be evolved, or in popular parlance, till it is ‘ cut.” By a reference to these diagrams, taken from Kölliker, this process may be more readily understood. Near the end of the second month of fœtal life, a longitudinal furrow, with rounded borders, makes its appearance on the gums ; the epithelium of the oral cavity completely covers it, so that it is only perceptible with difficulty if the surface alone be examined, but in a section of the fœtal lower jaw, from which the diagram is taken, a dipping down of the deepest portion of the epithelial layer into the subjacent mucous tissue may be observed. This depression, narrow at first, ultimately becomes wider at its lower end, and is the agent concerned in the formation of the enamel organ, as we shall see as development takes place.

A series of remarkable changes now occur in the more deeply-seated portions of the enamel-germ, the spheroidal cells forming the central part of it begin to increase rapidly, causing the depression, which was at first like a tubular gland in shape, to become flask-shaped, the neck being still continuous with the epithelial structure from which it sprang. The dentine germ, arising from the mucous tissue, also begins to enlarge, and shoot upwards till it projects into the base of the enamel-germ, which, growing in a contrary direction, at last invests the dental papilla.

Histological changes, of a very interesting character, now occur in this enamel-organ; the cells of it, in immediate contact with the dental pulp, become elongated, and, by mutual pressure, assume the shape of beautiful hexagonal prisms, each being bounded by a decided limiting membrane at the sides, but open at each extremity. Upon the top of the dental papilla the enamel-cells are perpendicular, while at the sides they assume a horizontal direction; in the intermediate positions they may be observed occupying every angle till they join the vertical cells—calcification of the prisms commences at those ends of the prisms which are nearest to the dental pulp, and at the sides of each prism, so that the centres of each are the last portions calcified—calcification proceeds from within outwards and only reaches its maximum of density some months after the tooth is cut. It would be foreign to the nature of this short paper to take up your time by entering into all the abstruse details relative to the changes which now take place in the enamel; it must suffice if I lay before you this brief outline of its developmental history, leaving to those who feel an interest in the subject the task of reading up for themselves the interesting information to be gathered from the numerous authors who have written especially on this subject.

While we have been considering the formation of the enamel, other changes have been taking place, to which I must now direct your attention.

About the period when calcification of the enamel commences the layer of cells covering the external surface of the dental papilla, and to which the name of the Odontoblastic layer may be given, assumes an active condition in forming a cap of dentine immediately beneath the developing enamel-fibres, so that if the young tooth, deprived of its soft structures, be examined at this stage it will represent a thin, hollow shell of dentine corresponding in shape to the future tooth.

Now, as the dental pulp at this time is busily engaged in the formation of the most important tissue in the tooth, I must ask your attention to such a short description of its histological characters as may enable you the more readily to comprehend the hard tissue which immediately results from its agency. The tooth germ, or dental papilla, corresponds in form to the future tooth, and is richly supplied with nerves and blood-vessels, the vessels being most plentifully distributed by loops beneath the odontoblastic layer—the odontoblasts clothing the exterior, stand on all sides perpendicular to the surface on which they are placed, and in close contact with each other; roughly speaking, they may be compared to grains on the head of Indian corn—under the microscope this layer of odontoblasts bears a remarkable resemblance to what is seen when we examine a section of dentine cut transversely to the tubes. The microscopical character of an odontoblast has been dealt with in my former paper, but, to be intelligible, I must again revert to that description. In the human subject, which especially concerns us this evening, the odontoblast is of an oval shape, having a slender fibril at either end, and its centre occupied by a well-defined nucleus.

The internal portions of the pulp are of a fibrous character, being composed of connective tissue with many fusiform nuclei dispersed throughout it; but this structure is not concerned in the formation of the dentine, that being formed exclusively by the odontoblastic layer. We have, then, in an odontoblast an active agent which, acting after the manner of a secreting organ, deposits the salts of lime in and around itself, and, being continuous with similar cells more deeply seated in the pulp, as it becomes calcified and used up, the work is taken up by the deeper layer, till the at first thin shell of dentine gradually thickens, and the process ceases when it arrives at the stage of growth with which we are all familiar. This, then, is a very brief outline of the development of the second element in the hard dentine structures.

The tooth now begins to elongate itself, and the fang to form, and here another structure will present itself for our examination—this is the cementum, or, as it is called in some works, "the crusta petrosa." It becomes developed from the remains of the dental sac, and after the manner of true bone, to which it bears a resemblance in some of its characters, and to which I will refer in the proper place. I trust this brief and, I fear, meagre outline of the development of these several structures may tend to throw some little light on the appearance of them in the mature state, as presented to us in an ordinary section.

The dentine of a tooth is exquisitely formed as an organ of sensibility and of touch, like most papillary organs, and, therefore, it needs to be covered by a substance which, while capable of transmitting sharp, clear, and well-defined impressions, is itself insensible. Such a substance we have in the enamel, whose histological characters we will first examine.

If we look at a healthy, well-developed tooth we shall find not only a good shape for the office it is designed to fulfil, but a surface smooth, regular, and compact; in texture it should be so hard that you might strike a light with it when brought sharply in contact with steel.

There are two methods by which we may examine more closely into the character of this structure. One is by sections cut longitudinally to the axis of the tooth, and also transversely to the course of the fibres; a second plan is by decalcifying such sections by placing them in a solution of one part hydrochloric acid to 12 parts of water when, especially in young and newly-developed teeth, many interesting results may be obtained.

If we take a tolerably thin section of a well-developed tooth, we shall have no difficulty in demonstrating the enamel fibres or prisms standing in a close and dense phalanx over that part of the tooth which is seen projecting from the gum in young and healthy subjects. It extends over that part in varying thickness, being thickest at the apex, and gradually diminishing to the neck of the tooth, which should be embraced by the gum. Its fibres should be nearly uniform in width, and its structure tolerably clear and free from granulations. The fibres do not run in one continuous course, but are marked by transverse striæ, presenting somewhat the appearance of voluntary muscular fibre. They lie in close contact with each other, without any demonstrable intervening substance, and are placed at right angles to the surface of the dentine on which they stand; in this way the ends, and not their sides, are presented to any opposing substance, and thus great strength and compactness are afforded by their union, for it is plain that, did the sides of the prisms present themselves, and one or two became detached, the whole structure would soon crumble down. In sections, taken transversely to the course of the fibres, it is said that the hexagonal character of the prisms may readily be seen, but, as yet, I have not been able to demonstrate more than a polygonal arrangement—a sort of irregular reticulation; the structure in a thin section is so friable that it generally breaks up before ground sufficiently thin for microscopical examination. But in some sections figured by Mr. Tomes, which have been cut and then decalcified, the dilute acid has acted first on the centres of the prisms, those being the last portions calcified in the developing tooth, and the peripheral portions remaining untouched present a fenestrated appearance, which more approximate to squares than hexagons.

This, then, may be considered a fair description of what may be seen in a specimen of normal properly-developed enamel; but appearances may present themselves which will need a word of explanation. In examining a section cut longitudinally, the enamel will present to your view arched lines of a dark colour, and granular in structure; in transverse sections these appear as rings—these are the *contour-lines* of Owen, and are the expressions of the stratified depositions of the lime in the development of the enamel. Again, the enamel fibres may be imperfectly joined, leaving interspaces and breaks in their continuities, this appearance is most frequently met with in the teeth of unhealthy subjects.

Another appearance may also be noted, which, while normal in some animals, especially in the Marsupialia, is not so in Man. I mean the extension into the enamel of the dentinal tubuli, which, crossing their proper termination, form dilated extremities for a considerable distance in the substance of the enamel, and generally accompany a want of proper development in the dentine. These I believe to be the principal points which will strike you in your examination of ordinary sections of enamel. We will now proceed to the consideration of the dentine, and its normal and abnormal characters. The dentine makes up the principal portion of the tooth, and is capped by the enamel above, and clothed by the cementum beneath the gum. Upon examining this structure in a fracture, it presents a silky, fibrous appearance, readily distinguishable from the fracture of the enamel, which appears crystalline. This tissue is best examined in longitudinal and transverse sections; and I will now proceed to describe in more detail the appearances presented to us in a longitudinal section of a perfectly healthy and well-formed tooth. Such a section should show us not only a sound cap of enamel free from all irregularities of formation, but a dentine in which a number of tubuli may be seen running, in curving but unbroken lines, from the central cavity of the tooth to the boundary-line between it and the enamel. The most casual glance through the microscope will reveal distinct and striking differences in the two structures—the enamel dense and crystalline—the dentine highly organised and permeable throughout its substance. A closer and more attentive inspection will lead us to see that these dentinal tubuli start from the wall of the pulp-cavity, where they are widest, being about 1-10·000 of an inch in diameter, and traversing the dentine towards the periphery of the tooth in curves, gradually become smaller, till they vanish in exceeding fine terminations below the enamel. If now we revert to what I have said in speaking of the development of the dentine, we shall find our explanation of the nature of these markings. You may remember that I called your attention to a layer of peculiar cells clothing the external surface of the dental pulp, the layer of odontoblasts—the oval bodies had a central fibre passing through the middle of each one—the distal fibre occupying the commencing tube, and the proximal fibre being lost among the meshes of the connective tissue of the pulp. Now, as the growth of the dentine proceeds, the ossification takes place round the distal fibre, and, as the development increases, each odontoblast becomes converted into the intertubular structure, while fresh odontoblasts forming, take up the work, and carrying it on from without inwards, a compact formation of dentine follows them, till a portion of about $\frac{1}{5}$ of the dental pulp remains as a soft centre to the tooth. Here the ossifying tendency of the odontoblasts appears to remain in abeyance, but ready to be called into action by any exciting cause.

In examining the dentine in some of its earlier stages of growth, the dentinal tubuli appear of greater width near the dental pulp than they do in the fully-formed tooth, and will be found to correspond to the dimensions of the distal fibres of the odontoblasts with which they are in connection. We shall thus see that these dentinal tubuli result from a progressive calcification round the odontoblasts and their distal fibres.

Occasionally the dentinal tubuli present an appearance of joining the adjacent tubes; this may be observed principally towards their extremities, and is occasioned by some of the odontoblasts having two or more distal fibres which, anastomosing with similar fibres in their neighbourhood, thus form loops with the adjoining tubes.

The intertubular tissue appears structureless. It was formerly supposed that each tube was surrounded by a substance of greater density, and described as the wall of the tube, but recent investigations have proved the error of this supposition. The appearances to which this error may be attributed, are presented by looking at a section of the dentine cut across the course of the tubes, when, as a necessarily high power must be used, a small portion of the interior of each tube is seen, which, being misinterpreted, was considered the wall of the tube. However, decalcification of the dentine reveals no wall, but it will afford an interesting evidence that the tubuli are not hollow, but contain the fibrils of the odontoblastic layer, which, if not the actual terminations of the dental nerve distributed to the pulp, have, at least, a close connection with it, as every one must have experienced who has had the dentine excavated previously to having a carious tooth stopped.

Now, all dentine examined under the microscope will not present the regular characters I have attempted here to describe. Instead of being regular and homogeneous in its character, it will appear as a mass of unfused globules—what is known as *globular dentine*—and it is a sign that the tooth has been imperfectly calcified; such teeth commonly have the enamel honeycombed and ridgy, and its prisms imperfectly joined, the teeth being very sensitive to all irritants applied to them, and prone to early decay. Another abnormal appearance manifesting itself in the dentine, and with which all observers should be familiar, is that known as *osteo-dentine* or *secondary dentine.* It usually presents itself to notice in teeth that have been subject to much wearing away of the crown, by which the enamel is ground away, exposing the sensitive dentine beneath, and so producing that exciting cause which I have just now said the odontoblasts wanted to wake them up to their suspended function. Again, when decay attacks a tooth, and the cavity has reached the dentine, its first effect is to irritate the fibres contained in the dentinal tubuli, and these become consolidated round the point of attack, probably by a calcification of the fibres, but advancing caries soon reaches the barricade, when a second is thrown up by a similar calcification, but barrier after barrier is set up and overthrown; at last the odontoblasts themselves take on activity, and fresh dentine, but of a very disturbed and irregular character, is deposited on the walls of the pulp-cavity, in front of the advancing foe.

In some specimens which I will place under my microscope this evening, several degrees of growth of this secondary dentine may be observed, from a slight patch on the walls of the pulp-cavity, to the entire obliteration of the cavity by this new formation. But I must hasten on to the brief consideration of the last of the hard dental tissues which will engage our attention this evening, namely, that which forms the clothing of the fang, and assists in its attachment to the jaw.

Referring again to our longitudinal section, we shall see the enamel on the crown thickest at its apex, and gradually diminishing at the neck of the tooth, but where it vanishes another substance will be seen commencing, at first in a very thin layer, which enlarges as it progresses down the sides of the tooth, reaching its maximum of thickness about the apex of the fang. In its histological character, it approximates more closely to true bone than does any of the other dental tissues, its development and character being allied to that of the bones generally.

Arising from the fibrous remains of the sac originally investing the primordial tooth, numerous processes shoot inwards; as ossification proceeds, these processes unite at different points, enclosing interspaces; round the peripheral portions of these spaces the new bone is formed in an irregular deposition, and after a time this process stops, and lacunæ having radiating canaliculi remain, being filled with a soft protoplasmic substance. This, then, is the general character of the investing substance coating the roots of the teeth. This cementum, as it is termed, like true bone, is permeable to the nutrient fluids of the body through the periosteal membrane, by which it is connected with the jaw; and it is not difficult, with high powers, to demonstrate fine tubuli which, entering in its periosteal surface, form channels of communication through the lacunæ and canaliculi with the dentine, so that when the "nerve" of a tooth perishes, a partial vitality is kept up through the medium of the cementum; but this tissue is likewise the seat of pathological changes which ought to be known to all who may examine the sections usually met with—I refer to that especially known as "*exostosis*." When much irritation from any cause arises around the root of a tooth, and inflammation sets in, this tissue becomes sometimes enormously hypertrophied, almost every exacerbation of the attack being marked by a fresh stratification of the osseous tissue, while the lacunæ are much larger and more irregular in their outline than are those of the original cementum. Absorption may also at the same time take place, and a fresh arrangement of the osseous elements be produced; thus it is not an infrequent occurrence to meet with specimens in which large portions of the cementum has been hollowed out, and in its place nodular, almost structureless, masses of ossific matter deposited. These changes are chiefly met with in teeth that have been the subject of the most intense inflammation—several specimens of which I shall hope to have the pleasure of submitting to your examination this evening.

Having now occupied your time longer than the usual limits of a short paper, and in which I have treated of my subject in, I fear, a very meagre manner, I must apologise for not having been more exhaustive, but the subject is one that would demand a considerably longer time to treat as it deserves than can be given in one paper. The aim I have had in view has been rather to afford some clue to the various tissues presented to our notice in looking at an ordinary section of a tooth, than to write a laborious paper, which, however in place in a professional theatre, would be foreign to the requirements of the general observer.

PROCEEDINGS.

AUGUST 13TH, 1875.—CONVERSATIONAL MEETING.

The following objects were exhibited :—

Skin of Sole, polarized, showing pigment cells ...	...	Mr. Enock.
Diatomaceæ from Hong Kong Harbour...	... ...	Mr. Ingpen.
Elytron of *Melolontha vulgaris*, polarized	... ...	Mr. Sigsworth.
Surirella gemma, with Hartnack's $\frac{1}{9}$ obj....	... ...	Mr. F. H. Ward.

Attendance—Members, 33 ; Visitors, 4 ; Total, 37.

AUGUST 27TH, 1875.—DR. MATTHEWS, F.R.M.S., President, in the Chair.

At the commencement of the proceedings, the President said : Gentlemen, —In assuming this chair by your kind favour for the second time, I trust you will permit me to express my unfeigned sense of the great honour you have done me. To have been elected once was no small matter to me, but when I found that I had received that honour for the second time, it was so entirely unexpected that I must confess I was very much surprised. I remember once hearing an anecdote of Lord Palmerston, and, in relating it, I trust you will not suppose that I am comparing myself, in words or works, with that great statesman. The story was this:—He was complimented once on the great amount of work he had done, and, on being asked how he got through it, his reply was, "Part I do, part does itself ; and the rest is not done at all." Now, I cannot help thinking that he was guilty of what he would, under other circumstances, have called a grievous piece of bad taste. He committed an error into which, I trust, I shall not fall, inasmuch as he had forgotten to acknowledge the help which he had received from others, and which no man can afford to ignore, whatever his position. I therefore now acknowledge, with all my heart, that it would not have been possible for me to have achieved the success that has attended my labours, unless I had received so much kind assistance and considerate help from those around me. Among those from whom I have received such help it is difficult, and might be somewhat invidious, to single out any particular person, but there is one to whom I may refer particularly, and that is the gentleman who sits at my right hand, to whose courtesy and counsel I am greatly indebted. That gentleman, I need hardly tell you, is our worthy Secretary. In conclusion, I beg to tender you my most sincere thanks for the honour you have done me, and I trust that my earnest efforts will compensate for any short-comings of which I may be guilty.

The minutes of the preceding meeting were read and confirmed.

The following additions to the Library were announced :—

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	,, ,,
"Proceedings of the Royal Society"	,, Society.
"Transactions of the Watford Natural History Society"	,, ,,
"Newton on Tasmanite and White Coal"	,, Author.
"Wonfor's Lecture on the Brighton Aquarium" ...	,, ,,
"American Naturalist"	In Exchange.

The thanks of the Club were voted to the donors.

The President presented a number of specimens of *Trochus zizyphinus* to the members of the Club.

Mr. E. T. Newton, at the invitation of the President, made some remarks upon Tasmanite, or White Coal, referring to the legal contest upon the subject that had been long carried on, and suggesting it as one well worth the while of members taking up, as being very interesting, and comparatively unworked.

Mr. W. Cole read a paper on *Sphærularia Bombi.*

The President asked how the *Sphærularia* gained access to the body of the bee, whether by piercing the integument, or by being taken in with the food?

Mr. Cole said it was very difficult to ascertain, owing to the impossibility of keeping the humble-bee alive for any length of time. But he thought that they entered through the skin, and were not swallowed with the food.

A cordial vote of thanks was accorded to Mr. Cole for his paper.

The President announced the meetings and excursions for the ensuing month, and the meeting concluded with the usual *conversazione*, at which the following objects were exhibited :—

Sphærularia Bombi	Mr. W. Cole.
Dragon-fly, *Agrion minium*, male and female ...	,, F. Enock.
Cyclosis in *Nitella translucens*	,, W. Slade.
Sphærularia Bombi	,, T. C. White.

Attendance—Members, 44; Visitors, 6; Total, 50.

September 10th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Chironomus variegatus	Mr. F. Enock.
Plant aphis, from Ceylon	Mr. Ingpen.
Rare Plant-bug	Mr. S. Israel.
Meerschaum	Mr. M. Hawkins Johnson.
"Kunkur"	,, ,,

Section of skin, tip of finger	Dr. Matthews.
Muscle of pig—ultimate fibre	,, ,,
Operculum of *Trochus zizyphinus*...	,, ,,
Cuticle of *Hippophäe rhamnöides*...	Mr. Slade.
Young *Talitrus*, alive	Mr. T. C. White.
Young *Medusæ*, alive	,, ,,

Attendance—Members, 42; Visitors, 4; Total, 46.

September 24th, 1875.—Dr. J. Matthews, President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced:—

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	,, ,, ,,
"Proceedings of the Geological Society" ...	,, the Society.
"Annual Report of the Belfast Natural History Society"	from the Society.
"Report of the Statistical Society"	,, ,,
Six Bottles of various insects for distribution ...	,, Mr. M. H. Johnson.
The text of "Ehrenberg's Infusoria"	,, Dr. M. C. Cooke.
Wyville Thompson "On the Depths of the Sea"	by Purchase.

The thanks of the Club were voted to the donors.

The Rev. W. Locock, who was introduced to the Club by Mr. Curties, exhibited and described a contrivance for securing slides in any position on a turntable. This was accomplished by means of a strip of metal or wood about $\frac{1}{8}$th inch thick, fitting by notches on to the screws which fasten the springs, and about $\frac{1}{8}$th inch broader opposite one screw than the other. A wedge sliding against this will allow of a badly-centred slide being brought into position, and secured by an excentric button. A depression was made in the centre of the turntable to receive cardboard discs, with holes or rings for guides in making cells. A contrivance for accurately centering objects on a slide was also described and shown, in which the slide could be placed in a wooden trough and adjusted over cardboard slips accurately marked. (See "Science Gossip" for September, 1875, p. 206 for figures and full descriptions.)

The President thought that anything which contributed to neat mounting would be regarded as a boon. The little contrivance of Mr. Locock for holding the slide upon the turntable, he thought would be found very useful, especially where it was necessary to apply some degree of pressure upon the slide, as, for instance, with a diamond, in which case it would prevent the slip from moving aside during the operation.

The President said they were also favoured by the presence of another visitor, Mr. Arthur C. Cole, of Liverpool, who had brought to the meeting for exhibition a beautiful collection of physiological specimens, prepared and mounted by himself.

Mr. Cole, in reply to the President, said he would rather not say anything about the objects he had brought; they were placed upon the table for examination, and he would leave them to speak for themselves.

A paper by Mr. James Fullagar—" On the development of *Actinophrys sol*" was read by the Secretary. The subject was illustrated by numerous diagrams, enlarged from drawings prepared with great care as plates for the Journal. The paper was supplemented by a letter upon the subject, addressed to Mr. Curties.

The President expressed his sense of the value of Mr. Fullagar's paper, which he thought set a good example to all in the matter of watching objects of this kind during the process of development.

The Secretary thought the whole subject was extremely interesting, and of the greatest importance, if it could be proved that *Amœba* and *Actinophrys* were really only stages of one and the same organism, and that *Actinophrys* underwent encystment. Dr. Cooke had divided naturalists into two classes, " Lumpers" and " Splitters," according to their respective tendencies to reduce or increase the number of species, and he confessed that in this matter he rather inclined towards the " Lumpers," and had always thought it somewhat rash to make so many species of *Amœba*. Certainly Mr. Fullagar had gone far to trace a complete cycle of changes in *Actinophrys*. On reading up the subject he had found many observations which confirmed portions of Mr. Fullagar's paper, but he did not know of a complete cycle having been worked out. What Messrs. Dallinger and Drysdale had done in the case of the monads, under exceptional circumstances, could not, perhaps, be done by many others, but similar observations to those of Mr. Fullagar must lead to important results as to the knowledge of the life history of those creatures.

The President said, with regard to the question of *Amœba* and Amœboid forms, he had for a long time been making observations of them, and he had found some with, and some without vacuoles. He had regarded *Amœba commune* as the type; and he had found that the one which had a vacuole did undergo changes. The vacuole became eventually lined with a membrane, then became a contractile vesicle, and then protruded *pseudopodia* proper (not the common processes). They knew there were instances in which ciliated corpuscles were found to exist, as in the case of the sponge *Bowerbankia*, but in all cases these seemed to degenerate. He thought what Mr. Fullagar had described was certainly the development of an Amœboid form, but not that of an *Amœba*. Mr. Fullagar well deserved their thanks for his observations, as tending to reduce the number of species, and also for his elaborate and interesting paper.

A vote of thanks to Mr. Fullagar was then put to the meeting by the President, and unanimously carried.

Mr. T. C. White said he had for distribution amongst the members a quantity of *Xylaria polymorpha*, a fungus found growing upon the roots of an acacia, and which made beautiful sections. It had been left in his charge by Mr. C. F. White.

The meetings and excursions for the ensuing month were then announced and the proceedings terminated with a *conversazione*, at which the following objects were exhibited :—

Alcyonella fungosa	by Mr. W. G. Cocks.
Numerous mounted sections of physiological and other preparations	„ Mr. A. C. Cole.
Section of Wood—*Pinus sylvestris*—polarized, shewing pitted structure	„ Mr. T. Curties.
Culex annulatus (Ringed Gnat) male	„ Mr. Enock.
Crystallized Sugar from Queensland	„ Mr. Golding.
Section of Medicinal Leech	„ Mr. Goodinge.
Pleurosigma quadratum, shown with Zeiss' E objective	„ Mr. McIntire.
Tongue of Cricket	„ Mr. J. A. Smith.

Attendance—Members, 65 ; Visitors, 5 ; Total, 70.

October 8th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Platystoma seminationis, male	Mr. Enock.
Silk Glands of *Epëira diadema*	Mr. Fitch.
Blood of *Amphiuma means* (Congo Snake) ...	Mr. Goodinge.
Seed of *Gnaphalium leontophodium*	Mr. Hailes.
Cochlea of Kitten, stained	Mr. E. T. Newton.
Empusa Musci—disease of the common House-fly	„ „
Flowers of *Tamarix Gallica*	Mr. F. Reeve.
Spicules of *Synapta*	Mr. Topping.
Living Diatoms and Desmids, from Marine Aquarium	Mr. T. C. White.

Attendance—Members, 52 ; Visitors, 4 ; total, 56.

October 22nd, 1875.—Dr. J. Matthews, *President*, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following additions to the Library and Cabinet were announced :—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	„
"Popular Science Review"	„
Berkeley's "Fungi, their nature, influence and uses"	Dr. M. C. Cooke.
"The American Naturalist"	in exchange.
"The Quarterly Journal of Microscopical Science"	by purchase
A quantity of feathers of Indian birds (named)	from Dr. M. C. Cooke.
1 Slide of villous coating of Intestine of Sheep	„ Mr. S. Turner.
3 Slides Parasites of Pelican	„ Mr. J. G. Tatem.

The President called the attention of the members to a little book which had recently come under his notice "On Animal Physiology." It was one of Mabbs' series of Science and Art Department, and was produced by their friend Mr. E. T. Newton. He had never seen anything of the kind so concisely written, and he felt he could scarcely speak too highly of it.

Mr. F. Cheshire and Mr. John Hunter were balloted for, and duly elected members of the Club.

A letter was read from the Secretary of the Croydon Microscopical Club, announcing that their soirée would take place on November 10, and inviting the assistance of members of the Q.M.C. on that occasion.

The President said that a valued member of the Club had lately departed for New Zealand, but had sent his carte de visite as a remembrance. It had occurred to some of the members that it would be a good thing to have an album in which the portraits of members might be preserved. They had during the past few years lost so many good and true men, whose likenesses they would be very glad to have, that he thought the idea of an album was a good one.

The Secretary read a communication from Mr. E. Gardner on mounting *Ostracoda*.

The President enquired whether anyone had tried this method? The reason why glycerine was so troublesome was because it had such an intense avidity for water. Dr. Carpenter had said that it was a solvent of calcareous matter, but when mixed with gum he believed it was not so.

The President said that Mr. Bolton, of Stourbridge, was present, and had brought for exhibition a specimen of a new *Melicerta*, the same as described by Dr. Hudson, at the October meeting of the R.M.S. He hoped Mr. Bolton would favour them by describing it.

Mr. Bolton said he was not prepared with a description, but would just say that he was with Dr. Hudson at Sutton Park when these creatures were found, and that he had kept some of them since. Those which he exhibited had a gelatinous case, the wreath round the mouth was larger than in the ordinary species, and there were also very long antennæ. He believed he had found them before, but had then thought they were *Tubularia*, but it was clear they could not be that, because they had eyes.

The Secretary remarked that the peculiarity which led Dr. Hudson to give this species the name of *Melicerta tyro* was, that the brick-making apparatus appeared to be perfect, but that the two lines of cilia, which were instrumental in bringing the material to form the pellets were incomplete, consequently the substances were thrown out instead of entering the mould, and the name of *tyro* was given because it seemed as if it were not properly up to its business.

Mr. Curties congratulated the Club upon having Mr. Bolton, a country member, amongst them that evening. Doubts were expressed in some quarters, as to whether or not this creature was a true novelty, and if the matter were discussed in print it would prove a great advantage to the members to have seen it for themselves.

Mr. Curties said that the name of Captain Perry, of Liverpool, was favourably known to most of the members of the Club. He was a gentleman who made occasional voyages, and being a persevering collector, he always brought home a number of new specimens. His success had been great in this respect with the Diatomaceæ, and now he was devoting himself to the collecting of micro-insects. On a recent occasion he had obtained some very curious parasites which had been examined and prepared by Mr. Tatem, who had also favoured the club by sending a note respecting them. In this Mr. Tatem described the parasites, "which were obtained from *within* the pouch of a pelican shot by Capt. Perry, in Galveston Harbour, Texas; one was a species of *Colpocephalum*, of which Capt. Perry presented to the Club the only specimen procured, the others, a species of *Trinotion*, the females of which were remarkable for the spur at the inferior angle of each tibia. This, he thought, afforded the means of firm attachment to the membrane of the pouch possessed by the females, while the unarmed males would be carried with the food into the stomach."

There was another matter he would take the opportunity of bringing before the notice of the Club. A short time ago he had the honour to be invited to the Annual Dinner of the Postal Micro-Cabinet Club, and he there obtained information which he thought would be of interest. This Club originated in the same manner as their own, and was formed for the purpose of carrying out a system of circulating boxes of slides through the post amongst circuits of members, each of whom examined, contributed to, and passed on the box in accordance with the rules. This system had worked very well, and had brought into contact many microscopists who had derived pleasure and advantage from the intercourse; and it had done more than this, for Mr. Tuffen West had written reports upon the objects, and had illustrated them in his own masterly style, with a view to publication. Mr. Tuffen West had succeeded Mr. Atkinson as President, and Mr. Alfred Allen, F.R.M.S., was Honorary Secretary. It had been found desirable to form a Metropolitan Committee, and he had the compliment paid him of being placed upon that Committee. He had brought with him to the meeting copies of the rules for distribution amongst those members who desired to know more particulars. One thing more he would mention. He knew that any microscopic subject was of interest to them, and therefore he wished to draw attention to a series of drawings of some minute animals found upon the surface of the sea, and published in the Journals of the United Service Institution. The drawings were made by Mrs. Toynbee, and were very beautiful specimens of what microscopic illustrations ought to be, and as such he had brought copies of the journals, and would highly recommend them to the notice of the Club.

The President felt sure the meeting must feel very much indebted to Mr. Curties for his communications, and would return him their hearty thanks. For his own part, he must say that the Micro-Cabinet Club was quite a novelty to him; but it seemed so to commend itself that he should certainly give his hearty support to it.

The thanks of the meeting were unanimously voted to Mr. Curties.

Mr. B. T. Lowne gave an address "On some recent Views of the Classification of the Lower Animals," in which he explained the meaning and uses of the terms *Protozoa* and *Metazoa*, illustrating his remarks by drawings upon the black board.

The President said he had never listened to observations of this kind with so much pleasure and instruction as he had on that occasion. He could not help feeling that a new light was really thrown upon the subject; but it made him feel how true it was that it was far more easy to learn than to unlearn.

Five gentlemen were then proposed for membership; notices of meetings, &c., for the ensuing month, were given out, and the meeting terminated with a conversazione, at which the following objects were exhibited :—

Parasites from interior of Pelican's Pouch ...	By Mr. Curties (for Mr. Tatem).
Melicerta tyro—the new rotifer recently described by Dr. T. C. Hudson	,, Mr. T. Bolton.
Capsus tricolor (Plant Bug)	,, Mr. Enock.
Sections of Foraminifera (*Orbiculina*)	,, Mr. Hainworth.
Seeds of *Capsella bursa pastoris*	,, Mr. Martinelli.
Surirella fastuosa...	,, Mr. Moginie.
Gemmules of *Pachymatisma Johnstonia* ...	,, Mr. Priest.
Section of *Epithelioma* of Tongue	,, Mr. T. C. White.

Attendance—Members, 78; Visitors, 9.—Total, 87.

November 12th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Gregarina, encysted, showing escape of *pseudo-naviculæ*	Mr. W. Cole.
Closterium rostratum and other Desmids ...	Mr. T. Curties.
Wing of White-plume Moth *Sterophorus pentydactylus*	Mr. F. Enock.
Collection of *Diatomaceæ*...	Mr. G. Green.
Salycic Acid (polarised)	Mr. J. H. Hadland.
Thomisus cristatus, male	Mr. Isaac.
Section of Young Elder Shoot, showing Cambium cells	Mr. B. D. Jackson.
Meerschaum, stained	Mr. M. H. Johnson.
Conemara Serpentine, stained	,, ,,
Wheel spicules of *Chirodota*	Mr. Moginie.
Spines of Star-fish	Mr. Topping.

Attendance—Members, 69; Visitors, 8.—Total, 77.

November 26th, 1875.—Dr. J. Matthews, President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	"
"Proceedings of the Geologists' Association"	the Association.
"Proceedings of the Watford Natural History Society	the Society.
"Lindberg's Hepaticæ"	the Author.
"The American Naturalist"	in exchange.
"Mr B. T. Lowne's address at Middlesex Hospital"	the Author.
Three Slides of Diatomaceæ from Congo ...	from Mr Curties.
Four Slides of portions of *Edelweiss*	Mr. R. T. Lewis.

The thanks of the meeting were voted to the Donors.

The President said it would be remembered that at the last meeting the photograph of a member who had gone abroad had been announced as a present to the Club; and it was suggested that an album should be procured in which to place it, together with the portraits of other members, as they were obtained. The idea was certainly a good one; and it would be pleasant to be able to look upon the likenesses of valued members who had been removed from their number, as well as to obtain a collection of the portraits of those who remained. It had been resolved to make some enquiries as to price, &c., but they had meanwhile been anticipated in a very pleasing manner; and he had the pleasure of announcing that they had received, as a present from Mr. Goodinge, two very handsome albums, each contained in a mahogany case. He might well say that they had that evening an "*embarras de richesse*," for in addition to these two books, he had to announce the gift of another beautiful album, from their esteemed Treasurer, Mr. Gay. This, as they would see, was large and excellent in both quality and taste, and had the initials of the Club impressed in gold upon its cover. The Albums were then handed round for the inspection of the members, and the special thanks of the Club were voted by acclamation to Mr. Gay and Mr. Goodinge for their valuable gifts. The President observed that it was of course useless to have albums unless they had something to put into them; he therefore invited the members of the Club to forward their cartes-de-visite to the Secretary for the purpose, and particularly expressed his desire that portraits of deceased members should, if possible, be obtained by those who were able to do so. If any gentleman present could procure a likeness of their first President, the late Dr. Lankester, it would be very highly valued. They could not of course be choosers in the matter; but if one of the cabinet size could be procured, it would be desirable, Mr. Gay's album being furnished with a number of spaces to take that size pictures in addition to the ordinary cartes-de-visite.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. Charles M. Bayfield, Mr. John Beulah, Mr. Francis Cunningham, the Rev. Thomas Freckelton, and Mr. Alexander G. Halley.

The President called attention to the slides which had been presented to the cabinet that evening, and requested the gentlemen who had given them, to favour the meeting with a few words by way of description.

Mr. R. T. Lewis said that the four slides which he had brought were portions of the *Edelweiss,* a rare and beautiful flower well known to all who had travelled much in Switzerland. The plant grew only in the higher mountain pastures, was of a pure white, and densely covered in every part with a kind of down; the separated flowerets were surrounded by a tuft of feathery hairs, and were very pretty objects under the microscope, particularly when well illuminated by the paraboloid. Two of the slides in question were of these flowerets, mounted dry and in balsam; the third was a petal with its downy covering; and the fourth a portion of the down separately mounted for the polariscope. He had brought the slides because he did not think they were represented in the cabinet of the Club, and also because he thought the Club should not be forgotten during one's holiday rambles. A fine specimen of the flower itself was exhibited, which was obtained in the Ober Engadine, at an elevation of about 10,000 feet.

Mr. Curties said he had the pleasure of presenting several slides, containing various species of *Aulacodiscus,* mounted opaque and transparent, from a gathering made by Mr. Martin, of H.M.S. Spiteful, during the late Congo expedition. The slides were contributed to the Q. M. C. by Mr. Redward, of Portsea, who reported that Diatomists are not quite agreed as to species. He hoped that the Club would be favoured with information respecting them at a future time.

The President, in moving the thanks of the Club for the donations and the descriptions given of them, said he had seen the specimens of *Aulacodiscus,* and thought they were extremely well prepared.

The President intimated that they were indebted to Mr. Lowne for a number of copies of his address, delivered at the opening of the Medical School in connection with Middlesex Hospital. It was of much interest, and he could commend it heartily to all as a very fair representation of the present state of scientific medicine.

Mr. B. T. Lowne gave a very interesting account of the Carnivorous or Insectivorous plants, describing and illustrating by diagrams the general appearance and structure of the leaf of the *Drosera*, and detailing the process of insect-catching. He expressed the hope that some of the members of the Club would give careful attention to the subject, which could not fail to yield interesting and useful results.

The thanks of the meeting were voted to Mr. Lowne for his communication.

Mr. T. C. White read a paper "On the Histology of the Hard Dental Tissues," which he illustrated by coloured diagrams.

The President thought they had received from Mr. White a most lucid explanation of an intensely difficult subject. His own attention had been much directed towards the formation, not only of teeth, but of all calcareous substances in animal organisms; and it appeared to be carried out by a process of dialysis from the surrounding structures. They had instances of this process in other cases besides that of teeth or shells, and even outside the limits of animal life. For instance, Mr. Hind had obtained crystals of lime deposited in much the same way by means of fluids of different densities. Dr. Carpenter also had given instances of the process in the case of the shells of slugs, &c. He had no doubt but that the Raphides in plants were due to the action of similar causes.

The thanks of the meeting were cordially voted to Mr. White for his paper.

The President announced that the next ordinary meeting of the Club would be held on December 17th, *instead of December 24th, as previously announced*, and that a paper would be read on that occasion by Mr. Henry Davis, "On a larval *Cirripede*."

The meeting then terminated with a converzatione, at which the following objects were exhibited :—

Section of Tongue of Hedgehog	by Mr. W. J. Brown.
Group of living Rotifera	Mr. W. G. Cocks.
Lampyris noctiluca (showing illuminating organs)...	Mr. Enock.
The Gibbous Startet—*Asterma gibbosa* ...	Mr. Goodinge.
Carbonate of lime, prepared by Rainey's process	Mr. F. H. P. Hind.
Diatomaceæ from Los Angelos	Mr. Moginie.
Stellate hairs on Fern—*Niphobolus lingua* ...	Mr. B. W. Priest.

Attendance—Members, 66; Visitors, 10. Total, 76.

December 10th, 1875.—Conversational Meeting.

The following objects were exhibited :—

Melicerta tyro and *M. ringens*	Mr. J. Badcock.
Floscularia	,,
Pediculi, &c.	Mr. Beulah.
Wing of *Vanessa Jo.*	Mr. F. Enock.
Zeiss' D. objective, arranged for Binocular ...	Dr. Matthews.
Bicellaria tuba, from Australia	Mr. Moginie.
Section of stem of *Jaborandi*	Mr. T. H. Powell.
Section of stem of Pepper (Polar)	Mr. Sigsworth.
Elytron of *Pachyrynchus*	Mr. J. A. Smith.
Lung of toad, injected	Mr. S. Turner.
Crystallized Gold	Mr. T. C. White.
Gorham's instrument to illustrate the magnifying power of short spaces ...	,,

Attendance—Members, 61; Visitors, 8. Total, 69.

DECEMBER 17TH, 1875.—DR. J. MATTHEWS, F.R.M.S., *President*, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced:—

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	,, ,,
"The Microscope in Gynæcology," by Dr. A. Mead Edwards	,, the Author.
"Owen's Lectures on the Invertebrates" ...	,, Mr. Bywater.
"The American Naturalist"	in exchange.
"Lecture upon the Geology of Croydon" ...	from Profr. Morris.
"Reports of the Medical Officer of the Privy Council"	,, Mr. Sigsworth.
Part 6 of "Schmidt's Atlas of the Diatomaceæ"	by subscription.
A large lithographic print of the tongue of the blow-fly	from Mr. Watkins.
A Photographic Portrait for the Club Album...	,, Mr. McIntire.
Six Slides...	,, Mr. Enock.

The thanks of the Club were unanimously voted to the donors.

The Secretary announced that Herr Möller's proposed work on the preparation and mounting of diatoms, to which attention had been called upon a former occasion, would not be published, in consequence of the number of subscribers for it being deemed insufficient.

Mr. Watkins, in reply to a question from the President, said that the print which he had presented to the Club was given to him by the late Mr. Topping, as being the last one he had. He believed that not more than 300 of them were struck off, and they were now becoming very scarce.

Mr. Topping stated that his father first prepared the proboscis of the blow-fly, in the manner shown in the print, in 1842. The object was very much admired, and Mr. Ross and others suggested that it should be lithographed, which was accordingly done in 1844. The expanded position of the lobes was considered by some to be unnatural, because the blow-fly was generally examined when feeding on syrup; but it would be observed in the case of a fly which was tasting vinegar, or any other substance it did not approve of.

Mr. A. Caplatzi, Mr. Thos. Farries, Mr. C. L. Jackson, Mr. Thos. May, Mr. Mansell Swift, and Mr. W. Tidmarsh were duly elected members of the Club.

Mr. Curties stated that Mr. Davis was not able to be present that evening to read his paper "On a larval Cirripede." He had sent the paper and drawings, but Mr. Curties thought the subject would have more justice done to it if introduced by Mr. Davis himself, and the paper was accordingly postponed till the next meeting.

Mr. Ingpen gave a description of the various methods employed from time to time for measuring the angular apertures of objectives, of which the following is an abstract:—Down to the year 1854, the method of measuring angular apertures devised by Mr. Lister, seems to have been the only one employed. This is described in the *Phil. Trans., Vol.* 121, *p.* 191, and will be found in

Quekett on the Microscope, ed. 1855, *p.* 497. The microscope, with its objective and eyepiece as in ordinary use, is placed horizontally, a candle is set on a level with it, a few yards distant; the microscope is then turned, till, on looking through the eyepiece, the field of view is bisected, half being light and half dark. The microscope is then turned round, with the focus of the objective as a pivot, until the opposite half of the field is illuminated. The angle can be measured by lines drawn on a suitable part of the instrument, or, preferably, by a divided semicircle. This method answers very well up to 90° or 100°, but for larger angles is not nearly so accurate as that devised by Mr. Wenham, and described in the *Quart. Journ. Mic. Sc.*, 1854, *p.* 134. A lens of about ¼ in. focus being placed centrally, in a sliding cap, above the eyepiece, the image of the flame can be observed, and the angle measured with great accuracy; also the condition of the definition at the margin of the field can be ascertained, sometimes suggesting the utility of reducing the angle of the objective. This plan appears to have been used some years earlier by Amici. In the *Quart. Journ. Mic. Sc.*, 1854, *p.* 293, Mr. Gillett's method is described: this was communicated to the Royal Society on March 9, 1854. The eyepiece is replaced by a cone having a small aperture, through which light is sent. The objective is focussed on an object which forms the centre upon which a second, or examining microscope, attached to a divided arc, turns. This plan is described in *Mr. Hogg's Treatise on the Microscope*, 1871, *p.* 45, as "a very perfect instrument," but there seems to be some source of error connected with the employment of a second microscope. Professor Robinson's method was first brought before the Royal Irish Academy in 1854, and is described in the *Quart. Journ. Mic. Sc.*, 1854, *p.* 295. Rays nearly parallel are sent through the eyepiece and objective, and intercepted by a screen at a distance greater than the focus. This distance, and the diameter of the base of the cone of rays so formed being known, the angle is easily calculated. This is a very elegant method, and likely to be valuable in certain disputed cases as to the true angle of immersion lenses. Mr. Sollitt describes a method in the 3rd Vol. of the *Quart. Journ. Mic. Sc.*, 1855, *p.* 85, which he considers simpler than Mr. Wenham's. He does not use the Huyghenian eyepiece, but a lens of 1½ in. focus, "as the eyepiece of a diminishing telescope." Two candles are employed, and moved till their images are seen at the extreme edges of the field. This is described in *Carpenter on the Microscope, 5th ed.*, 1875, *p.* 202. It is open to the objection that if the observing lens is held obliquely, a distorted image of the candle may be seen at a greater angle than that which is engaged in forming the image of the object, and probably the angle is overstated. Mr. Wenham's (or Amici's) method seems to have been again reinvented, as it is attributed by Mr. Brooke *(Quart. Journ. Mic. Sc.*, 1864, *p.* 84) to Professor Govin, of Turin. It was used in the examination of objectives at the International Exhibition of 1862; the only differences were the employment of a combination of two lenses instead of a single lens, the instrument being placed in a vertical instead of a horizontal position, and strips of white paper on a dark cloth used instead of candles. In the *Quart. Journ. Mic. Sc., Vol. VII., p.* 256, Mr. Peter Gray examines the images of two flames in the objective without an eyepiece, which amounts to a re-invention of Mr. Sollitt's method. Mr. Stephenson, adopting the same system, places two flames, such as night-lights, at known distances apart, and using the objective alone without any tube, has a very convenient scale of tangents engraved upon paper, thus showing the angle by inspection. This is described in the *Month. Mic. Journ.*, July, 1875, *p.* 3. In the *Month. Mic. Journ.* for May, 1874, *p.* 178, Mr. Wenham describes an adjustable slit formed by two slips of very thin platina foil, which can be separated to the exact diameter of any field of view, thus excluding all but "image-forming rays."* This is a very valuable adjunct, and greatly conduces to accuracy; and when used with a divided circle, with small flames at a suitable distance, or white crosses on a black ground, and with a lens or lenses centred and sliding above the eyepiece, it forms a very suitable and accurate combination. —Mr. Ingpen concluded with some general remarks upon the subject of angular aperture, with reference to the various opinions held upon this somewhat vexed subject.

A vote of thanks to Mr. Ingpen for his communication was unanimously passed.

The President thought that one of the most important points in connection with the subject was that the rage for large angular apertures had given the impression in some quarters that good low-angled objectives could not be made by English makers, and therefore foreign makers had stepped in and produced them; whereas, if there were a demand for low angles, they could be produced here with all the excellence which was usually found in English workmanship. He thought that the observations they had just heard had a very useful tendency, and would be valuable to those who did not make the microscope a mere toy.

The proceedings then terminated with a conversazione, at which the following objects were exhibited:—

Marine Algæ—in fruit	by Mr. T. Curties.
Polyommatus phlœas, male	„ Mr. Enock.
Allosopus calomelanos	„ Mr. Golding.
Aphis Galls on leaf of hedge maple	„ Mr. R. T. Lewis.
Spiral Vessels of Castor Oil Plant	„ Mr. Martinelli.
Podura Scale—with 1-6 in. objective	„ Mr. Swift.
Ova of Toad—injected	„ Mr. Topping.
Anchors and Plates of *Synapta*	„ Mr. Jas. Watkins.
Phtirius inguinalis—or crab louse	„ Mr. T. C. White.

Attendance—Members, 60; Visitors, 8; Total, 68.

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* See also *M.M.J.*, for *March* 1, 1874, *p.* 114.

Further Note on the Development of Actinophrys sol.

By Mr. James Fullagar.

(*Read January 28th*, 1876.)

The recorded observations of the various changes of *Actinophrys sol.*, which occupied more than four months, are by no means the whole that take place, for they have continued to exhibit, from time to time, fresh phases in succession, and the last, but not least important that has appeared, is the *Amœba villosa*, which Dr. Wallich described and illustrated in the "Annals of Natural History," vol. xii., 1863, stating that from certain peculiarities developed in it, he considered it to be of a much higher type, and its general character such as to elevate the genus to which it belongs considerably beyond the position it formerly occupied.

A number of *Amœba villosa* have made their appearance in the cell, varying in size from $\frac{1}{1000}$ to $\frac{1}{50}$ of an inch, and, at the same time, there are some very small *Actinophrys sol.*, only $\frac{1}{2000}$ of an inch in diameter.

Note on a Larval Cirripede.

By Henry Davis, F.R.M.S.,

Communicated by Thos. Curties, F.R.M.S.

(*Read January 28th*, 1876.)

Ever since those early days when the doctrine of evolution found delusive illustration in a barnacle developing into a goose, the Cirripedes have been the innocent cause of many blunders, and the latest of these—although not the least—it is my privilege to claim.

Last winter, while on a voyage to the Mauritius, a sea-fowl, called by the sailors a Cape-hen (*Procellaria gigantea*), was shot when we were about 800 miles N.W. of the Cape of Good Hope.

The bird was well supplied with parasites (which were mine by prescriptive right), and cemented to one of its feathers was a prettily marked chitinous shell that could or should only be one of their eggs. True, a bivalve egg of a bird's parasite was unknown, all such eggs bearing opercula, but some of the parasites found with it were probably new; then why not a new form of egg?—making a parallel case with the mollusca, the shells of some of which, we well know, are operculated, while others are bivalved. Having tried to hatch that egg myself, with the patience of an old hen "setting" on a chalk nest egg—and with the same result, I consigned it with the attached feather to a bottle of spirit, and, recently opening the shell, found within it the swimming legs of an undoubted Crustacean; and so was led on, step by step, from book to book, to identify my egg as an advanced larva (or pupa) of the Cirripede—*Lepas pectinata.*

Now, it having been represented to me that the members of the Quekett Club might be glad to examine the disjointed shell, and that a few explanatory notes would not be unacceptable, I briefly give an account of the larval pedunculated Cirripedes, as gathered mainly from Dr. Darwin's great work, while Mr. Curties has kindly undertaken to exhibit the specimens.

Dr. Darwin seems to have studied *Lepas australis* more than any other form, and gives the life-history of that species in detail, but, from what he says, there can be no doubt the observations and statements apply equally to *L. pectinata*, the latter, however, being, in all its stages, much smaller than *L. australis.*

The larva, immediately after its escape from the egg, is nearly globular; the carapace flattened in front, and it is provided with two long horns, two short ones, three pairs of limbs, and a simple heart-shaped eye. The long horns are supposed to cover the undeveloped antennæ, which play so important a part in the third stage of the creature's existence, while the smaller pointed horns soon develop into a pair of antennæ for present use. After a few moults of the carapace, in the manner of the entomostraca, with comparatively slight changes in form, the active larva reaches the second stage. In this the shell is compressed laterally, and it resembles a cypris, or minute mussel; it has still three pairs of legs, but these are moved backward, and with the prolongation of the body, foreshadow the final larval form. The smaller pair of antennæ disappear, but a second simple eye is added.

Of the larva in its third stage (in which it is sometimes called the "locomotive pupa"), Darwin gives a figure; and this, with certain additions to the carapace, will answer for the specimen now before you. Of the internal parts of the latter the only portions I could mount were the natatory legs and caudal appendages; the rest, being soft and oily, were decomposed—no doubt in my vain effort at incubation.

In Pl. xiii., Fig. 1, one valve is removed, and the swimming legs and appendages are seen at *C* and *D*. Just above the feet are dimly indicated the immature cirri of the perfect barnacle; at *M* the mouth, and at *N* the supports of the internal eyes—now compound. The remainder of the anterior inner part is occupied by cement-secreting glands, the incipient muscles of the young barnacle's foot, and, outside all, the prehensile antennæ.

Hitherto we have seen the creature in a free state; in the last stages swimming on its arched back, or crawling with the aid of its antennæ; it has now to settle down quietly and for the remainder of its life. This it does by holding on to the selected object by its antennæ, and pouring over them, from special glands, a liquid cement which permanently glues them down. After this the animal sheds its larval legs, eyes, and carapace; while the straightening-out of the peduncular muscles, consequent on the moult, draws the entire Cirripede from a position parallel to the attached surface to one at right angles to it (see Fig. 2). If this change of position were not effected the barnacle could only use its cirri against the object to which it was fastened, and its capture of food would be extremely limited.

Of the Cirripede in its perfected stage little need be said, we are all familiar with its external form, its fleshy peduncle terminating with calcareous valves enclosing the body and delicate casting-net; but a mature specimen of a Lepas, with some of the valves removed, is now before you under a low power, and this might teach more than a volume of words.

I should add a line as to measurements. The egg and youngest larva of *L. australis* are about $\frac{1}{100}$th of an inch long, the larva in last stage is nearly $\frac{1}{10}$th of an inch, and the well-grown Cirripede nearly two inches, including the peduncle. The larva of our *Lepas pectinata* is about $\frac{1}{18}$th of an inch long, and, had it not been prematurely cut off, might have grown fully three quarters of an inch.

The small amount of original matter I can offer on this animal is furnished by its carapace. Darwin speaks of it as being provided with two points at the posterior end, and with a pair of projections, like short horns, in front (which he thinks may be called the ears), but he says nothing of the very noticeable corrugated crest running over the back at the junction of the valves; and, failing any published figures of this larva, some doubt may be attached to the specific name I have appended.

The external microscopic structure is very interesting, and has been strangely neglected—only "marks and lines" are recorded—but under a binocular microscope, with a quarter inch objective and reflected light, we can see the surface covered with deep thin walls or ridges, generally parallel but in parts tending to confluence; their outer edges are serrated, and the thin walls are strengthened by a sort of buttresses, only seen in certain lights. Towards and over the "ears" the ridges are so modified as to leave hexagonal depressed spaces; while in one spot, beneath which the enclosed larva bears its eyes, the shell is left beautifully smooth and transparent. This creature, then, with its "toughened glass" window, is remarkably well protected;—in storms or any danger he has only to shut up his shells, hold on by his antennæ, and keep a good look out.

EXPLANATION OF PLATE XIII (Upper Part).

Fig. 1.—Larva of *Lepas australis* (after Darwin).
Fig. 2.—5 Larva of *Lepas pectinata*.

A Comparison of the Metamorphosis of the Crane Fly and the Blow Fly.

By A. Hammond.

(*Read January* 28, 1876.)

I purpose this evening to draw a comparison between the processes of metamorphosis as they occur in the Crane Fly and the Blow Fly respectively. The anatomy of the larva of the former insect has formed the title of some communications I have lately made to "Science Gossip," and, in endeavouring to continue these observations, by an examination of the pupa, I was influenced by the persuasion that I should find a close parallel in the mode of its development, to that followed in the latter, especially with regard to the re-development of the thoracic segments from a series of structures called by Dr. Weismann, "Imaginal Discs." In this expectation I have, to a certain extent, been disappointed, inasmuch as though I recognise the structures, I am doubtful if they represent, here at least, anything essentially exceptional in the mode of development of the segments to which they belong. Still, even if this doubt should be established, I regard it as none the less interesting to note, how in insects which belong to the same order, the perfect form should be reached through processes which widely differ.

Before proceeding further, however, I wish to say that I come before you more as a learner than as a teacher, and that the opinions I may express, especially where they differ from those who have preceded me, may be the result of imperfect information, and much of what I may say may possibly be already very well known.

I will now give a short account of the anatomy of the larvæ of these two insects, so far as is necessary for our purpose. That of the Crane Fly will be found detailed at length in the papers referred to. In the preparation of these papers, I have been guided solely by such light as Mr. Lowne's "Anatomy of the Blow Fly," and the somewhat general indications to be found in Shuckhard's translation of "Burmeister" may have afforded me. This larva is a footless maggot, measuring nearly an inch in length, and consisting, I believe, of 17 segments, of which five constitute the head, three the thorax, and nine the abdomen. The five segments, which together constitute the head, are consolidated into a rigid, horny case, of which the major portion, which I regard as the 5th or optic segment, is withdrawn within the softer integument of the succeeding thoracic ones. The four remaining segments, viz., those bearing the antennæ and the trophi, are external, not being included in the invagination referred to. The head thus formed, when seen from below, is shaped somewhat like a bishop's mitre, having a deep cleft down the centre of the internal portion, through which the œsophagus, the dorsal vessel, and the cephalic nerves pass; it is occupied in great part by the large muscles of the mandibles, the eyes being absent. A system of longitudinal and transverse muscles clothes the whole internal surface of the integument, with the exception of a narrow strip in the central line of the dorsal and ventral surfaces, in the former of which the dorsal vessel, and in the latter the nervous cord lies. Respiration is conducted by means of two main tracheæ, opening near the anus. These extend the whole length of the larva, but instead of terminating, as in the maggot of the Blow Fly, in two anterior spiracles, they break up abruptly into a number of branches, of which some enter the head, while others proceed to the imaginal discs, and the muscles of this portion of the body. The nervous system consists of a single nervous cord, with twelve ganglia, two of which belong to the head, three to the thoracic, and seven to the abdominal segments. Of the cephalic ganglia, one lies above the œsophagus, and the other beneath it. Burmeister regards these as the cerebrum and cerebellum respectively. From the former proceed the optic and antennal nerves, and from the latter those of the trophi. The three next, or thoracic ganglia, and the first abdominal, present in their close approximation, what seems an approach to the condition manifested in the Blow Fly, where the whole of the nervous system is collected in the anterior segments. These ganglia, together with the remaining abdominal ones, send out each two pairs of nerves, one from their superior and one from their inferior surface.

I must now speak of those structures found in the adult larva, to which the name of "Imaginal Discs" has been given, and within which the limbs of the future fly are developed. It is impossible to doubt that these are the homologues of similar structures found in the same situation in the Blow Fly, which have been regarded by Dr. Weismann, who first observed them, and also by Mr. Lowne, as indicative of a special mode of development of the segments where they are found. That this mode of development prevailed also in the Crane Fly, I was led to believe from the following quotation from Dr. Weismann's memoir on the subject, which appears in Mr. Lowne's book as follows, p. 7, viz., "I believe in all those insects in which the anterior larval segments are unprovided with legs, the head and thorax of the imago are entirely re developed, while in those in which the larva is furnished with legs, these parts depend for their formation upon the anterior larval segments."

I have stated that the limbs of the insect are developed within the discs ; it will be well, perhaps, to consider what these limbs are. Mr. Lowne says, "Each segment in the lowest *Articulata* is normally furnished with two pairs of lateral appendages, or rudimentary limbs, one pair placed above the other, the superior being dorsal, and the inferior ventral, at least such is their arrangement in annelides. Both pairs are much modified in the higher forms, and are often entirely suppressed." I believe I have recognised eight pairs of discs in the Crane Fly, two pairs in the head, and six in the thorax; those in the head are the antennal and optic discs, and are concerned in the formation of the cephalic appendages—viz., the antennæ and the eyes; those in the thorax are concerned in that of the superior and inferior thoracic appendages—viz., the wings, legs, and halteres. Now, it is a curious fact that, though in the imago these appendages are mostly well represented by the limbs referred to, the upper prothoracic ones seem to be wanting. On the contrary, in the pupa state, they are as conspicuous by their presence as they are subsequently by their absence; the former being indicated by the existence of two club-shaped processes on the dorsal region of the prothorax. These processes are not peculiar to the insect in question—they are very conspicuous in the pupa of the gnat, and I believe I also recognise them in that of the Blow Fly, in two button-like bosses in the same situation. A large trachea, continuous with the main trachea of the pupa, passes up the centre of each of them, being, I believe, a continuation inwards of the exterior integument, and both processes and tracheæ are cast off with the pupa skin on the emergence of the imago. Although, therefore, an examination of the perfect insect would fail to supply a *raison d'etre* for the existence of superior prothoracic discs, the hiatus is well filled by a consideration of the intermediate pupal condition; and, in fact, I have both found these discs, and traced their development into the appendages in question. A statement, therefore, of the limbs of the imago, into the formation of which the several thoracic discs enter, will, I should say, run thus:—Of the prothorax, the upper pair of discs have their development arrested—proceeding no further than the pupa stage, the lower pair forming the anterior legs. Of the mesothorax, the upper pair form the wings, and the lower the intermediate legs. Of the metathorax, the upper pair form the halteres, and the lower the posterior legs. Of these discs, the antennal and optic, and the three inferior thoracic pairs are certainly connected by prominent nervous cords with the brain and thoracic ganglia, the others—viz., the superior thoracic—are, I think, probably so, though I have not as yet traced the connection. As the nervous system participates but little in the otherwise general law of change, I believe that these connecting nerves are identical with those which subsequently form the proper nerves of the limbs of the imago, and, if so, their unions with the discs is much more intimate than that which, if I *rightly apprehend Mr. Lowne's meaning*, occurs in the Blow Fly, for he speaks repeatedly of the discs as being firmly attached to the nerves and tracheæ of the larva, as if the connection were merely one of attachment or support. In addition to their connection with the nerves, the discs also appear to have branches of the tracheæ distributed to them, but here again I regard the connection as a functional one, involving the necessary supply of air to these parts. As far as my means of observation will carry me, I cannot see any difference between the distribution of some of the tracheal branches to these structures and that of others to the various tissues over which they spread.

The optic and antennal discs are placed on either side of the œsophagus, between it and the large muscles of the mandibles; while the thoracic discs are placed immediately beneath the integument, between it and the subcutaneous muscular coat, the inferior ones closely adjoining the ventral cord, and the superior further removed towards the dorsal surface.

Mr. Lowne has described the discs of the Blow Fly as being each enclosed in a capsule of structureless membrance, and I was led at first to suppose that those of the Crane Fly were so likewise—indeed, I have so described them in my papers in "Science Gossip." Subsequent examination, however, has induced the opinion that the supposed capsules are really nothing more than infoldings of the newly forming pupa skin surrounding each disc; and that as the discs gradually acquire the form of pouches fitted for the elaboration of their respective occupants, the sacs or capsules thus surrounding them become continuous with them at the point of insertion of the limb. This, of course, alters the whole aspect in which these structures should be viewed. Instead of being regarded as so many separate centres of growth, which by their union form the head and thorax of the fly, they must now be looked upon as so many prolongations of the pupa integument in an internal, and subsequently by invagination in an external direction. In support of this the sacs, instead of being structureless, exhibit clear evidence of cellular origin, the same as the pupa skin; but further than this, I lately obtained a section of the leg discs *in situ* in a plane perpendicular to the integument, which exhibited the form and connection of the investing sacs.

The antennal and optic discs take the form of flattened cellular expansions, within which sooner or later the commencing areolation of the facets of the eye and the articulations of the antennæ become discernible. The leg discs present at first spiral folds, and subsequently develop into long wrinkled pouches coiled round within the sacs; those of the superior prothoracic appendages are small and of an irregular shape, those of the wings and halteres are broad and flat, of similar outline, but differing in size, the latter being considerably the smaller. The similarity of outline is singularly confirmatory of the view that regards the latter organs as mere modifications of the former.

An examination of the larva of the Blow Fly shews us a creature presenting many points of resemblance to that I have just described, and yet others of striking difference. The sixth segment is here furnished with a pair of anterior spiracles, an adjunct which is wholly wanting to the Crane Fly larva. The nervous system is very peculiar, to use Mr. Lowne's words—"All the nerve centres are concentrated in the anterior segments. They consist of a pair of hemispherical ganglia above the œsophagus, supra-œsophageal; and a large flattened nerve centre, composed of a series, probably of twelve pairs, of ganglia beneath the œsophagus, sub-œsophageal." A system of muscular bands clothes the inner surface of the integument as in the Crane Fly. Mr. Lowne has described seven pairs of imaginal discs as follows, viz., four pairs, the antennal and optic and the inferior prothoracic and mesothoracic, all of which are attached through the medium of short-nerve trunks to the nerve centres of the larva; and three others, viz., the superior mesothoracic and the superior and inferior metathoracic, which are attached to the lateral tracheal vessels. It will be observed that the superior prothoracic discs are not mentioned in this enumeration. It is true that Mr. Lowne adverts to a horseshoe-shaped arch of tissue attached to a pair of tracheal vessels in front of the supra-œsophageal ganglia and above the antennal discs, which he believes may be the disc in question. I have unfortunately not been able as yet to recognise this structure with certainty; but from the foregoing description and the accompanying plate of Mr. Lowne, I venture to think that this is not exactly the place where I should have expected to find the disc. It appears to me that the right rule which should guide our search for it should be to consider what is the proper limb or appendage into the formation of which it enters. And here, again, we are confronted by those processes on the prothorax of the pupa to which I have already called attention in the Crane Fly. Two button-shaped bosses appear in this situation in the Blow Fly pupa, upon which the scars of the anterior thoracic spiracles are seated, and in the larva I have found attached to the terminations of the main tracheæ minute cellular structures, which I believe to be the objects for which we are in search. One curious and apparently anomalous circumstance I must not omit to mention here, viz., that while in the Crane Fly the three pairs of inferior thoracic or leg discs appear ranged on either side of the nerve centres, to which they are attached by thick nervous cords; in the Blow Fly, according to Mr. Lowne's statement, the inferior metathoracic pair, representing the posterior legs, is detached from this connection, and ranged together with the superior discs, viz., those of the wing, the haltere, and what I believe to be the superior prothoracic pupal appendage, along the course of the main tracheæ, to which they are also seemingly affixed. I have not been able entirely to verify this statement, but I believe it to be true, inasmuch as I can discover only two pairs of thoracic discs attached to the nerve centres and certainly three, if not four, attached to the tracheæ; and if so, it is a circumstance which appears to require some explanation: you will understand my meaning when I say that these discs seem to have stepped out of their places to consort with those with which they have no lawful business.

Thus much for the anatomical peculiarities of the parts concerned in the metamorphosis of these two insects. I will now give a comparison of the manner in which this change is respectively brought about. Mr. Lowne says—"Every degree of metamorphosis exists among insects, from that in which the larva nymph and imago closely resemble each other, where the successive changes are merely those of ordinary development, as in the cockroach; to that in which the change is so complete that it might almost be doubted whether the larva and imago should be considered the same individual at all, so closely does the process resemble an alternation of generations;" and he adds, "This is the case in the fly." I must confess I find considerable difficulty in regarding the processes herein concerned as at all resembling the production of a sexual zöoid by gemmation from an a-sexual larval one; but I quite concur in the estimate these words convey as to the totality of the change involved. Mr. Lowne further says—"All the tissues of the larva undergo degeneration, and the imaginal tissues are re-developed from cells which originate from the disintegrated parts of the larva under conditions similar to those appertaining to the formation of the embryonic tissues from the yolk." With the exception of the brain and nervous system, the whole substance of the maggot is converted into a soft cellular mass, deprived of every organ of sense or motion, and the chain of being seems, indeed, almost snapped. Not so, however, with the Crane Fly. The intermediate cellular stage does not occur. The larval tissues, it is true, waste wholly away, and are replaced by those proper to the fly, but in a manner gradual and more consonant with our ideas of continuity of existence. Before the assumption of the pupa state the larval muscles of the thoracic segments have, to a very great extent, been supplanted by the newly forming muscles of the imago. The abdominal segments, on the contrary, present an opposite phenomenon, for the larval muscles here persist in their full integrity to a very late period of pupa life, long after the metamorphosis of the thoracic segments is complete; they then quickly disappear, a few traces of them only remaining in the newly emerged imago. There is, therefore, no such period of almost total disorganization as occurs in the Blow Fly; and the pupa wriggles actively, if touched, during almost the whole of its existence.

But in addition to this, there are other striking contrasts in the manner of the development of the two insects. In both the transformation takes place within a new cellular investment formed by the deposition of new layers of cells within the old larval skin. This forms the pupa skin, and upon it are marked out the position of the organs about to be developed, and of those whose development seems here to be arrested. Here, however, the parallel ends, and diversity again shews itself. In the Crane Fly, the old larval skin is discarded on the assumption of the pupa form. In the Blow Fly it is retained, forming around the pupa a hard horny protective covering, called the pupa case; the enclosed insect thus has two wrappings—the delicate pupa skin and the hard pupa case. Now, why this difference? I cannot pretend to speak with certainty on the subject, but I submit that it appears to be intimately connected with certain manifest differences in the mode of the formation of the thoracic segments to which I have already partly alluded. You will remember the expression of my opinion that in contradistinction to Mr. Lowne's description of the imaginal discs of the Blow Fly, I regard those of the Crane Fly as mere invaginations of the newly forming pupa skin; and, in fact, as such I question whether they are rightly to be called discs at all, in the sense in which Mr. Lowne uses the term. He describes the discs as enveloped in separate capsules which they eventually rupture by their rapid growth, and by their subsequent coalescence form the thoracic portions of the pupa skin. With a view to ascertain personally, if possible, the accuracy of this description, I made an examination of such larvæ and pupæ as I could then find. These were too few to enable me to form a very decided opinion. I could not satisfy myself as to the rupture of the capsules or the coalescence of the discs, but in confirmation of Mr. Lowne's views it appears that the discs instead of being situated immediately beneath the integument, as in the Crane Fly larvæ, occupy the perivisceral space between the œsophagus and nerve centres, and the surrounding muscular tissues in process of degeneration. Under these circumstances a little consideration will, I think, make it evident that some such process as Mr. Lowne has described is the only way of accounting for the continuity of the pupa skin in these segments. From this, too, it results that as the thoracic larval muscles degenerate outside of and around the growing imaginal discs, and before their coalescence is complete, the removal of the pupa case while the insect is in this condition would leave it without any integument at all—at least in the thoracic segments: hence the necessity for its retention.

The tendency of my observations is to disprove the distinctive character of the development of the cephalic and thoracic segments in the Crane Fly, but to retain it in the Blow Fly; and, if this be true, seeing that in either case the development originates in structures which are distinctly homologous, the question arises whether the two methods are separated by an impassable gulf, or whether the study of other insects, by revealing the existence of intermediate links between the form, disposition, and connections of these structures in the one case and the other, may bridge over the chasm which at present seems to separate the two methods, and indicate a gradation of modes of development, as well as of external form and internal structure.

EXPLANATION OF PLATES X. AND XI.

Plate X.

Fig. 1.—Part of the anatomy of the larva of the Crane Fly: the insect is represented as pinned out for dissection, and the head and digestive organs removed. In the centre is seen the nervous cord surmounted by the optic and antennal imaginal discs. Below these, in connection with the thoracic nerve centres, are seen the inferior thoracic imaginal discs, viz., those of the legs; these, again, are flanked on either side by the corresponding superior ones, viz., those of the prothoracic pupal appendages, the wings, and the halteres. On the left hand of the figure is seen the subcutaneous muscular coat, and on the right, one of the main tracheæ, with its branches.

Fig. 2.—The head of the larva from below shewing the ventral cleft through which the œsophagus passes. The salivary duct is seen as a ringed tube, and below it the cerebrum and cerebellum.

Fig. 3.—The superior prothoracic appendage of the pupa of the Crane Fly, with the trachea passing up its centre.

Fig. 4.—One of the leg discs—early stage.

Fig. 5.—The same subsequently; capsule (?) removed.

Fig. 6.—Section of the same perpendicular to the integument, showing the continuity of the capsule (?) with the newly forming pupa skin beneath that of the larva.

PLATE XI.

Fig. 7.—The pupa of the Crane Fly shewing the superior prothoracic appendages projecting from the thorax. The antennæ are seen bent down in front on each side of the Lead, and below are the outlines of the wings and legs.

Fig. 8.—The pupa of the Blow Fly, dorsal view shewing the superior prothoracic appendages.

Fig. 9.—The pupa case of the Blow Fly.

Fig. 10.—The imaginal discs of the Blow Fly in connection with the nerve centres and tracheæ. The greater part of this figure is adapted from those in Mr. Lowne's monograph; it is introduced chiefly for the purpose of illustrating my remarks on the position of the superior prothoracic discs, which I submit are situated as represented at the anterior extremities of the tracheæ, immediately beneath the integument. The discs in the centre are the optic and antennal, attached (?) to the nerve centres above, and those of the anterior and intermediate legs below. The remaining discs attached (?) to the tracheæ are those of the wings, halteres, and posterior legs.

Figures 1, 7, and 9 are slightly magnified; the remainder are drawn under an inch objective.

On a New Aulacodiscus, from the West Coast of Africa.

By Arthur Cottam, F.R.A.S.

(Read February 25th, 1876.)

An extraordinary diatomaceous gathering has recently been brought to England, from the West Coast of Africa, by Mr. Martin, an Officer of H.M.S "Spiteful," made by him when that vessel was sent with the Expedition up the River Congo, at a place called Banana Creek. The peculiarity of this gathering is that it consists of one species only, in countless thousands, without any admixture whatever either of other diatoms or of any foreign matter; and I believe he describes the quantity obtained as "about a pint."

The diatom so gathered is a species of *Aulacodiscus*—a genus, no member of which is very common, and most are decidedly rare.

When it was first seen by our leading diatomists it was with one consent dubbed a variety, and an exceedingly beautiful one, of that rare form *A. Kittoni.* But in November last Mr. Kitton himself wrote to me to say that, having looked over his slides of Aulacodisci he had found a specimen of *A. Johnsonii*, from Algoa Bay guano, that was identical with the so-called variety of *A. Kittoni.*

This letter excited my curiosity to see a specimen of *A. Johnsonii* from Algoa Bay guano, but they are very scarce; only the first sample of the guano that was brought to England having contained it, and only a small number were found in that. My cousin, Mr. Arthur C. Cole, of Liverpool, very kindly lent me his only specimen, and my good friend Mr. George Mansfield Browne, also of Liverpool, most generously presented me with another; and it afterwards occurred to me that the late Dr. Greville's collection in the British Museum was sure to contain some. I therefore went to the Museum and examined carefully every specimen in Dr. Greville's collection, both of *A. Kittoni* and *A. Johnsonii*—about half-a-dozen of each.

It is the result of these enquiries that I propose to submit to you this evening, in hopes that I shall be able to satisfy you that the diatom in question is a new species distinct from either of those to which it has been referred.

Both species, *A. Kittoni* and *A. Johnsonii*, were named by the late Professor Walker-Arnott; and as Dr. Greville's collection contains examples of each mounted by Dr. Arnott, I conclude that I have examined typical specimens.

The accompanying figures 1 and 2, Plate 12, are a large specimen, and one of the smallest specimens I could find of the new form. Figures 4 and 6 are varieties of *A. Kittoni*, the small one being a recent specimen from New Zealand; the large one a specimen out of the so-called fossil deposit from Mexillones, in Bolivia.

I will now quote Dr. Arnott's description of *A. Kittoni*:—"Disc hyaline, with 3 to 8 submarginal crescent-looking processes, connected by radiant rows of minute granules, with an umbilical rosette of oblong cellules. Recent, New Zealand and Monterey Bay; fossil Monterey Stone. An elegant species distinguished by its somewhat mammiform processes, which, being directed outwards, appear lunate. Granules punctiform, proceeding from umbilicus to processes in pencil-like rays; intervals between the processes bisected by similar pencils but less conspicuous, and without furrows; the rest of the granules in oblique lines, as in *A. Petersii*." This description is not to my mind very accurate; the granules certainly appear to run in places in oblique lines, and in others in curves, and the lines and curves are decussating (which he does not notice), but all are equally radiant from the centre to the margin; and all the lines of granules, except the two which run on each side of the rays from the centre to the processes are branched before they reach the margin. I believe the fact to be as Mr. Hardman describes it in a letter I received from him yesterday. He says—"The lines of granules I believe invariably bifurcate; indeed, they must of necessity do so if the space between the granules be alike and the granules all of one size—which, I think, you will find they are, except the granules of the 'primary rays.' Although it may be said that granules run obliquely from the primary 'rays,' it will be found that the same granules also radiate from the centre to the margin, bi-furcating at different distances, in accordance with the varying forms of the valves. . . . The decussating aspect of the lines of granules depends in great measure on the forms of the valves; if the processes be on a raised or mammate surface the lines will be more curved or arched than when they rise from a flat surface, and in such case the decussation is more striking to the eye." This arrangement of radiant, oblique, and decussating lines of granules is common to *A. Petersii*, *A. Kittoni* (though in some varieties very much more than others, and most striking where the processes are most numerous), *A. Sollittianus*, and in the new diatom from West Africa. The chief distinction, as it appears to me, between undoubted specimens of *A. Kittoni* and the new form is in the processes, which in the first are (as Mr. Hardman describes them) like "eye-brows," and the last are distinct "hoods."

I will now give Professor Walker-Arnott's description of *A. Johnsonii*—"Disc pale with a circular perforation-like umbilicus, and crowded radiating series of granules, becoming more numerous as they proceed outward so as to appear forked; processes within the margin, roundish, small. Algoa Bay guano. The rays near the margin become more numerous with smaller granules, so as to look like striæ; sometimes the processes appear within a faint circle. *A. Johnsonii* somewhat resembles *A. Kittoni*, but is less hyaline, with more conspicuous granules, and processes more distant from the margin." Figure 7 has been drawn from Mr. Cole's specimen of this species.

All the specimens of *A. Johnsonii* from Algoa Bay guano are small, none that I have seen are very much larger than the specimen figured. The valve appears to be without any raised portions, for there is no appearance of oblique or decussating lines or curves, and its distinct border nearly one-sixth of its whole diameter of very small granules is a feature that distinguishes it from *A. Kittoni*, as also does its umbilicus. The processes are covered by a "hood," which is so hyaline that it is easily overlooked, and so brittle that it is my impression that I have not seen a single specimen in which they were all perfect. At "*a*" in figure 7, I have represented the appearance of a process that has been broken off. From his description Dr. Arnott seems to have misunderstood their character, for he describes them as "roundish, small," and then adds—"Sometimes they appear within a faint circle." This description again is somewhat inaccurate, for the hood is not circular, but like the thick end of a wedge with the corners rounded off, and the point of the wedge, if the sides were produced, would be the centre of the valve or very near it. Mr. Hardman seems to think that the hoods may have been injured, some portion of them destroyed by the strong boiling in acids which was requisite to clean the Algoa Bay guano. And he informs me that he has found two specimens from the Cambridge, Barbadoes deposit, mounted some years ago, which are identical with the Algoa Bay specimens; "but the processes are *rather* more developed, yet much less so than the West Coast of Africa one."

The new African diatom appears, therefore, to agree with *A. Kittoni* in the arrangement of its granulation, although the granules are smaller. It differs from it in generally having a small umbilicus, and in its processes, which instead of being mammiform, have distinct circular hoods. It appears to me to differ from *A. Johnsonii* in the arrangement and size of its granules (although size is not of much value as a specific distinction), but especially in the fact that *A. Johnsonii* has no raised portions under the processes, and has granules of very different sizes on the same valve. They agree in having an umbilicus, although its presence in the new form is not invariable; and in these too the form of the processes is more alike, although more highly developed in the West African form.

It appears to me that the West African diatom differs in some respects so distinctly from both the species with which it has been connected, that it may be considered a new species, and I propose to call it *Aulacodiscus Africanus*, by which name Mr. Martin, I believe, wishes it to be known. I should describe it as follows:—

Aulacodiscus Africanus. Disc hyaline, with 3, 4, or 5 submarginal processes, each covered with a highly developed circular hood. Valve inflated under each process, in the centre usually a small umbilicus surrounded by a rosette of oblong cellules. Granulation minute, crowded, radiant, and equal in size all over the valve. Diameter from ·0046″ to ·0021″. Recent, Banana Creek, on the West Coast of Africa.

Figs. 3 and 5 on the accompanying plate have been drawn to show the curious resemblance in that position of two forms that in direct side view are very different; fig. 3 being the same form as fig. 2; and fig. 5 as fig. 4. The full front view of a complete frustule of *A. Africanus* shown in fig. 8, is again unlike what would be expected from the three-quarter view of it shown in fig. 3.

DESCRIPTION OF PLATE XII.

Fig. 1.	*Aulacodiscus Africanus*, side view, a large specimen.	
,, 2.	Ditto	,, a small specimen.
,, 3.	Ditto	on its edge.
,, 8.	Ditto	front view.
,, 4.	*Aulacodiscus Kittoni* (recent) New Zealand.	
,, 5.	Ditto	on its edge.
,, 6.	Ditto	(Fossil) Mexillones deposit, Bolivia.
,, 7.	*Aulacodiscus Johnsonii*. Algoa Bay Guano.	
	(a) Process broken off.	

All the figures are drawn to a scale of 400 diameters.

On a New Method of Cutting Fresh Frozen Tissues.

By R. Packenham Williams.

(*Read February 25th*, 1876.)

It is not my intention to occupy your time this evening with any very lengthy communication. I have felt under obligation to the members of the Club for the kind manner in which they received my communication respecting the little machine which I had the pleasure of introducing to their notice last year. That little instrument has not succeeded, I suppose, because the instrument makers thought that it could not be produced at a figure likely to command a sale. There is a further disadvantage it labours under; I find that the sharpening of the cutter is a serious obstacle in the way even of those who may be considered as respectable amateur mechanics. I may say, however, that I think I see my way clear to provide a means—purely mechanical—to effect that operation. For these reasons I have felt it to be somewhat incumbent upon me to put into form, and place before the Club an apparatus first suggested by the hearing of a paper read by Dr. Urban Pritchard, before the Medical Microscopical Society last November, "On a new Freezing Microtome." The extraordinary simplicity of the method by which the tissue was, by one and the same operation, frozen and attached to the cylinder on which it remained whilst it was being cut, presented a very obvious advantage. The sections were, however, cut by hand, which some say, so far from being an objection, is a positive advantage, as enabling them to cut thinner sections, which, I need hardly say, I fail to see. Surely if a section be thin enough only at the edge, one sufficiently thin throughout its whole extent is infinitely better. Therefore judging that it would meet with your approval, I went to work and produced a form of apparatus which, in my humble opinion, though only a modification of existing methods, is yet sufficiently original to warrant me in describing it to you as an eminently serviceable combination. In Dr. Pritchard's plan the temperature of the cylinder is reduced by plunging it in a mixture of ice and salt, from which it is removed when sufficiently cold, and covered with felt to prevent the conduction of heat; and the sections are, as I have said, cut by hand. In the form of apparatus before you, the cylinder is fixed in a chamber surrounded by the freezing mixture, and the sections are cut by a machine which may or may not be a modification of the American triangular frame instrument incidentally mentioned by Mr. E. T. Newton, in his paper read before the Club last year. Never having seen one of these instruments I made one, but soon found the moving of the three screws to be an intolerable nuisance. I then made another, in which I placed the razor exactly parallel to the base of the triangle, and the setting for thickness I obtained by means of one screw, that at the apex. The screws at the angles of the base are set through, so as to clear the razor-blade of the tissue, all except its cutting edge, when the setting screw is set through as far as it will go. It will be remarked that the value of the setting screw at the cutting edge of the razor is considerably less than in its place at the apex. It is, in fact, in direct proportion to the respective distances of the screw and the cutting edge from the base line, that is to say, as the distance of the setting screw from the base line is to the pitch value of that screw, so is the distance of the razor edge from the base line, to the interval through which it will have been moved by one turn of the setting screw. In the instrument before you one turn of the setting screw sets the razor edge for $\frac{1}{100}$ of an inch. If, therefore, the head of the setting screw be divided into 10, one of those divisions will set for a section $\frac{1}{1000}$ inch thick. It may be objected that the cutting angle of the razor is continually being altered by the setting of the screw, but when we remember that within certain limits, where there is no facing plate or guide, the operator cannot be sure at what angle he holds the razor with respect to the tissue which is to be cut, or that he holds it twice at the same angle, this objection will lose much of its force. There is, moreover, a positive advantage when cutting extremely thin sections in holding the razor at a considerable angle. I think it is not sufficiently borne in mind that the last operation of sharpening the razor—taking off the feather edge—practically introduces two new planes; thus, if we exaggerate the section of a razor,*

* It will be obvious from an inspection of the figure (Pl. xiv., fig. 3) that the angles A, B, C, would have to be ground off before a fine setting could be effected; or, which would be equivalent, the back of the razor raised, the edge being fixed, until the plane D C is parallel to F P.

you will see that the new surface is of prime importance, and until *it* is brought parallel with the facing plate there must be a positive displacement, without any cutting if the setting screw is not advanced enough. I do not think that there is much more to be said about the razor frame, except that by the movement of the base screws and those at the razor edge, the blade can be brought into parallelism with the facing plate over which it moves. Reverting to the other part of the apparatus. It consists of a wooden chamber with a thick bottom, to which is firmly screwed a pillar with a spreading base, and curved sides so as to increase the extent of surface in contact with the freezing mixture (ice and salt). This cylinder projects above the facing plate, and the top has a hole drilled and tapped in it to receive discs of any size; this arrangement allows the use of wax or cement for any substance which may not require to be frozen, in which case you would select a disc of convenient size; hold it over the spirit lamp, and cement your object upon it, adjusting it as occasion may require, screw it into its place, and cut away. To the top of the chamber is fitted a turned lid, with a projecting flange; the lid is turned out on the top to receive an 8 inch plate-glass disc, with a hole in the centre, $1\frac{1}{4}$ inch in diameter. A bead is left up around the external edge, and a ring of ebonite is turned into the centre hole, also projecting above the surface of the plate-glass; the object of this being to prevent the slipping of the razor frame off the plate to the probable damage of the razor edge. I do not think I need further commend this matter to your notice. I may, however, in conclusion, say that I should feel happy indeed if anything I have done should prove of any service whatever to microscopy, especially in relation to that most useful, and, if I may be allowed to say, most legitimate application of the instrument—the study of the organic tissues.

DESCRIPTION OF PLATE XIV.

Fig. 1.—Section of chamber, cylinder, &c. The chamber is filled with ice and salt.

Fig. 2.—The triangular frame, S the setting screw, B B base screws, C C razor edge screws, notched at the point, the notches corresponding to others in the razor edge.

Fig. 3.—Diagram of razor edge.

On a New Stage Arrangement for the Examination of Objects by Reflected or Transmitted Light.

By N. E. Green, F.R.A.S.

(Read February 25th, 1876).

This stage arrangement may be described in very few words. It consists of a plate of brass, 3in. by 2, which lies on the stage of the microscope. It has a large central hole to admit of free action in the condenser attached to the sub-stage. At the upper and lower sides of this hole there are two pieces of brass attached to the plate, about $\frac{3}{4}$ of an inch in height, having two springs on their upper surfaces for holding the slide, which is thus placed in a direction at right angles with the usual position; a condenser of short focus is placed at the side, and throws on the object an intense spot of light from a Silber burner. This arrangement, though exceedingly simple in itself, has resulted (and that almost unexpectedly) in a great increase of power. The old plan had been to produce the necessary elevation above the stage of the microscope by means of a mahogany block, which only permitted the passage of an exceedingly thin wedge of light; just as much as could be forced between the object glass and the object. By the new arrangement not only is this secured, but all the lower half of the condenser comes into use, throwing up its light from *below* the slide, and yet in such an oblique direction that it does not enter the object glass; so that dark background is possible up to a $\frac{1}{16}$. As a final result it may be stated that this illumination, is in many respects equal, and in some superior, to that previously obtained by the lime light.

With regard to the employment of transmitted light from the reflector, the large hole in the brass plate permits the freest action about the achromatic condenser, which is passed forward by the rackwork of the substage, till it nearly touches the under portion of the slide. It is then possible to arrange both lights on the object, cutting off one or the other at pleasure by interposing a piece of cardboard. Strange indeed (to one unaccustomed to this method of comparison) is the great alteration of appearance, as one illumination is exchanged for the other. Delicate and beautiful forms, which have just delighted the eye, and engaged the pencil, brought into relief by the great obliquity of side-ray, vanish like a dream, and are replaced by the old accustomed appearances with transmitted light. So complete is the disappearance that we are tempted to try an alteration of focus, hoping thus to recover *something* of that which just previously had been so evident, but to no purpose; all effort is useless, till the transmitted ray is shut off, and side-light again allowed to reproduce the lovely picture. A few drawings of the surface markings of some of the Diatomaceæ are exhibited in order that those accustomed to the usual appearances may judge of the changes produced by thus varying the method of illumination.

We exhibit this evening, by means of the new stage, a slide of *Angulatum*, under a $\frac{1}{25}$ by Zeiss, and would direct attention to the pearly gray tone of the background, from which the valve is projected with a brilliance like that of silver; the advantage in this case being a deliciously clear definition, without any glare of light upon the eye. The brilliancy of the picture is doubtless due, to a great extent, to the distance at which these German lenses focus from the object, thus admitting the passage of a greater amount of light. The definition of this lens by Zeiss must speak for itself. *Triceratium*, under a $\frac{1}{12}$ with the lime-light, and a valve of *Isthmia* are also exhibited as examples of the results of side-illumination.

Plate xiii *(lower half), illustrates this paper.*

On Silicified Structure in Pyritized Wood.

By M. Hawkins Johnson, F.G.S.

(Read March 24th, 1867.)

On the north coast of the Isle of Sheppey, when the tide is low, a great quantity of fossil wood may be found, which is washed out of the London Clay, of which the cliffs consist, by the action of the waves. Lying on the shore the fragments appear, at first sight, exactly like broken twigs and pieces of recent wood in a state of decay, but their weight, their bronze tint, and their glittering fracture soon dispel the illusion. They consist mainly of iron pyrites, and are used at Queenborough in the manufacture of sulphuric acid.

If a piece of one of these twigs be carefully ground to a smooth surface, and then submitted to the action of strong nitric acid for about an hour, the iron pyrites will be dissolved to a greater or less depth, and the woody structure left standing in relief; that is to say, the carbonaceous walls of the wood cells, which appear to have been silicified, are not dissolved, while the pyritous infiltration which subsequently filled the pores of the structure has been removed.

This structure is of so definite a character that it is impossible to confound it with any accidental arrangement of particles of sulphur, as was suggested by some, to account for the beautiful forms revealed by similar treatment of the pyritous nodules in the Chalk; while, supposing the structure revealed by nitric acid in the pyritous nodules from the Chalk, really to represent the original organic structure of the thing fossilized, and to be due, as I suppose, to the replacement of the carbon of that structure by silicon, much more might we reasonably expect to find so highly carbonaceous a structure as wood similarly preserved—which agrees with the fact.

In silicified wood, using the term as it is generally understood, the silicified woody structure, instead of being filled in with pyrites, is filled in with silica. If a slice of such wood be taken and stained with acetate of rosaniline, it will be found that it is the cell wall, the representative of the wood itself, that takes the colour, while the filling in remains uncoloured. In like manner flints, stained in the same way, show the structure of the organism coloured, while the filling in remains uncoloured, or comparatively so.

I offer these notes in the hope that they may help in some measure to elucidate the subject of silicification.

PROCEEDINGS.

January 14th, 1876.—Conversational Meeting

The following objects were exhibited:—

Wing of *Chrysolista Linneella*	Mr. Enock.
Scales of Carp...	Mr. A. H. Halley.
Absorption spectra of Cantharides ...	Mr. Ingpen.
Oolitic Limestone, Section	Mr. Martinelli.
Podura Scale, under $\frac{1}{6}$th objective	Mr. Swift.
Section of Rush, stained	Mr. Topping.

Attendance—Members, 58; Visitors, 5; Total, 63.

January 28th, 1876.—Dr. J. Matthews, F.R.M.S., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following additions to the Library were announced:—

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	" "
"Popular Science Review"	" "
"Proceedings of the Royal Society"	" the Society.
" " Geological Association ...	" the Association
"The American Naturalist"	in exchange.
"The Quarterly Journal of Microscopical Science"	by purchase.

Mr. W. Bowcher, Dr. Thos. Cotton, Mr. G. Dilnott, Mr. John Faulkner, and Mr. John Woollett, were balloted for, and duly elected members of the Club.

The Secretary read a letter from Mr. Fullagar in continuation of his paper on *Actinophrys.*

The Secretary said that, knowing how much the members of the Club were always interested in any new matters connected with microscopy, he had asked Mr. Swift to allow him to exhibit and describe his latest production, an extremely portable binocular microscope. At first sight it might be thought to resemble a victim of a recent railway collision, but though a confused mass as taken from the box, when properly adjusted and set up, it was as pretty a little binocular as could be seen, and it was not only pretty but also very useful. By turning the body a quarter round, it could be conveniently used as a monocular, as the secondary body was quite out of the way, and the whole of the light was shut off from the slot that the prism had previously occupied. The rackwork was of great length, so that it would take in a 4 or even a 5 inch objective, the extremely thin stage was an advantage in oblique illumination, and it was provided with a very convenient holder for the slides. Countersunk in the stage was a little rotating cell, in which a selenite, or a slide of diatoms, could be placed and concentrically rotated. The box contained, in addition to the microscope, a variety of apparatus, including one of Mr. Swift's achromatic condensers, and a new pattern nose piece, with the arm curved. The polarizing apparatus was also worthy of note, because the analyzing prism was placed ready in the tube above the binocular prism, an arrangement which was of advantage in the use of polarized light with the binocular.

The President thought the instrument and its arrangements were admirable; an important point was certainly that of placing the analyzing prism immediately above the reflecting prism, so that it could be used binocularly; and another to which he also drew attention, was the method of focussing the condenser by means of an inclined slot and pin.

A paper by Mr. Henry Davis, entitled "Notes on a Larval Cirripede," was read by Mr. Curties, who expressed his regret at the unavoidable absence of the author. The paper was illustrated by diagrams, and by specimens exhibited in the room.

The President said he need not say that any investigator who drew attention to larval forms, and prevented them from being referred to new genera, did good service to the student. It was something new to him to hear of a parasitic Cirripede.

The thanks of the meeting were unanimously voted to Mr. Davis for his paper, and to Mr. Curties for communicating it.

Mr. Hammond read a paper "On a Comparison between the Metamorphosis of the Crane Fly and the Blow Fly," the subject being illustrated by a series of excellent coloured diagrams.

The President said he must confess that the subject was one which he had by no means studied; he could therefore only express his pleasure at the amount of labour and delicacy which had been bestowed upon such investigations as those, in going over the ground so well worked by Mr. Lowne and others, not only confirming, but also, in some measure, going beyond them.

Mr. T. C. White thought that the paper they had just heard with so much pleasure, would reflect credit, not only upon Mr. Hammond, but also upon the Club itself; for it could not fail to be creditable to the Club to have such a paper printed in its proceedings. He hoped that the impression produced by this paper would not be allowed to die away, for there was no study more interesting, or more likely to be productive of good results, than the study of larval forms and their development. He should like to ask Mr. Hammond where and when these larvæ were to be obtained? He was himself only a tyro in entomology, and therefore desired information, and thought it quite possible that many of the younger members of the Club might like to have this question answered, because if they were to study these larvæ, of course the first thing to be done in the matter, was to find some to study. He was very glad to see that they had two papers on larval forms of animal life that evening. The first paper had greatly interested him, but he could not say very much about it, except that it was quite a surprise to him to hear of a larval form being found on the feathers of a sea bird. He had some opportunities of watching the development of marine forms, and had on one occasion seen, in his aquarium, the ejection of something from the open valve of a shell, and, upon closer examination, he found that not only the ova, but also free swimming larvæ of the barnacle were being thrown out. He should advise anyone who wished to follow out the study of these creatures, to separate the young from the parents as soon as possible, as the latter had a way of eating them up whenever they had the chance. He had found them hitherto to be very difficult to mount, having tried spirit and water, glycerine and water, and nearly all the usual preservative fluids, but without success—so that he should be very glad indeed if anyone would tell him how it was possible to preserve them.

The thanks of the meeting were unanimously voted to Mr. Hammond for his paper.

Mr. Hammond having briefly acknowledged the vote of thanks, said, in reply to Mr. White's question, that the larvæ of the Crane Fly might be found at any time during the five months previous to September, by digging in the ground under the roots of the grass—in September the pupæ might be found in the same way.

Mr. White thought it might be interesting if Mr. Hammond could tell them what was the best locality in which to search with success and safety, for it occurred to him that possibly the owner of grass land might object to several square yards being dug up in search of the larvæ.

Mr. Hammond could not point to any particular locality as being better than another, almost any turf or heath would do; the larvæ destroyed the roots, and so injured the grass.

Mr. White thought that in that case the destruction of the grass was of less importance, since in digging it up they would be merely forestalling the larvæ.

The meetings for the ensuing month, and the papers to be read at the next Ordinary Meeting were then announced, and the proceedings terminated with a conversazione at which the following objects were exhibited:—

Barnacles	by Mr. T. Curties.
Water Spider—*Argyroneta aquatica*—male	Mr. Enock.
Parasite of Dung-beetle	Mr. A. H. Halley.
Section of Willow, showing dotted ducts	Mr. Moginie.
Lung of Boa Constrictor—injected	Mr. J. Russell.
Schlerenchymatous cell from inner bark of *Pilocarpus pennatifolius*	Mr. Stiles.
Viscera of Humble Bee	Mr. T. Terry.

Attendance—Members, 83; Visitors, 10; Total, 93.

February 11th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Palate of *Doris*, polarized	Mr. A. L. Corbett.
Hippobosca equina (the Forest Fly)	Mr. Enock.
Moss from Hurstmonceaux, polarized	Mr. Glasspoole.
Aulacodiscus Petersii, seven rayed	Mr. G. Green.
,, *Normanii*, ,, ...	,, ,,
Pleurosigma angulatum, $\frac{1}{6}$th objective	,, ,,
Wing of *Vanessa Io*	Mr. A. H. Halley.
Series of preparations illustrating the development of the Crane Fly	Mr. Hammond.
Peristome of Moss	Mr. G. Hind.
Fossil Tooth in coal-shale	Mr. Ingpen.
Euglena viridis	Mr. Martinelli.
Seeds of *Epilobium hirsutum*	Mr. F. Reeve.
Astromma Aristotelis	Mr. Sigsworth.
Pleurosigma angulatum, $\frac{1}{6}$th objective	Mr. Swift.

Attendance—Members, 44; Visitors, 4; Total, 48.

February 25th, 1876.—T. Charters White, Esq., M.R.C.S., &c. Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced :—

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	,, ,,
"Proceedings of the Royal Society"	,, the Society.
"Proceedings of the Natural Society of Glasgow," three parts	,, the Society.
"Course of Practical Instruction in Physiology," by Huxley and Martin	,, Mr. T. C. White.
"The Medical Examiner," weekly	,, the Editor.
"The American Naturalist"	in exchange.

Also for the Album of the Club :—

Portraits of Mr. Fitch, Mr. Chas. Mills, and the late Dr. Joseph Toynbee (the latter presented to the Club by Dr. M. C. Cooke).

The thanks of the meeting were unanimously voted to the donors.

The following gentlemen were balloted for, and duly elected members of the Club :—Dr. W. R. Ballard, jun., Mr. John Godwin, Mr. W. R. May, Rev. Thos. E. Meredyth, M.A., Mr. Henry H. Ongley, Mr. Ed. Smith, F.S.S., and Mr. Geo. Wheeler.

Mr. R. P. Williams read a paper "On an Improved Freezing Microtome," which he illustrated by diagrams drawn upon the black board, and by the exhibition of the apparatus described.

The Chairman thought the club was much indebted to Mr. Williams for his very interesting paper, and that this new piece of apparatus would be invaluable to all who did not cut sections by hand. There could be no doubt whatever as to the greater value of sections cut from fresh material in comparison with those which had been kept for some time hardening, and he thought that a fresh specimen of a morbid or animal tissue would undoubtedly be more likely to give accurate details to the observer than one which had been for weeks hardening in chromic acid. Dr. Pritchard's freezing microtome was certainly good; but there were many persons who could not cut sections by hand, and therefore required an assistance of this kind, and of all that he had seen this one appeared to be decidedly the simplest. For his own part he preferred to cut sections by hand, but he was quite aware that many persons found it difficult to do so; he was, however, strongly in favour of the plan of freezing as a means of hardening fresh specimens. It was very hard to have to wait three weeks for a morbid specimen to harden before it could be cut, and at the end of that time to find that it had undergone distortion; for although some of the advocates of re-agents would say there was no distortion, he knew from experience that there were very often alterations on account of contraction, and he could bring specimens cut both before and after hardening which would clearly show that such was the case. He should like to ask Mr. Williams if he had any experience in the use of ether spray for freezing, in the place of ice and salt? Some had recommended it, but it seemed to him to be an expensive and somewhat disagreeable substitute.

Mr. Williams said of course there were many freezing mixtures, but he did not think that there were any so effective or so cheap as ice and salt.

The Chairman announced that Mr. Williams had promised to give them a demonstration on the use of the microtome at their Gossip night in March.

A vote of thanks to Mr. Williams for his paper was unanimously carried.

Mr. A. Cottam read a paper "On *Aulacodiscus Africanus*, a new Diatom from West Africa," illustrating the subject by a number of beautifully executed drawings.

The Chairman said that as he had not gone very much into this subject he could hardly express an opinion upon it, but he felt sure that all who had heard the paper would join with him in giving a hearty vote of thanks to Mr. Cottam for bringing the subject before them.

The thanks of the Club were voted to Mr. Cottam for his paper.

Mr. N. E. Green read a paper "On a New Stage Arrangement for Examining Objects by Reflected or Transmitted Light." The subject was illustrated by pencil drawings of the appearances described in the paper, and by the exhibition of objects under microscopes in the room.

The Chairman asked for a vote of thanks to Mr. Green for his very interesting paper, and also for his exhibition of the specimens. Some time ago Mr. Green gave them a beautiful demonstration of the illumination of objects by the lime light, and this would doubtless be remembered with great pleasure by all who were then present. Before he sat down he wished to advert for a moment to the noticeable absence of their President—for he believed it was the first time he had been absent since his election. They would all be deeply sorry to learn that he had been called upon to endure a heavy domestic loss. He felt sure that though absent from them, their President would be in their thoughts, and that they would sincerely sympathise with him in the severe affliction which had befallen him.

The thanks of the Club were unanimously voted to Mr. Green for his paper.

Four gentlemen were then proposed for membership, announcements of meetings, &c., for the ensuing month were made, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

"*Chlamydomonas pulvisculus*" ... ... by	Mr. Badcock.
Melicerta tyro	Mr. C. W. Balls.
Spawn of *Anodon*	Mr. Cocks.
Skin of Spotted Gunnel-Butterfish... ...	Mr. Curties.
Panorpa communis	Mr. Dunning.
Antennæ of *Liparis dispar*	Mr. Enock.
Pleurosigma angulatum, shown with $\frac{1}{25}$in. objective, on elevated stage ... Crater-like surface of *Isthmia enervis*, $\frac{1}{2}$in.; *Triceratium fimbriatum*, with $\frac{1}{12}$in. objective, uncovered, to show surface markings	Mr. N. E. Green.
Young Spiders	Mr. Halley.
A new beaded test object	Mr. Ingpen.
Section of Proglottid of *Tænia grandis* ...	Mr. F. H. Ward.
Spicula of Glass-rope Sponge	Mr. Moginie.
Alvin	Mr. T. H. Powell.
Pleurosigma angulatum (with $\frac{1}{6}$in. objective)	Mr. J. Swift.
Rotifers	Mr. Martinelli.

Attendance—Members, 89; Visitors, 14.—Total, 103.

March 10th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Foot of Hawk-fly	Mr. C. G. Dunning.
Leaf of *Drosera rotundifolia*	Mr. Enock.
Nitophyllum laceratum	Mr. H. G. Glasspoole.
Aulacodiscus Petersii...	Mr. G. Green.
Chrysaora	Mr. Ingpen.
Tongue of Bee-fly	Mr. S. Israel.
Silicified Wood, showing Coniferous structure, from Portland	Mr. M. H. Johnson.
Gill of Gold Fish, stained	Mr. W. W. Jones.
Farrea fecunda	Mr. B. W. Priest.
Trachyte, from the Rhine, polarized ...	Mr. W. S. Smith.

Young of *Anodon*, polarized	... ...	Mr. Spencer.
Podura scale, with $\frac{1}{6}$th objective	... ...	Mr. Swift.
Selected *Polycystina* ...	... ...	Mr. Topping.
Spinal Cord of Pig, stained...	... ...	Mr. F. H. Ward.
Teeth of Tadpole	... ...	Mr. T. C. White.
Demonstration of Section Cutting ...	...	Mr. R. P. Williams.

Attendance—Members, 76; Visitors, 11.—Total, 87.

March 24th, 1876.—Dr. J. Matthews, F.R.M.S., President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced :—

"The Monthly Microscopical Journal"	... ...	from the Publisher.
"Science Gossip"	... ...	" "
"Proceedings of the Royal Society...	... ...	" the Society.
"Proceedings of the Watford Natural History Society"		" "
"The American Naturalist" ...	... ...	in exchange.
"Report of the Smithsonian Institution for 1874 ...		from the Institution.
"Tyndall's Notes on Electricity, &c.	...	" Mr. Watkins.
"Baker on the Microscope" ...	... ...	" Mr. Watkins.

Also Photographs (for the Album) of Mr. T. Curties, Mr. G. Gardner, Mr. Long, and Mr. Ernest Hart (the latter presented by Dr. M. C. Cooke).

The thanks of the Club were voted to the donors.

The President said he should like to see Photographs come in a little more quickly, and commended the matter to the notice of members.

The following gentlemen were balloted for, and duly elected Members of the Society .—Mr. A. Clarkson, Mr. G. D. Colsell, Mr. Edward M. Nelson, and Mr. Chas. J. Wilson.

The President said he had an announcement to make which had long been on his mind. They called themselves a *Microscopical Club*, and yet they had no microscope belonging to them as a Society. He thought this was a deficiency which ought no longer to exist, for they ought certainly to be able to place a first-class microscope at the disposal of the reader of a paper, who might desire one for the purpose of demonstration. Hitherto they had relied upon the kindness of friends to supply this deficiency, and although they had always been supplied with the instruments they might require, yet he thought the acquirement of a *Club* microscope was a subject which ought to receive their attention. The Committee considered that the time had come when the matter should be brought forward, and they had passed two resolutions which he would lay before them. The first was —"That it is desirable that the Club should possess a microscope," and the second was, "That the President shall announce this from the chair, and solicit subscriptions towards the same." He did not propose to have any subscription list, nor to fix a maximum or minimum sum to be subscribed;

he would rather say that they did not mind how much or how little the amounts were; but as they wanted a *good* instrument, they must be prepared to go to the expense of one. The Treasurer would be happy to receive subscriptions for the purpose, and he would only add that the sooner the Society was in the possession of a good instrument the better.

The President was sorry to say that Mr. Bridgman's paper was unavoidably postponed, but he believed that they should not be wanting in topics to engage their attention, as several gentlemen present had interesting subjects to bring before them. He would first call upon Mr. Green, who had some supplementary remarks to make relative to the paper which he read at the last meeting.

Mr. N. E. Green said he had brought his microscope with him, in order to prove the statements he had made at the previous meeting, as to the value of very oblique light in showing diatoms, and he thought it would be obvious to all that the surface markings were shown in the most distinct and evident manner by side light and opaque illumination. In *Triceratium* they were accustomed to see, in the ordinary manner, a small bead at each angle of the hexagons, which seemed generally like a bright spot, but the lime-light, directed as he had already described, showed it to be a small crater. He might also mention that a few evenings ago Mr. Cole was with him, and after seeing the diatoms, under the new illumination, he expressed himself to be greatly delighted. He could also speak very highly in praise of the new 1-25 in. by Zeiss, which he had found to work very well, and to focus most comfortably. This should be a great convenience to those who desired to work with high powers.

The thanks of the Club were unanimously voted to Mr. Green for his communication.

Mr. M. Hawkins Johnson read a paper "On Silicified Structures in Pyritized wood."

The President in moving a vote of thanks to Mr. Johnson, was sure the members must have felt much interest in the subject, which, it was evident, had been treated in great part not as a matter of theory, but as one of observation.

The thanks of the meeting were unanimously voted to Mr. Johnson for his paper.

Mr. Charles Stewart gave a highly interesting description of the Echinoderms, than which he considered there were few more beautiful objects to claim the attention of the microscopist. The class was a large one, and was divided into several primary groups. First amongst these were those which were supported on jointed stems, and being somewhat lily-like in appearance, were known by the general name of the lily-stars. The next group was very different, and comprised the snake-armed star fish, distinguished by the great number of joints. The next were the common five-fingered stars—the great hollow-armed, or true star fish. Then came a group which was specially rich in objects for the microscopist—that of the Sea Urchins or Sea Hedgehogs, and next to these, the Sea Cucumbers or Sea Gherkins. Some of the specimens obtained from these groups were very beautiful, the anchors and plates of *Synapta* and the spicules of *Holothuria*, would be remembered amongst many others. Mr. Stewart then directed attention more particularly to the *Echini*, of which he gave a general description, figuring the typical forms—the teeth, alimentary canal, nervous system, &c.—upon the black board. Attention was then called to the structure and arrangement of the spines, the five rows of sucking feet or ambulacral discs, and the still more remarkable pedicellariæ. In addition to the drawings made by Mr. Stewart in the course of his remarks, the subject was further illustrated by a most interesting collection of mounted specimens of hard structures of the Echinoderms, exhibited under nine microscopes in the room.

The President said he had listened to the address of Mr. Stewart with the utmost interest, and had felt it to be most instructive. He was in the Isle of Man some time ago, and went in a boat out to the island called the Calf of Man. The weather was very calm, and he found upon the rocks a large number of *Echini* within reach of his arm. They were upon a kind of shelf, and he particularly noticed that each one had a hollow place scooped out under it, which seemed, without doubt, as if it had been made by the creature itself. The land about that part is mostly of volcanic origin, and the rocks are exceedingly hard, so that it would seem difficult for these creatures to excavate the hollows themselves; but he should like to ask Mr. Stewart if it were possible for them to do this, and also by what means it was done.

Mr. Hainworth enquired how Mr. Stewart preserved *Echini*, and also what was the best way in which to mount them, so as to exhibit them to the best effect.

Mr. T. C. White said he had a specimen of *Alcyonium digitatum* (exhibited in the room), in the mouth of which he found some *Echinus* spines, and he had often wondered whether the *Alcyonium* preyed upon the *Echinus*, or *vice versa*. The spines were found in the mouths of these Polyps in several other instances also.

Mr. Charles Stewart said, in answer to the President's question, that the subject was one which had frequently received attention, for, in the case of the common Echinus *(Echinus lividus)*, it was invariably found that these depressions existed, and the way in which they were supposed to be formed was by the constant sucking action of the ambulacral tubes. It had been supposed by some, that the spines had something to do with the formation of these hollows, but this was not at all borne out by examination, as not even the smallest spines showed any appearance of being worn away. With regard to preparation, the smaller star fish presented very little difficulty, as they had no tendency to throw off their arms as the others did. The best way was to put them upon a piece of glass, and spread them out with a needle, then allow a little fresh water to run up to them, though not enough to let them move about, this speedily killed them, and they could then be turned over and spread out with a needle. If it was desired to mount them transparently, they should be dropped into spirit, and then into oil of cloves and balsam in the usual way. He thought that, in the cases mentioned by Mr. White, the *Alcyonium* was not likely to have been in any way the aggressor, but that the *Echinus* must have been crawling about, and had some of its spines seized by the *Alcyonium*, or else, perhaps, they had got stuck into it.

The cordial thanks of the Club were unanimously voted to Mr. Charles Stewart for his very interesting communication.

The Secretary then said that on one of the tables, members would find a new Microscope and Mounting Lamp, designed by Mr. Lane Sear, and manufactured by the Silber Light Company.

The President announced that it had been decided by the Committee to postpone the Soirée until October or November next.

Excursions for the ensuing month were then announced, but that for April 8th to Barnes, was abandoned in consequence of the difficulties likely to arise in the matter of conveyance to that place during the University boat race. The next gossip night falling upon Good Friday, would also be omitted.

The proceedings then terminated with a conversazione, at which the following objects were exhibited:—

Oridium monliöides	by Mr. W. J. Brown.
Various *Spongidæ*	Mr. Cole.
Clubiona brevipes (showing muscles *in situ*)	Mr. Enock.
Orbitolites complanatus	Mr. J. W. Goodinge.
Various Diatoms shown with ½in. objective as opaque objects	Mr. N. E. Green.
Meyerina—a new sponge	Mr. W. W. Reeves.
Acrocladia trigonaria section of spine) *Echinometra triangularia* (section)	Mr. J. A. Smith.
Collection of specimens of hard structures of Echinoderms (under 9 microscopes)	Mr. Chas. Stewart.
Foraminifera from the Mediterranean ...	Mr. Watkins.
Section of *Alcyonium digitatum*... ...	Mr. T. C. White.

Attendance—Members, 94; Visitors, 14; Total, 108.

On the Principles of Illumination in Connexion with Polarization.

By W. K. Bridgman, L.D.S.

(*Read April 28th*, 1876).

Plate xv.

Although it appears to be universally recognised that the illumination of an object under the microscope is of scarcely less importance than the performance of the object-glass itself, it must be fully admitted that the perfection of the one has greatly outstripped that of the other, leaving something more to be accomplished with the latter in order to bring them both up to the same level.

It is commonly understood that an object is rendered visible by the light reflected from its surface. This, however, is a misleading statement, and requires explanation. Let a lamp or candle be held in front of an oil-painting, and then let the eye be so placed as to receive the light reflected from its surface, when it will be found that nothing whatever of the detail of the picture will be visible, but that only a confused glare, accompanied by an indistinct outline of the source of the light, will present itself. If, however, the eye be now brought to a point midway between the light and its reflected image, all the previous glare will be absent, and at the same time the minutiæ of the drawing and colour of the picture will have become beautifully clear and distinct; thus making it seem as if it were light absorbed rather than reflected, which causes the object to be seen, although the fact admits of a different interpretation.

Light is supposed to be derived from undulations or vibrations in an "ether" which is believed to be ubiquitous, and to permeate, more or less, all objects in nature. These waves constituting light, are propagated in all directions, and being given off laterally, tend thus to effect its general diffusion. Now, it is these undulations or vibrations, that are spread transversely to the line of the reflected ray, which enter the eye and produce the phenomenon of vision; or, as it is expressed by Dr. Spottiswoode, "the vibrations producing the sensation of light take place in planes perpendicular to the direction of the ray."* Hence, in viewing the picture, instead of placing the eye in the line of the reflected ray, let it be moved to a point vertical to the spot upon which the incident rays fall, when the transverse vibrations thrown up from the angle where the rays are bent, reach the eye unaccompanied by any of the direct reflections, and hence the freedom from "glare" or fog.

Now, if the preceding experiment be repeated more carefully with an ordinary "graphoscope," it will be found also, that the richness of colour and purity of the light will depend very greatly on the angle at which the light shall be incident upon the surface. Selecting a piece of glowing scarlet, or of rich crimson, as being colours most sensitive to the addition of white, let a small lamp or wax candle be fixed upon a movable arm, pivotted to the centre directly beneath the spot of incidence, and around which it may be moved in the segment of a circle, and with the direct light properly screened off, it will soon be perceived by an experienced eye that there is one particular position of the light at which the colour shows to the greatest advantage. Let this angle be now measured, and it will be found to be about fifty-six degrees, or the polarising angle for a painted surface. On moving the light so as to enlarge the angle, the colour will begin to fade for want of sufficient illumination, while, on the other hand, if the light be brought nearer to the centre, it will become brighter and more vivid, but then it will be at the expense of its purity, and appear as if seen through a silvery mist of fog, owing to the direct reflections getting spread up into the field of view. In the illumination of an opaque object under the microscope, the same law necessarily holds good. For day-work it is best to obtain the light from a white cloud *opposite to the sun*. If this light be tested it will be seen to be wholly devoid of polarization; but let the analysing prism and selenite be directed either to the blue sky, or in a direction *across the sun's rays*, and the light will then appear strongly polarized, and which scattered polarization affords the worst possible kind of illumination for the microscope. It is not the mere fact of using light already in a state of polarization which has to be considered, but it is *the act of polarization at the time*, which seems to develop some other correlative force concerned in the result. It has been shown by Sir Wm. Grove that a beam of light produces heat, electricity, magnetism, chemical action, and

* "Nature Series, Polarization of Light," by W. Spottiswoode, LL.D., F.R.S., &c.

motion, and each one of these again reproduces all the others, so that a light-ray is not an isolated force, but is one of an association of forces, of which illumination is only one of the effects; but of this group, the first five out of the six are effective solely by virtue of *polar action*, heat and light, in becoming polar; electricity, magnetism, and chemical action, in losing polarity and becoming passive. It is thus the polarity induced by the impact of the ray which excites, or confers upon the reflected or the refracted portion of the ray, a condition enabling it to convey the impression of the object to the eye, and the desideratum is to restrict the effect as much as possible to this one action.

"If light reflected from the surface of almost any *except metallic bodies*, be examined with a plate of Tourmaline, it will, in general, be found to show traces of polarization. . . Every ray of ordinary light incident at any angle upon a transparent plate, is partly reflected and partly refracted: the reflected ray is partially polarized, and so also is the refracted ray. . . . Reflection is generally, perhaps always, accompanied by refraction." There is, however, one particular angle at which polarization is at a maximum. This angle is not the same for all substances, as it varies according to their refractive power; hence, for water it is 52° 45'; glass, 54° 35'; amber, 56° 35'; Iceland spar, 58° 23'; and for the diamond, 68° 02'.

When light is incident at the polarising angle, the reflected and the refracted rays make together a right angle, while the tangent of the incident ray equals the refractive index of the substance employed, so that this tangent subtracted from 90° gives its angle of polarization, and it has been assumed that the angle for *amber*, or about fifty-six degrees, will be about the angle for the majority of organic bodies viewed with the microscope.

In the illumination of an opaque object by means of a side lens, or a metallic reflector, a very satisfactory light is generally obtained almost as a matter of course; this, however, is to be accounted for by an approximation to the polarizing angle happening to present itself as the most convenient position available. But should the Lieberkühn be substituted for the side illumination, the very reverse of this becomes a natural consequence. The mass of *direct* rays which are thrown down, drowning the object with vertical light that obliterates all detail, is an abuse, and not its legitimate use, and has done much to prevent the instrument from being appreciated as it deserves. If it be arranged, as shown in Fig. 3, so as to direct the rays at the proper angle of incidence upon the object, no better means of illumination can be desired either for effect or for convenience.

In applying it, the lamp may be placed, as usual, on the left-hand side of the instrument, and the mirror should be turned *a little* to the right and the rays directed on to the *outer edge* of the Lieberkühn on the same side as the mirror; after which a very slight movement of the mirror will suffice to bring the best part of the flame on to the object. When rightly adjusted the light will be full and clear, and perfectly free from haze or glare. An excellent test for obtaining this is afforded by the underside of the leaf of the *Blumenbachii coronata*, the delicate transparent hairs of which are almost invisible under an imperfect illumination, but, under a proper light, stand out distinct and fresh, like herbage after a shower of rain.

To prepare a scale for obtaining this angle, in the absence of a sector, the following plan will be found sufficiently accurate:—Procure a large sheet of paper and fold it in two, so as to obtain the base line *a*, *A*, *b* (Fig. 1) at one edge, and, perpendicular to it, the median line *A B*. Then, with a pair of compasses opened to $3\frac{1}{2}$ inches, draw the semi-circle *c*, *d*, *e*. Closing them to $3\frac{1}{4}$ inches, mark that distance on each side of *d*, and draw the lines *C A*, *A D*, which will give *C A B*, *B A D* at the angle of 56° on each side of the perpendicular *A B*. Repeating the same operation with the compasses opened to $3\frac{1}{8}$ inches, will give *E A B*, *B A F* angles of 54°35', the polarizing angle of glass. Let any small card or paper now be placed, with a marked point to coincide with *A* upon this diagram, and let the lines be continued on it to the point *A*, and it will then serve as a guide for obtaining the angles with the instrument. On placing the card upon the stage behind the object glass, and with the median line behind the axis, the mirror or condensing lens may then be easily placed in the proper position, as at Fig. 2, and the light afterwards brought to its corresponding place, as there shewn.

In viewing objects by transmitted light the same law equally applies; every cone of rays necessarily contains, at its axis, certain portions that are either vertical, or so nearly so, as to suffer very little refraction, and hence, are too direct to be other than detrimental to distinct vision. In practice, therefore, the central portion should be "stopped out" by a suitably shaped diaphragm, and the light be taken from that zone of the condenser which will afford rays of the required degree of obliquity for each occasion ;* but it must be remembered that with all transparent substances it is the *refracted* (and not the *reflected* ray as for opaques), that is utilised, and hence it is that a modification of arrangement becomes necessary.

For an opaque object the light is purest and best when taken direct from its source and thrown down at the required angle by a metallic reflector, without the intervention of any bullseye or other condenser ; but when the refracted ray is required, the *reflected* rays are dispensed with, and may be sifted out to commence with. If the mirror were of polished silver, or speculum metal, the light would be thrown upwards undecomposed ; but with the silvered glass, a portion is first reflected from its upper surface, after which the refracted portion is sent up from the silvered under-surface ; now, as the reflected ray is in the plane of the reflecting surface, and the refracted ray at right angles to it it is obviously necessary that any subsequent reflections and refractions as by the glass slip containing the object, should preserve the same relative position of plane and refracting surface. It is, therefore, best to place the light directly in front of the stage, and at a distance suitable for admitting of the mirror being adjusted, so as to receive its rays at an angle of about $54\frac{1}{2}^{\circ}$ (which may readily be done by the help of the card scale placed across the setting of the mirror) ; the refracted and the reflected rays will thus be separated from each other by a distance proportionate to the thickness of the silvered glass and the incident angle of the ray. A second reflection and refraction then takes place at the under side of the glass slip, and others successively from the object and from the cover ; but each set of rays separated by the mirror will follow its own course and behaviour, and, in all subsequent stages, producing its own corresponding results.

By thus getting rid of direct reflected rays, we at once dispose of the question of contracting diaphragms and other means of lessening

* Since this paper has been in progress, I have succeeded in adapting the principle of the side reflector as a *substage arrangement for transparent objects*, which possesses all the merits of the Bramhall mode of illumination without any of its defects ; and combines also the additional advantage of being applicable to general purposes (which the other is not) producing a beautifully soft and clear light, with great perfection of definition. It is so arranged that the angle of incidence may be regulated at will and set at any degree of obliquity capable of producing from a darkground illumination to almost direct rays ; whilst it admits of the lamp being placed in front of the instrument, so as to be entirely out of the way of the hands and face.

quantity, *as light in its proper state* can hardly be too abundant ; for it is only when contaminated with the unnecessary rays that it becomes distressing to the eyes. Then, as regards *intensity*, it must be borne in mind that light, like its correlatives, varies inversely as the square of the distance ; so that at two inches distance it becomes four times less than at one inch, and at four inches, sixteen times, and so on in like proportion. Hence, to increase or diminish intensity, we have only to adjust the distance of the lamp accordingly, and we may by these means dispense with ground or tinted glasses, both of which materially interfere with delicate vision.

On a New Method of Mounting Microscopical Objects.

By Professor H. L. Smith, Hobart College, Geneva, N.Y.

Communicated by Mr. T. Curties.

(*Read May* 26, 1876.)

I have noticed so many enquiries lately as to the best mode of mounting objects requiring a cell of moderate depth, and often the use of a fluid, that I am induced to give a short description of my own method, both for Diatomaceæ and for Foraminifera. For the latter I punch, out of a sheet of wax (dark-green or black), a disk a trifle larger than the brass curtain-ring which is to constitute the wall of the cell. This disk is pressed by one edge to the centre of a glass slide, and slowly warmed till it melts—if well done no bubble of air is enclosed under it, and the whole cools with a smooth, somewhat dead surface. The ring is then pressed into this, and centred by the turn-table, and then again pressed fully home, showing the brass, when looked at from the under side; and the whole finished with the usual "Brunswick black" outside, and also the ring inside. To attach the Foraminifera, or other objects, a *minute* drop of turpentine is applied to the wax, and in a minute or so, before it is quite dry (and we may proceed leisurely), the object is placed on the softened wax; when thoroughly dry, it will be found so strongly attached that a violent blow or a fall will not dislodge it. Of course, if the object is very large the turpentine may have a little of the Brunswick black, or some size dissolved in it. The improvement over the glistening gum attachment for minute objects is very manifest—indeed no signs of the cementing material show if the turpentine is judiciously used. While all this is being done, the Brunswick black on the brass ring will have set sufficiently to fasten the cover, which should be of such a size as to rest, not on the top of the ring, but to slip just within, so that its surface will be flush with the top of the ring. When the cover is pressed home, the whole may at once, without any danger of its "running in," be finished with the black varnish. Nothing can exceed the soft and delicate appearance of these wax backgrounds, nor can a cell be built up in any manner more readily. I use the sheets prepared for wax flowers, and of course colours may be selected to suit the object. The disks are punched by a solid plunger, which must frequently be cleaned by punching disks from a thick card either oiled or prepared with a little turpentine. Care will enable one to prepare these rapidly. The thin cells for large Diatoms, &c., to be mounted dry, I make as follows :—The wax disk—in this case say bright red—is put under another press, and the centre punched out, leaving a ring of wax. With my own press I do this readily, and I will try to describe, as well as I can without a figure, the operation. Concentric with the hole that receives the plunger to force out the centre of the wax disk is a larger hole (the same size as the wax disk) in a brass plate, the plate being a trifle thicker than the wax disk ; this plate is, say two inches long, and can be turned aside from over the hole in the bed plate of the press, on a screw, or pin, inserted near one end. Above this brass plate is another turning on the same pin, but having a hole only just the size of the solid plunger. The operation is as follows : The lower brass plate is brought into place, its hole concentric with the hole in the bed plate (this is determined by a limiting pin inserted in the bed plate) ; the wax disk, wetted in the mouth, is now dropped in, and the upper plate swung round over it, the hole in the latter of course coming into place against the limiting pin so as to receive the plunger. When the plunger is forced down, a ring of wax is left on the bed plate, and on swinging round the lower brass plate this ring drops out free. The only precaution is to keep the wax from sticking to the edges of the plunger and of the die (simple wetting will answer admirably, and will enable one to make these rings very nicely); if water is used, the steel plunger must afterwards be dried and oiled. Suppose now the rings made. We place one on the centre of a slide, putting upon it a piece of oiled paper (so dry as not to leave marks on the slide) ; press the wax forcibly on to the glass, and burnish it with the nail, or an ivory handle, not so hard, however, as to press it out of shape. The object is now put in the cell (or, if Diatoms, mounted on the cover), and the cover applied—it should be the same size as the ring, and may be held in place by one of the ordinary spring clips ; next, by means of a pin's head (the pin mounted in a handle), or by a wire used as a soldering tool, by heating in the flame of a lamp, and which is applied on the *top* of the cover at the margin; the wax is melted (only under the margin of the cover, however), thus fastening the cover securely—the different colour of the melted and attached wax shows when this is completely done. The whole may now receive immediately a finish of any of the ordinary varnishes, and with no fears of running in. If the wax ring is neatly made, and soldered to the cover (if I may be allowed the expression), a minute ring of it—red, or blue, or white—may remain as a finish, or the whole may be covered with the black varnish. I find the coloured wax works somewhat better in punching than the bleached or white. For mounting Foraminifera the wax bottom cell cannot be surpassed; indeed, no one who has used it will return to paper or any other substitute.

On a New Process of Histological Staining.

By Frances Elizabeth Hoggan, M.D.

(*Read May 26th*, 1876.)

A description of the following histological process has already been given in a paper which I read before the British Medical Association last year, at its meeting in Edinburgh. Although that paper has been in the hands of the editor of the Journal for the last nine months, it has not yet been published, but inadequate, and, in some cases erroneous, accounts of my process, have been largely circulated, especially in the continental scientific journals. Enquiries are still often made of me respecting it, and I have, therefore, considered it advisable to give, as shortly as possible, the details of this very simple and effective process to your Society, whose members will, I doubt not, put it to every variety of test.

The tissues to be stained are principally membranes or soft sections, which may be either fresh, frozen, hardened in alcohol, or hardened by the picric acid and gum process, but such hardening agents as the chloride of gold or any chromate whatsoever, are inadmissible.

The colouring agents required are: a 1 or 2 % solution of perchloride of iron in distilled water or alcohol (tincture of steel); 2, a solution of similar strength of pyrogallic acid in water or alcohol, the latter fluid being preferable in both cases.

The section or membrane to be stained is first treated for one or two minutes with alcohol; the iron solution is filtered upon it, allowed to remain for a couple of minutes, and then poured off. The pyrogallic acid solution is then filtered in a similar way upon it, and in the course of a minute or two, the desired depth of staining having been obtained, the tissue is washed and may be mounted, in the usual manner, either in glycerine, balsam, or varnish.

The nuclei and nucleoli will be found coloured black, and the cell substance will also be coloured more or less, according to the age and other conditions of the cell. A bluish tint may be given to them by washing the section with an alkaline water ; the household water of London, containing lime, is suitable for this kind of tinting.

This process is especially useful for photographic purposes, and to those who can only work with the microscope in artificial light, the definition being very clear and distinct. It is probably the best process for staining silvered preparations, as it has no effect on the black lines, while it makes the nuclei very distinct.

I have advised that the solution be filtered upon the preparation. This, although unnecessary with clean fresh solutions, obviates any chance of foreign matter becoming deposited on the preparation. It is easily effected by taking a piece of blotting paper about two inches square, folding it twice, and pouring into one of the cavities thus formed about a teaspoonful of either solution, or more, according to the size or number of the materials to be stained.

The whole process is speedy, simple and permanent. The staining may be accomplished in five minutes, and the staining materials can be bought at any country druggist's shop. The filtering paper should be held with forceps to avoid staining the fingers, as the stain is difficult of removal except with the binoxalate of potash.

On Tubicolaria Najas.

By James Fullagar, Hon. Assistant Secretary of the East Kent Natural History Society.

(*Read June 23rd,* 1876.)

Plates xvi, xvii, xviii.

I have lately been making some observations upon a Rotifer, named (in "Pritchard's Infusoria") *Tubicolaria Najas*, and figured there as inhabiting a transparent tube, into which at times the creature retreats. That which I have had under consideration certainly has a transparent tube, as the animal can be distinctly seen through it, but at the same time it is surrounded with brownish-coloured filaments which appear to grow out of and around it, and attached to which also are various diatoms and desmids, together with portions of decayed vegetable matter.

On one or two occasions Colonel Horsley exhibited specimens of this rotifer, as a very pretty object, at the Canterbury meetings, deeming it quite equal in beauty to *Melicerta ringens*. Though it had no beautiful and curiously-formed case like *Melicerta*, nor had it the pellet-making machine, yet it was a very interesting object under the microscope. I obtained of Colonel Horsley a number of these rotifers, found in some water he had taken some months back from a dyke at Chartham, and which had been kept in a small aquarium. I had them under my notice for a month, during which time I made the following observations on their development from the ova. I had often been puzzled when I had seen the eggs of these and like creatures hanging loosely on the outside of their bodies, and have wondered in what way they were developed ; I have now been able to witness this, and some other peculiarities in their economy. At Fig. 1 is a sketch of the *Najas* when it is placed so that the ciliated lobes are equally expanded, and in a perfectly uniform position ; they then present a very beautiful appearance, the cilia passing like an endless band round the extended disks. By the action of these cilia, of which there is a double row, a current of water is made to flow towards the mouth in the direction indicated by the arrows, bringing with it the particles of food on which the animal feeds; the food thus introduced into the mouth (Fig. 1 *a*), which is also lined with long cilia, is thereby conveyed down to the grinding apparatus termed the gizzard or jaws (Fig. 1 *b*), where it undergoes mastication, and then passes into the stomach, where it is subjected to the process of digestion (Fig. 1 *c*), and then proceeds to what is termed the lower stomach (Fig. 1 *d*), where it is retained for some time in order to perfect the process of digestion, and to extract that which is essential for the nutriment of the creature. The effete matter left is thrown out by a curious motion of the intestine (Fig. 1 *e*), up which it travels, and is discharged at *f*. The intestine, with the lower stomach when empty, is seen to be thickly lined with vibratile cilia.

The ovum of *T. Najas* is formed in the upper portion of the body (Fig. 2 *g*), gradually growing there until it has attained the full size; it then occupies about two-thirds of the body, and is of a dark-brown colour. It progresses thus far within the body. The ovum being now ready for expulsion, is slowly forced down to the lower part of the body, the stomachs being drawn upwards, and on one side, in order to make way for it. Yielding to the pressure produced by the successive contractions of the body, the ovum passes down to, and out through the oviduct (Fig. 2 *h*), and is lodged within the gelatinous substance with which the animal is surrounded (Fig. 1 *i*). When once the egg has begun to move downwards from its original position, it occupies not more than two minutes before it is fully expelled from the body. It then presents the form shown at Fig. 3 *k*, is of a brownish colour, and reticulated, as though covered with a network consisting of oval-shaped meshes. It gradually becomes less opaque, and in about four days after extrusion the first trace of life becomes visible, presenting itself in a few freely-moving cilia at two points, one corresponding to the future head (Fig. 4 *l*), the other near the centre of the ovum. Shortly after, at the latter place, the central parts of the dental apparatus or gizzard are seen in motion at intervals (Fig. 4 *m*). The cilia at the head continue to increase in activity, and the whole contents of the egg are seen to twist to and fro, as the time of development draws near, but no definite form of the future animal can be detected. Two dark spots now make their appearance (Fig. 4 *n*), but what they are I have not been able to make out. In two instances I had watched the progress of the eggs almost up to the time at which the development should take place, when I was obliged to leave them, and on both occasions, when I returned, that which I had been anxiously looking for, had taken place during my absence, and neither egg nor young animal was to be seen. This somewhat puzzled me, as I expected at least to see an empty and deserted shell, but nothing of the kind was to be found. The egg continues to hold its form, as shown at Fig. 3, to the last, when the motion within increases in violence, evidently the creature is struggling to escape from its prison; I now expected to see the egg open and the animal escape, leaving the empty shell behind, but this was not the case, for after some more violent turnings and twistings the whole egg itself elongated, and took the form of Fig. 5; thus, the outer case of the egg now became the outer skin of the animal, and for about the space of ten minutes continued to turn and twist in all directions, sometimes elongating itself to twice the length of the original egg shape, and then again contracting, but still remaining in the place it had occupied, as shown at Fig. 1 *i*; at the end of about ten minutes it suddenly evolved a circlet of cilia (Fig. 5 *o*), and quickly assumed the form of Fig. 6; it then immediately commenced to move up towards the head of the parent, and on coming in contact with its cilia (Fig. 1 *p*), it sheered off into the water, and swam quickly away, as though rejoicing in the new life just acquired; and thus for a time it roams about at large. This continues for a short period, when it chooses a spot and settles down, fixing itself by its posterior end to some weed (Fig. 7), with one circlet of cilia in rapid motion on the margin of its head, the head being raised on a sort of neck. At this stage the internal arrangement of the stomachs, &c., are seen to be very similar to those of the adults (Fig. 7 *r*). In the course of two days the wreath of cilia appears to be divided, occupying two projections on the head, and having then the appearance of two rotating wheels, very much resembling those of *Rotifer vulgaris;* this continues for a time, when it is gradually changed to the form shown in Fig. 8, and the two lobes become further expanded; thus the gradual growth goes on until the full form of the adult is attained. At times the young creature closes itself up in the form of Fig. 9, and now the gelatinous tube begins to form (Fig. 8 *s*.) It is not clear to me where that comes from, but I think it probable that it is thrown out from the body, thus forming the tube into which the *Najas* retires suddenly when alarmed; and this it frequently does without in any way interfering with the eggs, though the *Najas* goes down to, and even passes the eggs when it retires, and sometimes two and three eggs are to be seen in various stages of development at the same time, yet the movement of the *Najas* is not obstructed by the eggs, nor are the eggs interfered with by the contracting or expanding of the animal.

I have remarked that there is a double row of cilia ; this is rather difficult to make out, but I have at times been able to do so, and I see that a correspondent to "Science Gossip," in describing *Melicerta ringens* mentions the same fact. The motion of the cilia on the outer edge of the disk appears to go in the direction indicated by the arrows (Fig. 8 *t*), while the inner current appears to move in the opposite direction (as at *u*.) Fig. 10 is a sketch of the jaws or gizzard, the dotted lines show them open, the dark lines shut.

I have previously mentioned that the mouth was lined with cilia ; this, in some instances, was very clearly seen, that is, when the Rotifer was more transparent than at other times, which is the case now and then, and also when the animal was bent from the observer. In one particular position the mouth is then very prominent, and the cilia are observed to be very long, and to project some distance from it. At the same time small particles, of what I should suppose to be rejected matter not fit for food, are seen thrown out with some degree of force ; and it is a peculiar trait in the character of *Najas* that it is enabled, by the action of the cilia, to draw particles towards the mouth with some degree of rapidity, and, at the same time, and by the same agency, to repel and cast off whatever the animal may find unsuited to its wants.

Description of Plates XVI, XVII, XVIII.

Fig. 1.—*a*, mouth ; *b*, gizzard ; *c*, stomach : *d*, lower stomach ; *e*, intestine ; *f*, vent ; *i*, position of egg after extrusion.

Fig. 2.—*g*, formation of egg in the body ; *h*, oviduct.

Fig, 3.—Egg after extrusion.

Fig. 4.—Egg four days after extrusion ; *l*, first appearance of cilia, and at *m*, where also the jaws appear ; *n*, two spots.

Fig. 5.—Elongation of egg ; *o*, wreath of cilia.

Fig. 6.—The form taken on escaping from the parent tube.

Fig. 7.—When first fixed ; *r*, stomachs seen.

Fig. 8.—Further development of the ciliated lobes ; *t*, outer current of cilia ; *u*, inner ditto ; *s*, commencement of gelatinous tube.

Fig. 9 —Young, closed.

Fig. 10.—Jaws of *T. Najas.*

PRESIDENT'S ADDRESS,

Delivered at the Annual Meeting, July 28th, 1876,

By JOHN MATTHEWS, M.D., F.R.M.S.

Gentlemen,—Various circumstances have concurred to make me delay the writing of the following paper until it was no longer prudent to do so, if I meant to fulfil with any degree of propriety the duty which devolves on your President of offering you an annual address. Amongst these, and almost the chief, was the difficulty of the choice of a subject; not, indeed, because of the paucity of topics, but quite the reverse. I had to find one of special, yet of such sufficient general interest as in some degree to secure me the indulgence of my audience, notwithstanding the possible shortcomings of its treatment. It was while thus hesitating that my kind friend on the right suggested to me the discussion which I will now endeavour faintly to outline to you. He has also assisted me materially by some most valuable hints and thoughts which I now thankfully acknowledge, and a few of which he may possibly recognise in his "*ipsissima verba*." I shall take for my motto a sentence from Bacon, as you will presently see that it bears with peculiar significance on my subject.

"He that is wise, let him pursue some desire or other; for he that doth not affect some one thing in chief, unto him all things are distasteful and tedious."

It seems but a very short time since I stood before you addressing myself to the same duty, and yet it is a whole year which has rushed over us with ruthless speed—a year crowded with events, political, social, and scientific, of the most stirring import. To the young, inexperienced, and enthusiastic, this rapid march of events, being a state of things into which he was born, seems the most natural possible; one, too, with which he can deal at his leisure. In the pride of his expected wealth of days he thinks that there is time enough before him for the solution of all the delicate and difficult problems of politics, of sociology, or of science. He either does not consider, or else he forgets, that he is but a unit in the great army of workers, and ignores the lament of the philosopher "that Art is long, and broad, and deep; and time, opportunity, and our little hour, brief and uncertain." And thus if he be untrained, as well as enthusiastic, he inevitably drifts into the fatal error of underrating or neglecting the labours of others, and attempting on his own part too much for one man. As he advances in life he is gradually and reluctantly forced to the admission that even *his* time will not suffice, and that *he* has not at his disposal so much working power as he at the outset supposed, and so he is compelled slowly, perhaps even unconsciously, to narrow the sphere of his labours, until at length, in his dearly-bought experience, he recognizes the absolute necessity as well as the wisdom of devoting himself to one branch of science alone. And well is it for him if he learn duly what is taught by that experience, even although the great drawback of its lessons may be that they are learned too late. The life wherein they would have been of use, may be lived out whilst we are learning them. Coleridge has said the same thing somewhat more poetically—" Human experience, like the stern lights of a ship at sea, too often illuminates only the path we have passed over." He might have added—" And yet may serve as a beacon to others that follow." The lament of the sage may thus be confirmed by the experience of a single life. I therefore hold myself justified in asserting that one of the surest effects (I fear it my seem paradoxical to say *causes*) of a judicious scientific training is the early recognition of this necessity of the division of labour. The concentration of energy and intellect upon one subject is far more certain, or at least likely, to lead to valuable results than that diffuseness of pursuit which is tempted from the determined path by every flower at its side. And such a vigorous pursuit is not long without its compensations, either direct or indirect, dry and fruitless though it may at times appear to be. Neither must we forget that the more the individual worker is compelled to narrow the sphere of his activity, so much the more will his intellectual desires induce him not to sever his connexion with the subject in its entirety. How shall he go forth stout and cheerful to his toilsome work—how feel confident that what has given him so much labour will not moulder uselessly away, but remain a thing of lasting value, unless he keep alive within himself the conviction that he also has added a fragment to the stupendous whole of science, which is to make the reasonless forces of nature subservient to the moral purposes of humanity? But for all this it is not possible to touch one of the sciences alone—they are links of a chain; touch one, you disturb or implicate more—perhaps all—though that which you touch may appear at the outset to be no nearer than the ends of a chain so far removed that they cannot be seen. Your pursuit may thus be attended with unexpected results—the very flowers of science, and its fruits too. The general tendency of the judicious division of scientific labour in these days is the creation of a body of persons whom we agree to call experts, and who are those amongst us that are supposed to have devoted themselves so much to a single branch of science or of art as to be distinguished by a knowledge of it, presumably superior to that of other men. Yet, even with such men, the word knowledge is but a relative term. Here I may, perhaps, be permitted to quote a most eloquent passage from the "Dissertations" of Sir W. Hamilton.

"The highest reach of human science is the scientific recognition of human ignorance—

'Qui nescit ignorare—nescit scire.' *

There are two sorts of ignorance. We philosophize to escape ignorance, and the consummation of our philosophy is ignorance; we start from the one, we repose in the other; they are the goals from which and to which we tend, and the pursuit of knowledge is but a course between two ignorances, as human life is itself only a travelling from grave to grave. This 'learned ignorance' is the rational conviction by the human mind of its inability to transcend certain limits; it is the knowledge of ourselves—the science of man . . . . In fact, the recognition of human ignorance is not only the one highest, but the one true knowledge; and its first fruit, as has been said is humility. Simple nescience is not proud; consummated science is positively humble. . . . . But as our knowledge stands to ignorance, so stands it also to doubt. Doubt is the beginning and the end of our efforts to know; for as it is true—'*Alte dubitat, qui altius credit*;' † so it is likewise true. '*Quo magis quærimus eo magis dubitamus.*'" ‡

But, gentlemen, as regards ourselves, we have been "wise in our generation," for we have long since selected our special branch of enquiry or research, and have amply vindicated our title to be deemed special workers. Nevertheless, it cannot be denied that the question of specialism may wear other aspects, as well as present some disadvantages—notably in my own profession—much to be deprecated. On the 13th of this month, Mr. Gladstone, in his address to the students of the London Hospital, on the occasion of the delivery of

* The man who feels not conscious of his own comparative ignorance has not yet learnt how to possess knowledge aright.

† The man who doubts much, is he who believes more.

‡ The further we carry our inquiries, the more room shall we find for doubt and hesitation.

the prizes adjudged in its Medical College, deprecated, in the most eloquent terms, certain (notable) forms of specialism in professions, as well as divisions of labour in trades, setting forth his reasons as follows :—

But there was another topic present to the minds of those whom he was addressing connected with the medical profession, which was the activity of speculative thought. That activity had undoubtedly reached a point in this age which they were not aware of in former times. In this activity of speculative thought, with all the hopes and with all the efforts it might tend to excite, he could not help seeing that an opportunity was given to the medical profession to exercise increased influence, and assume a greater share in the leadership of thought at large. He would give his reason for this. If he were asked what was the besetting danger of this age in the region of thought, he should venture to answer it was thought which was known professionally by the name of "specialism," which generally, in the world of industrial production, was called the "division of labour." These were excellent things, and we would not get rid of them if we could; but, at the same time, few of the goods which came to us in this world came unmixed with some drawback or besetting hazard, and the besetting hazard in the division of labour in the industrial world, and in the description of thought he had mentioned, was that it might tend to disproportionate development in the faculties of the mind, and consequently to a diminution, and not an increase of its aggregate power. With regard to the division of labour, there was no doubt of this at all. Unless there were counterpoise and a diligent use of the general means of improvement which the present age supplied—unless a man pursued more than a special branch of labour, he was in danger of becoming a stunted and deformed human being (hear, hear). Limited contemplation tended to diminish the general aptitude and ability and the command of resource which was so valuable to all persons in all the positions of life.

Yet I think you may notice that his observations refer more to specialty of thought than of pursuit or research.

Be that as it may, however, it cannot be said of our Society that we are mere specialists, for this evening are here assembled mathematicians, physicists, chemists, and zoologists, the teacher of natural science, and the physician, the technologist and the amateur who finds in scientific pursuits relaxation from other occupation. And what is our bond, if I may so call it, of association ? We are called a Microscopical Club, but what does that title mean to us ? Is microscopy an art or is it a science ? How shall we who desire very honourably and properly to be classed as experts, describe our occupation ? A question which may not at first sight be very easy to answer. My attention shall therefore be directed to the search for a reply to this most interesting question. Now, in all enquiries of this—or, indeed, of any kind—it is best to start from the basis of definite ideas. In this case, therefore, I will begin by attempting, mind, I only say attempting, a parallel of Art and of Science, by way of contrast, in some axioms, which I will presently place before you. Let me premise, however, that by the word Science, I mean chiefly, if not wholly, Physical Science, and that in the sense of information, as "ascertained truth," or, "as having to do with doctrines." The word "Art" is used in the sense of "practical knowledge and applied power." Moreover, it must always be remembered that Art, even of the lowest and most inarticulate kind, is always tending towards a scientific form, and Science—if it deserve the name—is never absolutely barren, but bears fruit in some form of human action—becomes an Art. The two run into each other. The following are the axioms :—

	ART.	SCIENCE.
1.	Knows little of its birth.	When recorded, recognizes its birth—can register it—and has recorded much of its after history.
2.	Invents.	Discovers.
3.	Uses the imperative.	Uses the indicative.
4.	Teaches us to do.	Teaches us to know.
5.	The methods of Art are tentative and constructive.	The methods of Science are inductive and deductive.
6.	Has rules.	Has laws.
7.	Is mostly unconscious of mental process.	Is conscious of it.
8.	Does something and could do it again.	Says something and could say it again.
9.	Apprehends.	Comprehends.
10.	Can be transmitted, but is often life rented, and may die with its possessor.	Can also be transmitted, but is *always* transmissible.
11.	Is often Science materialized, and unconsciously applied.	May be Art spiritualized.
12.	Makes knowledge a means.	Makes it an end.
13.	Asks *how*.	Enquires *why*.
14.	Sees.	Looks.
15.	Uses one eye.	Uses the other.

But wisdom uses both, and is stereoscopic, discerning solidity as well as surface, and seeing on both sides—its vision being the *unum quid* of two images. Bacon calls Science and Art a pair of Cyclops.

I have selected these aphorisms from a larger number which have occurred to me from time to time in my reading,* because they seemed the most easily applicable to the solution of my question, as well as the most terse. But I must admit that they are by no means exhaustive, and that the subject merits, and indeed admits of a more extensive treatment. But then this Address would have been prolonged far beyond its proper limits, and would possibly have taxed your patience unduly. Moreover I ought, perhaps, to have considered these axioms *seriatim* in reference to their help in assigning its due place to Microscopy ; but then, again, this Address would certainly have swollen into a volume. I have therefore confined myself to a few illustrations (or applications), leaving the rest to be filled up by my hearers at their leisure, if the subject really interest them. There can be but little doubt that most of, if not all, the sciences began their existence as arts. Thus one of the best of modern treatises on surgery has been entitled by its author "The Science and Art of Surgery," by John Eric Erichsen. But surely the words "Science and Art" should have been transposed, since the word "Surgery" means hand-work, and thus was at first an Art or Handicraft, whatever has been its subsequent developement into a science. It may serve as an evidence of the light in which microscopy was regarded by the late Mrs. Somerville, when we find that her very last scientific treatise was thus entitled "On Molecular and Microscopic *Science*." Clearly, then, microscopy seemed something more than an art to such a master-mind as hers. The Art of Microscopy began, I take leave to assert, with the discovery of Glass, so that its birth is hidden in the midst of ages. Layard found a lens amongst the ruins of Nineveh. I am of opinion that it was scarcely possible to manipulate glass, which is essentially, even in its oldest forms, a transparent or translucent body, without recognising its refractive powers.† The science of Microscopy certainly

* J. S. Mill, Dr. J. Brown, Helmholtz, and others.

† We may here notice some facts connected with glass, which shew that the ancients were on the verge of making one or two very important discoveries in physical science. They were acquainted with the power of transparent spherical bodies to produce heat by the transmission of light, though not with the manner in which that heat was generated by the concentration of the solar rays. Pliny mentions the fact that hollow glass balls filled with water would, when held opposite to the sun, "grow hot enough to burn any cloth they touched;" but the turn of his expression evidently leads to the conclusion that he believed the heat to become accumulated in the glass itself, not merely to be transmitted through it. Seneca speaks of similar glass balls which magnified minute objects to the view. Nay, he had

began when men having observed the phenomena of refraction, perhaps even for the first time in a dew-drop on a rose-leaf, and next in the tear of glass so closely resembling it, had so far reasoned on their cause as to reproduce and vary their effects by variation of shape, and thus to extend their applications. It is evident then that the present *art* of Microscopy is the result of a wonderful series of *inventions* from its birth. But the *Science* dates from the period when the Lens ceased to be a mere toy, as it probably was at first; and having been constructed by definite rules and applied to definite purposes, enabled men to make the wonderful discoveries which have well-nigh ceased to astonish us in these days, on account of our familiarity with them, and our conviction that the applications of scientific principles, as well as their extensions, are practically illimitable. And yet some are despondent enough to affirm that Scientific Microscopy is "played out." But I am very far from sharing this opinion; on the contrary, I firmly believe that a new era of discovery has dawned upon us, and that it has been inaugurated by the invention of new and effectual methods of producing what is technically called "the Differentiation of Tissues," by single and double staining, by the Polariscope; as also in the case of the fluids, as well as in that of the chemical elements and compounds, by the use of the Spectroscope. Nor must the defining powers of rays of greatly intensified oblique light on surfaces be omitted.

It will readily be seen, by these few and cursory remarks, how far the phrases Art and Science are mutually interchangeable as respects Microscopy. The plain fact is that the scientific results have been so mixed up from the beginning with the development of the instrument by which they were effected, that it is diffiult, nay, well nigh impossible, at this period to separate them. Another point of view from which to regard the argument is the axiom that Art "*sees*"—Science "looks." Now "Seeing" is a state passive and receptive, "looking" is a voluntary act, it is "the man within coming to the window." *Seeing* is registrative only; *Looking* is actively and thoughtfully meditative. Gentlemen, I have noted those amongst us in this Society, who have passed with infinite credit to themselves

nearly stumbled on a more remarkable discovery, the composition of light, for he mentions the possibility of producing an artificial rain-bow, by the use of an angular glass rod. At a far earlier period Aristophanes speaks of the ὕαλος "a transparent substance used to light fires with"—usually translated glass. The passage is too long to quote, but "it is curious, as it shews a perfect acquaintance with the use of the burning glass." ("Dyer's Pompeii," p. 563.)

and interest to us, from the *one* condition, from the *one* state, of passivity, into a most honourable activity, which has not been without its fruits—the boundary—the neutral ground, I may call it, being so narrow, that the space between was easily, perhaps unconsciously, overpassed. Another of the axioms to which I wish particularly to call your attention is that which affirms that "Art apprehends"—"Science comprehends." Let me fairly state my meaning, thus—the word "apprehend," by its etymology, seems to express that kind of grasp of a subject which is more mechanical than mental, *i.e.*, manipulative—a grasp by the hand (a thief is "apprehended,") and yet it cannot be so wholly. Now to "comprehend," equally by its etymology, means to grasp mentally—and after all has been said, the two are really convertible—interchangeable terms. And so, I argue, is Microscopy regarded either as an Art or a Science. I do not believe that it is possible for a man to possess and exercise the Art of Microscopy in any intelligent degree, without also rising into a more intelligent appreciation of its scientific relations than that which at first animated him. The Science thus again has fairly grown out of the Art. But, alas! it must be admitted, that the converse is not always equally true, since it must be confessed that the Microscope is *not* used with sufficient skill by those in whose researches it is all-important—I mean by the members of my own profession. I really think that these gentlemen ought to become members of the Quekett Club; for *if*—pray remember I only say *if*—our Club possessed no other function than that of fostering—may I say teaching—the Art of Microscopy, it has discharged itself of that duty well, to my happy knowledge! Plainly, we *may* thus neglect Art in seeking to master Science. "Truly there is a Science of Art, and there is an Art of Science, the Art of Discovery—as by a wonderful instinct, enlarging human knowledge. Some of the highest exercises of the human spirit have been here. All primary discoverers are artists in the sciences they work in. Newton's guess that the diamond was inflammable, and many other which must occur to you, was of the true artsman kind—he did it by a sort of hunting sense—knowing somewhat and venturing more—coming events forecasting their shadows—but shadows which the wise alone can interpret."

There is thus a neutral ground between the Art of Microscopy and its Science—a place, as in the Stereoscope, where the two images are mentally or visually superimposed or concurrent. My contention then is, that this is the point of view from which we may, and indeed ought, to regard Microscopy, neither as merely an Art nor as wholly a Science, yet a happy compound of both—just as you would regard an object seen by the binocular microscope. As regards its future and place, it is clear, I think, that a middle course is possible, and that it may thus be defined in terms which have been suggested to me by our Secretary. "It should be clearly understood that a Microscopical Society's principal aim should be to take into consideration the wants of the various branches of Science with regard to minute research. Its members should aim to be *experts*, ready to assist in any delicate work that may be required; to devise new instruments and methods of manipulation, and to improve old ones. This would be the Art portion of the work; and it is evident that all branches of science are interested in its development and improvement. With regard to the Science portion, such a Society has a claim upon all researches into which the use of the microscope, or of special processes connected with it, enter; such researches eventually taking their proper place in relation to Natural Science generally. For instance, the paper on Cavities in Crystals, recently read before the Royal Microscopical Society, is primarily a *microscopical* one, but will eventually find a place both in Geology and Chemistry."

Gentlemen, I am afraid that your patience must now be well nigh exhausted. I will therefore conclude with what is a most sincere expression of gratitude. I have now had the great honour of presiding over this Club for two long and yet short years. I found it prosperous, and I am thankful to be able to say that I leave it not less so. I am therefore encouraged to think that my shortcomings of which—and I speak most honestly—I am but too conscious have not impeded its progress. I have to acknowledge with hearty thanks the genuine courtesy and kindness with which I have ever been met both in my official and in my private capacity; and most of all do I rejoice in the harmony which prevails amongst us. I leave this chair with a large amount of undefined regret, certainly, but that consists entirely in the consciousness that I intended to do so much, but have really done so little. I do not know that it is possible for my successor to compensate for all this, but of this I feel sure, that if it be possible, he is just the man to do it, but I cannot speak of him as he deserves in his presence.

Gentlemen, I now bid you officially farewell, but am happy to be able to assure you of my unabated interest in this Club, with all of its, to me, most happy associations.

PROCEEDINGS.

APRIL 28TH, 1876.—ORDINARY MEETING.

DR. J. MATTHEWS, F.R.M.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The President said that he wished to call attention to the announcement made at the last meeting respecting the proposed purchase of a microscope for the use of the Club, as no doubt there were many members who being then absent were not aware of what was contemplated. There was a proposal then made that a good microscope should be purchased for the Club, but that as its funds were not sufficient to bear the expense, subscriptions from members who were willing to contribute were invited towards this very desirable object. It was stated that although they were a Microscopical Club they did not, as a club, possess any instrument of their own; and it was thought that this ought not to be. The Treasurer would be very happy to receive subscriptions for this purpose.

The following Donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	" "
"The Popular Science Review"	" "
"Proceedings of the Royal Society" ...	the Society.
"Proceedings of the Geologists' Association" ... ... "Annual Report of the Geologists' Association"	the Association.
"Annual Report of the Brighton and Sussex Natural History Society"	the Society.
"The Quarterly Journal of Microscopical Science"	by purchase.
A Photograph of the late Mr. Robert Hardwicke	from Mrs. Hardwicke.

The thanks of the Club were unanimously voted to the donors.

Mr. William E. Horne and Mr. William Stopher were balloted for and duly elected members of the Club.

An abstract of a paper by Mr. W. K. Bridgman "On the Principles of Illumination in connection with Polarization" was read by the Secretary.

Mr. B. T. Lowne said that in listening to the paper it occurred to him that there were two or three very important points with regard to the illumination of objects, which it would be very well to bear in mind. He did not say that an angle of 56° was not a good one at which to let the light fall upon an object—probably it was, but he was not prepared to say it was the best under all circumstances. He pointed out that when a ray of light fell upon a surface of glass obliquely, a part of the light was reflected, and if the eye were directed along the line of the reflected ray towards the point of incidence, an image of the reflected body would be seen, not at this point, but apparently as much behind the reflecting surface as the reflected body was in front of it. And if two divergent rays were reflected, it was important to remember that their relation was not altered, but that they would go on their reflected course as divergent rays still. And then, again, it should be remembered that it was an axiom in optics that all rays which proceeded from a point came back again to a point in the eye. When the eye was looking in the position drawn on the board, so as to receive the reflected ray, the portion of the surface which reflected it was absolutely invisible so far as the reflected light was concerned; but then not all the light would fall at that particular angle, some of it would spread out and become diffused light upon the surface, and it was by this alone that the surface could be perceived. The amount of light which was reflected bore a proportion to that which was diffused, according to the angle at which it fell, and the nature of the surface on which it fell. But the light which became polarized was light which was directly reflected, and which, therefore, could not give an image of the surface of the object on which it fell. So that although he did not say this was not a good angle, he did not think it was the only good angle for illumination. With regard to objects which were not opaque, they could only be seen by light which was bent out of its course in passing through them; and if an object having the same refractive index as balsam were put into balsam, it would become at once invisible, for if the light passed through the object in a single bundle of rays the same as it entered, it would not be possible to see the object. To be seen it must emit rays from every one of its points, and in viewing objects through the microscope only the bundle of reflected or refracted rays which went through the objective enabled the object to be seen, and no others were of any use whatever in rendering it visible, no matter what the angle might be at which they originally fell upon it.

Mr. Ingpen said he did not know whether he had done the paper any injustice by not reading the whole of it, but there could be no doubt—looking at the diagrams alone—that what he had stated was the tangible idea of the paper, namely, that the light should fall upon the plane of the object at the polarizing angle. The contention was that the angle of polarization was the angle at which an object should be illuminated, but the author did not say it was the angle at which an opaque object should be *examined*. Of course it was clear that they could in any case only view an object by the rays reflected from the surface in every direction. The contention appeared to him to be that the direction of the rays of light reflected on or through the object should be always at the medium polarizing angle from the vertical at which it was viewed.

The President thought that until they had the whole of the paper before them they could hardly discuss it further. He had great pleasure in proposing a vote of thanks to the author of the paper.

The thanks of the Club were unanimously voted to Mr. Bridgman for his paper.

Seven gentlemen were proposed for membership, and the certificates in favour of them were ordered to be suspended until the next meeting.

Meetings and excursions for the ensuing month were then announced, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Living objects (not identified) ... ... by	Mr. Badcock.
Aulacodiscus superbus	Mr. Cottam.
Zoea of Crab	Mr. Dunning.
Anatomy of the Spider	Mr. Fitch.
Sphœraphides of *Echinocactus*	Mr. Halley.
Spawn of Snails	Mr. Martinelli.
Leaf of *Sphagnum*	Mr. Moginie.
Navicula rhomböides	Mr. Nelson.
Aulocodiscus Brownii	Mr. Powell.
Ovarian Spicules of *Geodia*	Mr. Priest.
Trombidium	Mr. J. A. Smith.
Section of Sciatic Nerve	Mr. Ward.
Head of Sheep Tick	Mr. Watkins.

Attendance—Members, 84; Visitors, 15.—Total, 99.

May 12th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Skin of Air-Bladder of Fish, used for making Isinglass, from Bombay ...	Mr. A. L. Corbett.
Polysiphonia, in fruit	Mr. T. Curties.
Larva of *Eristalis*	Mr. C. P. Dunning.
Nitrate of Potash	Mr. F. H. P. Hind.
Transverse Section of Tooth of Cape Ant-eater	Mr. W. Moginie.
Aulacodiscus Petersii...	Mr. E. M. Nelson.
Frond of *Platycerum alcicorne*	Mr. B. W. Priest.
Leaf of Primrose	Mr. F. Reeve.
Various Test-objects, and series of High-power Objectives	Herr W. Siebert, of Wetzlar.
Wood Sections, cut and mounted by the late W. J. Wellsman	Mr. Sigsworth.
Section of Tooth of *Dendrodus*	Mr. J. Slade.
Polycistina (dark ground) $\frac{1}{2}$ obj.	Mr. Swift.
Trienophora nodulata—Tapeworm of Pike and various parasites	Mr. J. G. Tatem.
Section of Corn from Toe (human)	Mr. F. H. Ward.
Eggs of *Planorbis*	Mr. T. C. White.

Attendance—Members, 60; Visitors, 11.—Total 71.

ORDINARY MEETING.

May 26th, 1876.—T. Charters White, Esq., M.R.C.S., Vice-President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced, and thanks voted to the donors.

"The Monthly Microscopical Journal"	from the Publisher.
"Science Gossip"	" "
"Proceedings of the Royal Society," No. 168 ...	" the Society.
"The Medical Examiner" (weekly)...	" the Editor.
"Third Report of the Medical Microscopical Society"	" the Society.
Three Slides	Prof. H. L. Smith.

The following gentlemen were balloted for, and duly elected Members of the Club:—Mr. Joseph Blundell, Mr. John Wm. Brigstock, Mr. Chas. Emery, Mr. James F. Powell, Mr. Thos. Shepheard, Mr. Edward Simpson, and Mr. Chas. W. Southwell.

A paper "On a New Method of Mounting," by Prof. H. L. Smith, of Hobart College, New York, was read by Mr. T. Curties.

The Chairman proposed a vote of thanks to Prof. Smith, for his communication, and for the kind way in which he had sent them the slides; their thanks were also due to Mr. Curties for reading them the paper. He had himself been in the habit of mounting in wax for some time past, for small objects which did not need any great depth, and it would be remembered that he had, some years ago, recommended a mixture of wax and Canada balsam for the purpose. He thought it was very handy to know of this plan of Prof. Smith's, for it frequently happened that a person had not a cell ready of the proper depth required for mounting; he doubted, however, whether these cells would be permanent for fluids.

Mr. Hainworth enquired whether such cells would be safe when exposed to the small amount of heat given off by the lamp when placed near to them for purposes of observation, also whether they would bear the ordinary risks of carriage without becoming displaced.

The Chairman thought there would not be much danger of softening with the ordinary amount of heat, but it would really be a matter of little moment if it did slightly soften. He should be afraid that with a large mass of wax displacement might occur, but he fancied this might be got rid of by using some hardening material, as an addition to the wax.

Mr. Curties said that the cells had every appearance of extreme hardness, and with regard to their fitness for travelling, he could only say that those he had brought to the meeting had just come across the Atlantic, and though they were not very well packed, all had arrived in good condition.

Mr. J. E. Ingpen described a very fine microscope, by Amici, which had been brought for exhibition to the meeting by Mr. Curties.

The Chairman proposed a vote of thanks to Mr. Curties and to Mr. Ingpen, and remarked that no doubt this microscope was a very perfect thing in its way, and made a great sensation when it was first brought out, but for his own part he could conceive of nothing more painful than to use it if one had a stiff neck—perhaps, however, their ancestors were not subject to stiff necks.

A paper by Dr. Frances Elizabeth Hoggan, "On a New Method of Staining Histological Specimens," was read by the Secretary.

The Chairman said that he believed this was the first occasion on which they had had a paper written by a lady, and their thanks were due to Dr. Hoggan for her short and carefully written communication. He had seen the specimens which had been alluded to, and thought that this method of staining gave the sections such a clear, definite outline, that it had a great advantage over the blue or yellow stains often used; and it had the further advantage that the materials could be purchased at any druggist's. He thought, however, that there were other things which would stain as well, and he should not like, therefore, to recommend that this new method should be adopted to the exclusion of the others.

Mr. Chas. Stewart, in reply to a question from the Chairman, said that, having had the opportunity of seeing the specimens, he thought they showed the features fairly well, but he did not see that there were better results obtained than with silver. There might be an advantage in the case of some special tissues, but he did not see himself that there was any special advantage in those which had been exhibited.

The Chairman enquired if Mr. Stewart thought there was any danger of the staining undergoing a change after a little time.

Mr. C. Stewart said he had never heard of the method before, and it was so difficult to prophecy in such cases, that he should rather not speculate upon any probable future chemical decompositions which might take place.

Mr. Newton said he had only just had the opportunity of seeing the specimens, and could therefore not say much about them. There was one point which he thought should be borne in mind, and that was that they never could tell what staining methods would do until they tried them. He did not think, so far as his observation went, that this method was better than the others, but he thought they ought to feel very much obliged to Dr. Hoggan for communicating the process, because as they never knew when a method would fail them, they should put this one upon their lists, and no doubt they would find some instances in which it might be of great service.

Mr. Ingpen said there was a little hint about mounting, communicated orally, which he though worth mentioning. One or two of these specimens were mounted in glycerine, without any preparation at all. Dr. George Hoggan simply pressed the cover down with a clip, dropped a little warm sealing-wax upon it, and ran a hot wire round the edge to smooth it, finishing it off with some solution of wax in spirits of wine. Another of these preparations was also mounted in glycerine in the same way, but merely confined by copal varnish. Dr. Hoggan said that copal varnish would resist glycerine, and this, he thought, was a hint worth remembering.

The Chairman thought the idea with regard to the sealing-wax varnish, was a very good one. Shell-lac—the basis of sealing-wax—was not acted upon by glycerine in any proportion, and would keep it in, provided that they kept the edges clean; and they might then paint it round with ordinary liquid glue, or a mixture of gold-size and napthaline varnish made with indiarubber.

The thanks of the meeting were then unanimously voted to Dr. Frances Hoggan for her communication.

Excursions and meetings for the ensuing month were then announced, and the proceedings terminated with a converzatione, at which the following objects were exhibited:—

Thistle bug—*Monanthua Cardui*	by Mr. F. Enock.
Lips and teeth of Blow-fly	Mr. Fitch.
Omentum of Rat—stained by Dr. Frances Hoggan's process	Dr. Hoggan.
Aulacodiscus Johnsonii	Mr. Moginie.
Fungus in Hydrate of Silica (species of *Penicilium*)	Mr. W. W. Reeves.
Bradford Coal	Mr. Slade.
Cornea of Pig stained with chloride of gold ...	Mr. F. H. Ward.
Laomedea	Mr. T. C. White.

Attendance—Members, 79; Visitors, 14; Total, 93.

June 9th, 1876.—Conversational Meeting.

The following objects were exhibited:—

Heterotoma spissicornis (Scissor bug)	Mr. F. Enock.
Mouth and antennæ of *Volucella pellucens* ...	Mr. H. E. Freeman.
Selected Diatoms from California, *Triceratum sept-angulatum*	Mr. G. Green.
Petal of Geranium	Mr. A. H. Halley.
Balani (alive)	Mr. Martinelli.
Section of Rattan cane, stained	Mr. Sigsworth.
Sections of *Ruscus aculeatus*	Mr. Slade.
Section of Diorite from Ratho, Edinburgh ...	Mr. W. S. Smith.
Podura scale (1-6th objective)	Mr. M. Swift.
Young *Medusæ* (alive)	Mr. T. C. White.

Attendance—Members, 59; Visitor, 1; Total, 60.

ORDINARY MEETING,

JUNE 23RD, 1876.—DR. J. MATTHEWS, F.R.M.S., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced :—

"The Monthly Microscopical Journal"	from the Publisher.
"Proceedings of the Royal Society," No. 169 ...	„ the Society.
"Proceedings of the Bristol Naturalists' Society"	„ „
"Proceedings of the Geologists' Association" ...	„ the Association.
"Proceedings of the Watford Natural History Society"	„ the Society.
"The Popular Science Monthly," 2 Nos. (American)	„ Mr John Michels.
"The American Naturalist"	in exchange.
"The Medical Examiner" (weekly)	from the Publisher.
"Science Gossip"	„ „
A Slide of *Aulacodiscus Solittianus*	„ Mr. Curties.
A Slide of *Arenurus caudatus*	„ Mr. Fitch.

Photographs of Dr. Ramsbotham, Mr. Thos. Rogers, and Mr. J. A. Smith were presented for the Album of the Club.

The thanks of the meeting were voted to the donors.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. Addis, Mr. Chas. Allison, Mr. Jas. Bowles, Mr. Wm. S. How, Mr. T. R. Johnson, Mr. Thos. E. Jones, Mr. Chas. J. Kindon, Mr. H. S. Leeson, Mr. Rd. G. Pearcy, Mr. John T. Redmayne, Mr. Henry J. Roper, and Mr. Jas. W. Wills.

The President said he had to make an announcement relating to their official arrangements for the coming year. Having been their President for two years, the time had come for him to retire, and the Committee had nominated Mr. Henry Lee as his successor. The four gentlemen who filled the office of Vice-Presidents also retired in accordance with the rules, and the Committee had nominated, as their successors, Dr. Matthews, Mr. Hailes, Mr. Waller, and Mr. T. C. White; they had also nominated, as Treasurer, Mr. Gay; as Hon. Secretary, Mr. Ingpen, and as Hon. Secretary for Foreign Correspondence, Dr. M. C. Cooke. There were four vacancies upon the Committee, consequent upon the retirement of Messrs. Hailes, Hind, Waller and Williams; and whilst it was within the power of any member of the Club to substitute other names upon the balloting papers in lieu of those nominated by the Committee, for the offices of President, Vice-Presidents and Secretaries, it was especially their duty to nominate gentlemen to fill the vacancies upon the Committee. He therefore had to ask them to do this, and he should be happy to receive the names submitted to him.

The following nominations were then made:—

Mr. Goodinge,	proposed by	Mr. Waller,	and seconded by	Mr. Freeman.
Mr. Cottam	„	Mr. Smith	„	Mr. Hainworth.

Mr. Andrews	,,	Mr. Richards	,,	Mr. Topping.
Mr. Priest	,,	Mr. T. C. White	,,	Mr. Marks.
Mr. Parsons	,,	Mr. Marks	,,	Mr. Dunning.
Mr. Dunning	,,	Mr. J. A. Smith	,,	Mr T. C. White.

The President announced that Mr. Hainworth had been appointed Auditor on behalf of the Committee, and requested the members to select another gentleman to act with him in that capacity, on behalf of the Club.

Mr. Dobson was then proposed by Mr. Guimaraens, seconded by Mr. Brown, and duly elected.

A paper by the Rev. J. Bramhall, "On a New Oblique Illuminator," was read by the Secretary, who afterwards further explained the principles upon which the instrument was constructed, and the method of using it, by means of diagrams drawn upon the black board.

Mr. Curties, in reply to a question from the President, stated that he had not employed this illuminator by lamp-light, but by sun-light he had obtained results which were very satisfactory.

The President enquired whether dark-ground illumination could be got by it with high powers?

Mr. Ingpen said he had obtained a black ground with a $\frac{1}{4}$ in. by lamp-light.

The President thought the effect must resemble very much that of an Amici lenticular prism; he was, however, of opinion that one great difficulty existed in all these methods of illumination from beneath, namely, that in most cases the objects examined had markings below as well as above, and a false impression often arose from seeing the one through the other; so that nothing would give them a perfect idea of the real surface but good opaque illumination. He was quite sure that terrible confusion arose in consequence of the two sets of markings being seen at the same time. This new mode of illumination, however, was likely to be very useful in many cases, and one of its merits certainly was its simplicity.

A vote of thanks to Mr. Bramhall for his communication, was unanimously passed.

A paper by Mr. Fullagar on *Tubicolaria Najas*, was read by the Secretary. It was illustrated by some very beautifully executed drawings, which were handed round for the inspection of the members.

The President thought this a most admirable and suggestive paper. He was not aware of any other case in which an ovum had developed in the manner described. The acuteness of observation displayed, and the delicacy of the drawings, were, to his mind, beyond all praise.

A vote of thanks to Mr. Fullagar, for his paper, was unanimously passed.

Mr. Badcock said he had found this object at Walthamstow, in a pond where *Conochilus* was also found; it could be obtained there by dredging up some moss from the bottom of the pond.

Mr. Ingpen said that Mr. Fullagar gave his attention to these animals in the intervals of business, and kept them under view for long periods of time; observations conducted in this way could hardly fail to be of great use.

Mr. Fitch said that, at the suggestion of the President, he had introduced to their notice that evening an object which was of some interest, but as this was the first time he had ventured to address them at a meeting, he wished to express his regret that his deafness prevented him from taking any active part in their discussions. In his researches in ponds, he was sorry to say he had not been so fortunate as some of his brethren, he could not get polyzoa, nor was he very much more fortunate amongst rotifers. He went some time ago to try and get some objects of this class, but without success, and he came back much disappointed However, when he got home, he found, amongst some other things, a little red mite, which proved to be very rare. It was a species of *Arenurus (A. caudatus)*, and it seemed desirable to introduce it to their notice that evening. It very much resembled *Arenurus viridis*, only instead of being green it was red. He had brought it with him for exhibition, and, as there was not a specimen of *Arenurus* in the Cabinet of the Club, he had also brought a slide for their acceptance.

The President expressed the thanks of the meeting to Mr. Fitch for his communication, and observed that though it was not given to mortal man to command success, it was to deserve it.

Announcements of the meetings and excursions for the ensuing month, and also of the excursionists' annual dinner, were then made, and the proceedings terminated with a converzatione, at which the following objects were exhibited:—

Alcyonella fungosa	by Mr. Badcock.
Eggs of Parasite of Pheasant	Mr. W. J. Brown.
Aulacodiscus Sollittianus	Mr. T. Curties.
Trombidium	Mr. Enock.
Arenurus caudatus	Mr. Fitch.
Ciliary action in Mussel / Oölitic Limestone	Mr. Martinelli.
Section of Pearl from River Tay	Mr. Mogenie.
Fungus—*Trichia varia*	Mr. W. W. Reeves.
Fenestrated Membrane of Human Omentum ...	Mr. F. H. Ward.

Attendance—Members, 65; Visitors, 6; Total, 71.

July 14th, 1876.—Conversational Meeting.

The following objects were exhibited:—

Chelura terebrans, the boring crustacean	Mr. Dunning.
Hilara cilipes (Merry Dancer Fly, male)	Mr. Enock.
Larva of *Phlœothrips statices*	Mr. Fitch.
Mouth and Antennæ of *Chrysops cœcutiens*	Mr. Freeman.
Alisma plantago (Water Plantain) transverse section	Mr. Priest.
Section of Granite from Guernsey	Mr. W. S. Smith.
Young Asterias	Mr. T. C. White.

Attendance—Members, 50; Visitors, 4; Total, 54.

ANNUAL MEETING.—July 28th, 1876.

Dr. J. Matthews, F.R.M.S., *President, in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The President then formally declared it to be the annual meeting, and proceeded to the election of officers for the ensuing year. Mr. Reeves was appointed scrutineer on behalf of the Committee, and Mr. Topping on behalf of the Members.

The Secretary read the Annual Report of the Committee, and also the Treasurer's Annual Statement of Accounts.

The following resolution was moved by the President, seconded by Dr. Gray, and carried unanimously, "That the reports which have just been read be received and adopted, and that they be printed and circulated in the usual way."

The President said he had next a very pleasing duty to perform in making the awards of the Committee from the munificent donation of Mr. Frank Crisp. They would no doubt remember that when this fund was first placed at their disposal, the Committee gave their careful attention to the best means of applying it, so as to further the object for which it had been given, and that they had drawn up a series of rules for their guidance in the matter. In accordance with the spirit of these rules, the Committee, whilst carefully avoiding anything like the stimulation of any special work which might be the means of drawing members away from their own more useful studies, or of creating a spirit of rivalry, had been watching silently the work which had been going on in the club and had found it to be satisfactory. But whilst many had been doing good work, there were some who had been more prominently distinguished than others, and the Committee had selected three members as being specially deserving of honourable distinction, namely, Mr. Cole, Mr. Hammond, and Mr. R. P. Williams. The paper of Mr. Cole "On *Sphærularia Bombi*," was not perhaps a matter of original research; but to examine and to verify, if possible, the work of those who have gone before, was work of the highest value, and a man who could do this was capable of embarking in original research. The painstaking paper of Mr. Hammond, "On a comparison between the Metamorphoses of the Crane-fly and the Blow-fly," was one which entitled the author to special distinction. Few persons knew how arduous a thing it was to engage in constant and continuous observation of living objects, and the labour and painstaking of Mr. Hammond in this respect were beyond all praise. Then, again, as Microscopists, they were not all gifted in the same way—some were skilful manipulators, others were glad to avail themselves of mechanical aids, and to these last the section-cutting machine was an important and valuable addition; its parts might have been known before, but it was in the combination of these parts, and in the perfection of the way in which it was done, that the merit of Mr. Williams was displayed.

He had, therefore, very great pleasure, in the name of the Committee of the Quekett Microscopical Club, in presenting to those gentlemen the articles which they had selected, the cost of which had been defrayed from the sum placed at their disposal through the munificence of Mr. Crisp.

The President then formally presented to Mr. Cole two objectives, by Mr. Swift; to Mr. Hammond, a selection of books on Entomology; and to Mr. R. P. Williams, a lantern for the exhibition and class demonstration of microscopical preparations.

The President then read the Annual Address, which was listened to with the greatest interest, and concluded amidst prolonged applause.

Dr. Gray had much pleasure in proposing a vote of thanks to the President, for his admirable address, and moved that it be printed and circulated with the report in the usual way.

Dr. Foulerton seconded the proposal, and expressed his sense of the value of the President's remarks, and the pleasure with which he felt they would be read by the members generally.

The motion having been put to the meeting by the Secretary, was carried unanimously.

The Scrutineers having examined the papers, handed in the result to the President, who declared the following gentlemen to be elected as Officers and Committee for the ensuing year :—As President—Mr. Henry Lee, F.L.S. F.G.S., &c.; as Vice-Presidents—Mr. H. F. Hailes, Dr. Matthews, F.R.M.S., Mr. J. G. Waller, Mr. T. C. White, M.R.C.S., &c.; as Members of the Committee in the place of the four rétiring members—Mr. F. W. Andrew, Mr. A. Cottam, F.R.A.S., Mr. C. G. Dunning, Mr. J. W. Goodinge, F.R.G.S., &c.

Mr. Henry Lee said he rose to make a few remarks. A pleasing duty had been assigned to him. It was always a satisfaction to good men to give thanks for good service, and it was with much pleasure that he availed himself of the opportunity of moving a vote of thanks to the Officers of the Club for their services during the past year. He need not say much as to the way in which their President had performed his duties—of that they were all well aware. For himself he could only say that when first he saw Dr. Matthews he felt at once that he should like to make him a friend, and he now desired in the name of the Club to thank him for the able manner in which he had fulfilled the duties of his office, and also for his very able address, which contained much that was worthy of the careful consideration of them all. In a humourous and effective speech, Mr. Lee then proceeded to refer to the respective services rendered to the Club by their Treasurer, Secretary, Foreign Secretary, Librarian, Curators and Reporter, and included their names in the terms of the resolution which he had risen to move.

The resolution having been duly seconded, and put to the meeting, was carried by acclamation.

The President, in the name of the Officers of the Club, returned thanks to Mr. Lee, and to the Members for the way in which the vote of thanks had been proposed and carried, and added his own testimony as to the efficient manner in which the work had been carried on.

A vote of thanks to the Auditors was then moved by Mr. Curties, seconded by Mr. Moginie, and carried unanimously.

The President moved a vote of thanks, on behalf of the Club, to the donors of the numerous serial publications which had been contributed during the past year, and which he regarded as of great value, not simply from a money view, but because it placed these useful productions within their easy reach, and because it showed an amount of sympathy with them in their work which they could not fail to appreciate. The vote was unanimously carried.

A vote of thanks to the Scrutineers was moved by Mr. Waller, seconded by Mr. Sigsworth, and carried unanimously.

The President said that one other duty devolved upon him, and upon the members. They enjoyed the great privilege of meeting in that noble hall, and by the great courtesy and kindness of the Council of University College, it was placed at their service free of expense for rental. It was obvious that this saved them a considerable sum, but far more than this they appreciated the liberal spirit in which this great advantage was afforded, as a mark of true sympathy with their work, and with the general progress of scientific research. He therefore called upon the meeting to show its sense of the value of this privilege, by passing a hearty vote of thanks to the Council of the College for past favours, and also for the permission again accorded to them of holding their meetings there during the ensuing year.

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

The President said it now only remained for him to introduce to them his successor, and, vacating the chair, he formally installed the newly-elected President—

Mr. Henry Lee, who, on taking the chair, was received with great applause, said he could not allow that occasion to pass without saying a few words of thanks to Dr. Matthews, and to the members, for the kind welcome which they had given him on the occasion of taking his seat amongst them for the first time as their President. He accepted the position with a profound sense of the responsibility attached to it, and this caused him to ask for time for consideration before he acceded to their invitation, and in doing so he highly appreciated the honour which had been conferred upon him. He accepted the position without any desire or intention to signalize his period of office by the introduction of any startling changes or innovations, but, on the contrary, with a firm and earnest desire to support the intentions of the Club's original founders, and to emulate the worthy example of his predecessors. He looked upon the Club as consisting of a number of men brought together from sympathy with a common object, to pursue that object in a spirit of social intercourse, to enjoy the society of those who hàd similar tastes, and to carry out their object together, as companions in social life as well as fellow-workers. Nor must they forget that they were a body of workers, and whilst it was their pride and privilege to consider their Society always as a *club*, it was also ever to be borne in mind that it was a club of workers; therefore though it would be always his endeavour to encourage and to preserve the social spirit amongst them, he should especially feel that his best energies should be brought to bear upon the still more important encouragement of good and useful work. It did not, however, become him, as one putting the armour on, to boast as one who was putting it off, but he looked to the future to show them that as he should ever be desirous of promoting their welfare as the friend of all true advancement amongst them, so they would never find him to be a partizan of any clique or section. Those amongst them who knew what his work had been for nearly seven years as president of the Croydon Microscopical Club knew how, during the whole of that period, there had not been one single disagreement or unpleasantness in that Club; and in his association with the Quekett Club, he looked forward without any doubts to a period of equal harmony, and hoped for much of that pleasant intercourse of which they had been so feelingly reminded on that occasion. Those of the members who knew how hard he worked some years ago to bring about a reciprocity of good feeling with the Royal Microscopical Society, when the first coolness arose between that Society and the Quekett Club, well know how strong was his desire to break down all jealousies, and to see the harmony exist between them and other kindred Societies, which tended so much to the happiness and benefit of all.

The business of the Ordinary Meeting was then proceeded with.

The following Donations to the Club were announced:—

"Science Gossip"	from the Publisher.
"The Popular Science Review"	" "
"The Monthly Microscopical Journal"	" "
"Proceedings of the Natural History Society of Glasgow"	" the Society.
"The Medical Examiner" (weekly)	" the Publisher.
Six Slides of Wood Sections	" Mr. Sigsworth.
19 " various objects	" Mr. W. K. Bridgman.
"The American Naturalist"	in exchange.
"The Quarterly Journal of Microscopical Science"	by purchase.

Photographs of Mr. J. Davis and Mr. R. P. Williams were also presented for the Album.

The thanks of the Club were unanimously voted to the donors.

Mr. Henry Barnard and Mr. Edward Halford were balloted for, and duly elected Members of the Club.

The Secretary exhibited and described a new form of quadruple nose-piece, made by Mr. Swift.

Mr. Curties said he should be glad to hear Mr. Ingpen's objections to the use of nose-pieces.

Mr. Ingpen said he considered nose-pieces the opticians' best friends, and thought that there were probably more objectives damaged by them than by any other cause. He also thought that the use of nose-pieces and all similar apparatus tended greatly to encourage an amount of fussiness which was against good steady quiet work. It was generally the tyro who got hold of these things, and the exhibition of objects under the rapid changes of power and illumination had often the character of a pantomime trick.

Mr. Curties said that the greatest objection to this class of nose-piece was its weight; but he understood from Mr. Ingpen that in the form he had described, the weight was much lessened.

Mr. Hainworth thought the objection was not so much against the weight of the nose-piece itself, as the weight of the objectives which it carried.

Mr. Ingpen said of course if there were heavy objectives screwed into it, the weight would take the centering out of any slow motion.

Dr. Matthews thought the chief value of such a piece of apparatus was to use it first as a finder, with as low a power as possible, and then to pass on to higher ones—in such cases its use was invaluable.

Mr. Hainworth considered that it was also of great use in comparing two objectives by different makers.

Announcements of meetings and excursions were then made, and the proceedings terminated with a converzatione, at which the following objects were exhibited :—

Transverse section of Yew	by Mr. A. H. Halley.
Sphoerosira volvox (alive)	,, Mr. Martinelli.

Attendance—Members, 71; Visitors, 8.—Total, 79.

August 11th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Bowerbankia and *Campanularia*, from Ilfracombe (alive)	Mr. W. G. Cocks.
Stylops Spencii (male) emerging from the body of a wild bee	Mr. F. Enock.
Vertical section of Rhinoceros Horn (polarized)	Mr. A. H. Halley.
Flints containing pyritized structures ...	Mr. M. H. Johnson.
Sections of Norway Birch, *Betula alba* ...	Mr. Sigsworth.
Sertularia Bryonia	Mr. S. Turner.

Attendance—Members, 34; Visitors, 6.—Total, 40.

On a New Anti-vibration Turntray.

By W. K. Bridgman, L.D.S.

(Read September 22nd, 1876.)

Plate XIX. (Upper Part).

The immense superiority in the performance of an object-glass under the entire absence of tremor is such as to render its practical attainment a very great desideratum. That this was fully recognised by the late Andrew Ross is sufficiently evidenced by his endeavouring to obtain immunity from it by supporting the feet of his instrument upon a combination of felt pads and springs, which, however, was abandoned as insufficient, simply because it was incorrect in principle. It is a law in nature, that working power is not derived from any one force alone, but it is *the sum of the difference between two opposing* forces, the preponderance of either constituting the amount of the potentiality in store. Hence, if a board be supported upon four bent springs, one at each corner, as shown in section at Fig. 1, these, when weighted, will tend to become straightened, and thus shift their points of contact with the support, the friction of which would cause vibration, which would be communicated to the board; but if these four springs be made to rest upon four other similar springs *in an inverted position*—as in Fig. 2—so as to oppose two forces in contrary directions, all vibration imparted to the lower springs will be taken up and neutralised or destroyed by the upper ones, and leave the top board comparatively at rest.

Now, as vulcanised india-rubber is often an efficient substitute for steel springs, it has been had recourse to in the present instance with a fair amount of success. Two boards about three-eighths of an inch thick, and sixteen inches long by ten inches wide, are notched at the corners—as shown in Fig. 3, *a a*—so as to admit of a small sewing-machine thick india-rubber ring being stretched over them, as seen in Fig. 4. The boards are then stretched apart, and four other rings are compressed in edgeways, as at *b*. There will then be the tension of the one set of rings opposed to the expansion of the others, and the vibrations of the one will be counteracted by the other. To obtain greater stiffness, four other *pairs* of rings—one within the other, forming a cross and expanding in opposite directions—are inserted midway at the ends and sides, as at *c*, *c.*; while to prevent flexure and warping, four pieces of thin board are glued across the inner sides so as to fit alternately without touching—as shown in Fig. 4—an edge view of the two when put together, 1 and 1 being on one board and 2 and 2 on the other.

Although this arrangement has been found perfectly successful against the upward tremor arising from street traffic and the passing of vehicles, it is not proof against the swinging motion of an elastic floor, without having a corresponding arrangement applied to the edges in addition. To accomplish this, it only requires to have a ledge attached to the two sides of the lower board, rising up to the level of the upper surface, and having indentations to receive the compressed rings *b*, *b*. Fig. 5, which prevent the boards touching each other. In order to avoid the corner rings being too much stretched *when not in use*, it is desirable to have the boards kept together by a hook and pin at the four points, two of which are seen at *e*, *e*., Fig. 84, but which must be turned quite clear of the upper board when being used. By covering the lower side with thick baize or cloth, it will be found to slide freely on a polished table without scratching, and by supporting both light and instrument, the whole may be passed from one observer to another as a "turntray," without having to rise from the seat, which is a great comfort to all concerned.

Description of Plate XIX. (Upper Part).

Fig. 1. Section of board on four springs as not checking vibration.

„ 2. Ditto, showing Fig. 1 inverted upon a second similar set of springs so that the vibrations of one are counteracted by the elasticity of the other.

„ 3. Inside arrangement of two boards separated by india-rubber rings.

„ 4. Side view of Fig. 3, when the two boards are put together.

„ 5. Front view, showing the tension rings upon the corners, and the side springs to counteract *lateral* motion.

On Empusa Muscæ.

By T. Charters White, M.R.C.S., &c.

(*Read October 27th*, 1876.)

About this time of the year the observer may notice flies, apparently alive, attached to the walls, doors, or window-panes, and upon attempting to capture them he will be astonished at the carelessness as to the result displayed by the intended victim, but his astonishment is not the less great when, upon examination, he finds the fly dead and dry, with every abdominal ring distended, and stretched apart from its neighbour, yet simulating in its dead body every attitude of its living state. Such a fly is the subject of an interesting disease, which I have endeavoured to illustrate this evening by a slide under my microscope. My bibliographical knowledge is not extensive, but a careful search through several volumes of the Microscopical Journals has served to show me that this subject has not been brought under the notice of microscopists since the year 1857, when it was noticed in a review of a paper by Cohn, in the fifth volume of the "Quarterly Journal of Microscopical Science." As 20 years have elapsed since the publication of that review, I may be permitted, for the benefit of our younger members, to call their attention to one or two facts in reference to this diseased condition of the House Fly, that may afford some interest to them, should they feel disposed to carry on observations for themselves.

It appears that the disease was first observed by De Geer, in 1782, and was also noticed by the acute naturalist and poet, Goëthe; and accurate observations were made on it in 1827, by Nees von Essenbach; but in 1835, from the careful investigations of M. Duméril, he was enabled to pronounce it a true fungus, allied to the "muscardine" infesting the silkworm. In 1841 Mr Berkeley determined the mould to be *Sporendonema muscæ*, but Cohn named it *Empusa muscæ*.

The characteristic appearance of a fly affected with this disease is best detected when the fly, in its last moments, settles on a window; it then may be recognised by a zone of white deposit surrounding the fly like a halo—the fly maintains its living attitude, and will be found attached solely by the lips of its proboscis. Its legs are not crossed under it as is the case with all dead insects, but distended, as in the live state. Examining the fly now externally, you will find the hairs covered with minute white globules. These are the spores of the fungus, and are scattered also round the fly for some distance, in a very curious manner: in some cases almost as if they had been squirted out of regular points of the body. The abdominal rings are separated by about their own breadth from each other, while they seem bursting from over-distension. The thorax and head do not seem so much affected as the abdomen. On opening the fly in a little glycerine and water, the cause of this over-distension is soon discovered by the appearance of a dense mass of mycelium threads, that emerge as soon as an opening is made in the abdomen. It is not an easy thing to make a tidy dissection of a fly in this state, for it becomes so dry and brittle under the influence of this disease, that it breaks up on the slightest force being applied. A small portion that I was enabled to procure I have stained with carmine, and placed under my microscope for inspection this evening.

With these few particulars relative to the external appearances presented in these diseases, it will, perhaps, be as well to enquire into the origin of it, and here in the absence of all particulars relative to the life history of the fungus, we are placed face to face with a difficulty that needs to be overcome by further investigation. We are aware that fungoid diseases manifestly affect many insects, as instanced in the muscardine, so fatal to silkworms. The *Botrytis bassiana*, principally concerned in the production of this disease, is supposed to enter through the breathing pores, the sporules being drawn into the tracheal tubes of the silkworm, where they develop so rapidly that the tubes become blocked up; now, in the fly, the tracheal tubes seem remarkably free, and the disease seems to attack only the soft tissues, which have become entirely consumed by the growth of the fungus.

Dr. Carpenter mentions the fact that it is not at all uncommon in the West Indies to see a species of *Polistes* (the representative of the wasp in our own country) flying about with fungoid plants of their own length projecting from some part of their body, their roots having a firm hold of the soft structures within; and in his work, "The Microscope and its Revelations," he mentions several other instances of vegetable fungi investing insects, but he does not attempt to account for its origin.

The disease manifests itself first in the fly being stupid and "groggy," sluggish in its movements, and pertinacious in its visits to one spot. If at this time the fly be examined, a great number of minute free-cells may be detected, in what answers the purpose o blood in these creatures, and the fly settles down to its last resting place, which is generally some warm spot indoors. I have never yet found many out of doors. Under the influence of warmth, and probably the moisture derived from the soft tissues of the body, the fungus grows apace, till it consumes, not only the life of the fly, but all its tissues, excepting the tracheal system and the chitinous parts. It is not every fly that perishes this way, but only some, and that would seem to argue the existence of a predisposition to this disease. It seems to affect the house fly, "*Musca domestica*," and not the blow fly, "*Musca vomitoria*." It does not appear from the few observations that I have been able to make, that the disease is contagious, as I have confined healthy specimens of the house fly with plenty of fresh air, with some of the dead flies covered with the spores of *Empusa muscæ*, and although they have died from the confinement, they have not had a particle of the fungus within their bodies, so that we have yet to know more of the life history of this *Empusa*, and, as at this season of the year many infected flies can be obtained, I thought it might be of service if I called attention to the subject this evening for a few minutes, as an accompaniment to my slide.

On a New Universal Reflecting Illuminator.

By W. K. Bridgman, L.D.S.

(Read October 27th, 1876.)

Plate XIX. (Lower Part).

Having for several years past been endeavouring to obtain a controlling command over the obliquity of an illuminating pencil of light by means of a metallic speculum, placed between the condenser and the object, I was altogether unsuccessful until the advent of the "Bramhall" reflector, which, by suggesting the substitution of a small bull's-eye lens in the place of the ordinary hemispherical condenser, gave a new turn to the direction of the investigation, which has resulted in a complete success.

The Bramhall arrangement consists of a reflecting surface placed beneath and within a very short distance of the object; whilst the light, being thrown down as for an opaque substance, first passes through the glass slip, and is then reflected upwards, so as to produce a transparent illumination of great obliquity. There are, however, several very important drawbacks in addition to the difficulty of adjustment, and the very limited range of action, which restricts its use to a comparatively small class of objects, and of these, to only a small proportion of such as are mounted in the ordinary way; yet, all who have once seen the marvellous sharpness and force with which the most difficult *diatom* tests can be displayed, must be quite ready to admit *the principle* to be very far in advance of all other modes of illumination, making it highly desirable that it should form the basis of some other special arrangement, that would not only be equally effective, but be easily managed, and free from its other objections, at the same time extending *alike superiority of effect to all other classes of objects*, and equally applicable under all the common conditions of ordinary mountings—properties that are now claimed for the present arrangement.

In the illumination of a transparent object there are two considerations requiring attention; first of all, the light should be composed of certain definite parts of the spectrum, and consist of rays approaching somewhat to parallelism, or be in one plane, and not convergent upon the object from all points of a circle ; next, it is indispensable that the light should impinge upon the object at that particular angle which serves best to bring out its minutest detail with the greatest sharpness.

With perfectly transparent material, such as the siliceous frustule of a diatom, it is only at some particular angle, to be found by experience and patience, that the so-called markings are displayed. Now, with a flint-glass prism, light undergoes total reflection from its interior at an angle of 41° 48″, and, therefore, with the flint frustule of the diatom, its net-like structure causes it to present surfaces at the angle producing this total reflection, and hence, where the light is stopped, the lines, bars, or dots appear dark, or as shadows by contrast with those parts through which the light is transmitted. When the light is, however, merely refracted unequally by inequality of thickness, or by varied direction of surface, the lines, dots, or shadows are only faint or dark in proportion to the amount of refraction produced, but not sharp and deep like those arising from total reflection ; and hence arises the extreme nicety of adjustment necessary to "hit off" the exact position of the frustule and the precise direction of the light required to obtain the greatest effect. From this will be understood the necessity of stopping out all cross rays, or rays coming in opposite directions, and which principle applies equally to every description of transparent material.

With the prism, or with the concave mirror, we can obtain a degree of obliquity only up to a certain point, when it becomes restricted by the thickness of the stage ; but if we direct a cone of rays from a small condensing lens, placed in the position shown at L, in Fig. 1, so as to throw its focus beyond the centre and to the point A, and then interpose a small metallic speculum S vertical to the plane of the stage, the intercepted portion of the light will hence be reflected back to a focus at B—a point in front of the reflector equidistant with the point A beyond it, and it will thus be made to reach the object irrespective of any amount of stage-thickness. It will now be seen by the different positions of the reflector S′ S″ S‴, in Fig. 2, that to obtain light at any particular angle from its greatest possible obliquity down to direct rays, it will only require a very slight alteration in the position and the angle of the reflector, and needing little or no interference with either the lens or the lamp, while the latter may be placed at its ordinary level, and in front of the instrument, and thus be altogether out of the way of the hands and face.

In reducing these views to a practical form, the following arrangement has been found to answer the purpose very efficiently. In my own instrument, to which it has been adapted, the stage is rectangular, and the frame (F), figs. 4 and 5, slides in beneath it. To the under side of this frame the brass plate (C) is firmly screwed at right angles and parallel with its length, and upon this, which is an inch and a half square and a quarter of an inch thick, the reflector-carrier (Fig. 6) is held by the bar and spring (I and H), allowing it to be moved about by the finger and thumb applied at the ends of the tube (J), as shown in Fig. 4; after which, and when adjusted, it may be fixed by the tightening screw (K), so as to be immovable from its position.

Now if the cone of rays be made to fall upon *the centre* of the speculum, it will be reflected in a *converging circle* still; but let it be directed *upon the lower edge* instead, and it will then become bisected, and only a plano-convex section will pass upwards, so that by this means we shall get rid of a large proportion of the conflicting rays. Then, again, if a horizontal shutter or diaphragm (D) be placed in front of the speculum, as in Fig. 3, the opposite convex portion of the cone will likewise be got rid of, and we shall then retain only a narrow strip or ribbon of light converging in a fan-shape almost in the same plane, which, for an illuminating pencil, will be a very near approach to perfection. But as some objects absorb a much larger proportion of light than others, the shutter or diaphragm requires to be made adjustable for distance from the speculum, in order to regulate the consequent width of the slit admitting the light, and therefore it has, as the simplest means of effecting that object, been made to turn upon a pivot, as at (C), Fig. 3, and which is worked by the milled head, (N), Figs. 4, 5, and 6.

In order, also, to facilitate the adjustment of the speculum for its angular position, it has been attached by a hinge at its back (Fig. 3), and through the intervention of the tail-piece, (P), and the bent lever acting thereon, it admits of being regulated by the screw and milled head, (M), and which serves, in addition, to regulate the light during observation.

In commencing to observe a lined or dotted object requiring extreme obliquity of the light, let the reflector be placed as far back as possible, or from an inch to an inch and a quarter or more, according to the power to be used, so as to produce a dark-ground illumination, (to effect this every different object-glass will require a different angle, according to its angular aperture and its working distance from the object,) and when this has been obtained, let the speculum be gradually advanced until the markings become sufficiently distinct, when the light may be finally adjusted for intensity, &c. Should the preparation, however, be one only requiring a moderate degree of obliquity, such as, for instance, injections, or parts of insects, or similar objects, let the frame (F) be drawn forward, until the slit shall be nearly in a line with the optical axis, when the reflector may be inclined, as in Fig. 3, and then be moved back until a satisfactory effect shall have been produced. It may be observed that, with preparations that are *translucent* rather than transparent, the light may be thrown at such an angle as to be reflected down upon the object from the under side of the glass cover, and thus, by the combination of transmitted and reflected rays, render its detail remarkably clear and distinct. The bull's-eye lens, which is an inch and a half in diameter, and about two inches focus, requires to be attached below the stage in a corresponding position to that which it usually occupies above, only, in this case, each joint needs to have a tightening screw to prevent its settling down by its own weight.

There are some objects, however, that are best seen under an illumination intermediate between a dark ground and a bright field, and which will be easily found by advancing or receding the reflector. With the low powers and with daylight the concave mirror may be used by placing it centrally and inclining the reflector in a slight degree *forwards*, and moving it until the whole of the field shall have become illuminated. Where stereoscopic effect is desired, it will be found to be very materially affected by the inclination of the light, and when this has been arranged at its best, it will be found to contrast highly favourably against the ordinary modes of illumination.

If the reflector be made of *very white* silver, or speculum metal, it will afford a light of extreme brilliancy; but this dazzling *whiteness* is highly objectionable for two very important reasons; in the first place, under it, objects are *not* seen best, and next, it is extremely trying and injurious to the eyesight. The *tint* of the light is of much greater consequence than is commonly supposed, both as regards the distinctness with which minute detail can be made out, and also for the comfort and safety of the observer. It is well known that the yellow light of an inferior flame is very fatiguing, and hence it is often corrected by blue glass; but although right in principle, it is mostly a failure through being over-done with the blue, producing the cold indistinctness of moonlight, but which has also against it other serious objections. Under the actinism of the blue ray seeds germinate in a much shorter time than their natural period; but they speedily die a premature death from being unable to grow under its effects. Plants similarly circumstanced produce neither leaves nor flowers, for want of the yellow or luminous rays which effect the elimination of their sap. The chemical action is unbalanced, and is all one way—that is, it is *unipolar*, and the chemical life of the plant differs but little from the chemical life of the eye, and hence, under bright blue glass spectacles, the frequent cases of inflammation are readily accounted for. But whilst the blue rays are thus detrimental from their powerful chemical effects, the next colour in the spectrum—the yellow—is equally remarkable for their absence, and it is this absence which allows the photographer to manipulate his chemicals, unaffected, under its influence. Now if we arrange a micropolariscope and a revolving selenite so that we can get a succession of tints from the green to the yellow, we shall find that as the blue rays of the green decrease in quantity, and are ultimately lost in the yellow, there is one particular point at which neither the green nor the yellow is clearly appreciable, but that a soft neutral tint only appears, and any delicate test being submitted to this light, it will be found to be clearly discernible without effort and without glare. By this admix ture of the two opposite conditions, the actinic and luminous rays, we produce a perfectly balanced light, which is in every way all that can be desired.

If pure gold be alloyed with about a fifth part of its weight of silver, it then forms the *green* gold of the jeweller, but if to some of the silver of commerce be added a small proportion of gold, it will form a tolerably hard alloy, capable of taking a high polish, and giving a beautifully soft and mellow light of the desired quality.

Appendix.—As it is an essential point to have a *well-defining* polish upon the speculum, it may not be out of place to offer a suggestion as to how this can most readily be obtained. My experience was gained nearly half a century back in polishing the specula for a Newtonian telescope ; but I am not aware that any better method has since been devised, and, therefore, as this has fully answered the purpose, is very simple and easily put in practice, it may be followed with advantage. Having obtained the silver plate, and had it soft-soldered to a brass back and cut to the size, let a piece of sealing-wax or a small block of thick plate glass be attached to its back as a handle and to prevent flexure. Now procure a common writing-slate with a flat and smooth surface, and grind the silver with water until all scratches have disappeared, and a level face has been produced. If the surface be now well burnished with a straight burnisher it will add greatly to the brilliancy and durability of the polish. Next, take two pieces of thick plate glass, not less than three or four inches square, and upon the surface of one melt some pieces of clean pitch until soft enough to be spread evenly with a hot knife to about the thickness of a sixpence. Let the surface of the other glass be smeared with soap and water, and then pressed upon the soft pitch until the latter shall have acquired a flat and highly polished surface, when it may be *slid off*, and the pitch left to harden.

Obtain at the chemist's a pennyworth of "precipitated carbonate of iron" (the softest and finest "rouge" possible), and mix with a few drops of water to the consistence of cream, and let the metal be lightly worked with this over all parts of the pitch in small circles, carefully avoiding all dirt or grit until the polish, commencing in the centre, shall have spread to the edges, and having a deep and brilliant lustre that will reflect objects with the utmost sharpness of definition. Any future "refreshing" will be best done with the tip of the finger, slightly breathed upon and then dipped in the dry powder, and, very gently, with a small circular motion, the whole surface gone over by degrees from one side to the other.

Description of Plate XIX. (Lower Part).

Fig. 1. A side view of lamp, lens, and reflector, deflecting the light from A to B.

,, 2. Indicates the different positions of reflector required for obtaining different angles of illumination.

Fig. 3. Vertical section of reflector, with its directing tailpiece (P) for altering its angle, and its movable shutter or diaphragm (D) for regulating the quantity of light and restricting the admitted portion to a vertical section through the diameter of the cone of rays.

,, 4. Inside view of arrangement for carrying the reflector and its diaphragm. (F) and (G), a frame of brass attached to the instrument, and upon which Fig. 6 is held by the bar (I) and spring (H), and adjustable by the finger and thumb applied to the tube (J).

,, 5. Outside view of Fig. 6 in position upon the frame and set fast upon (G) by the screw (K).

,, 6. The speculum carrier, (S), speculum, (D), diaphragm or shutter attached to the bent arm, (E), and adjusted by the screw, (N); (M), milled head to the screw and bent lever acting upon the reflector, (S).

On the Relation of Sphærosira volvox to Volvox globator.

By W. H. Gilburt.

(*Read October 27th*, 1876.)

Plate XX.

The relationship of many of the lower forms of minute life, both among plants and animals, is a fact which year by year is becoming more and more apparent, so that many which were once considered good species are now regarded as but stages in the life-history of other and more or less different forms.

Such, without doubt, proves to be the case with the two organisms, the names of which head this paper.

It appears that Ehrenberg was the first to observe *Sphærosira volvox*, and by him it was classed as a distinct species from the better known *Volvox globator*. As such it was regarded till 1852, when Mr. Busk cast some doubt upon it, and suggested that it was but a stage in the development of the commoner form, his reason being that in water containing *Volvox globator* no *Sphærosira* was at first to be found; yet after a few days they were there in abundance. He likewise carefully examined and described the doubtful species, but of the connection of the two forms nothing further appears to have been ascertained up to the present.

Fortunately we are now able to carry our knowledge one step further at least, and to show that what has hitherto rested upon supposition was really in accordance with fact.

On Saturday, the 21st inst., I obtained some water from a pond in Epping Forest, near Walthamstow, containing *Volvox globator* in great numbers. On first looking at them, nothing particular was observed, save that many were decaying, and were occupied by one or more rotifers and their eggs. Making a more careful examination, I found that in some of the vigorous and more active ones, a difference between the macro-gonidia existed—some of them being smaller in size, lighter in colour, and the disposition of their gonidia less regular (Fig. 1*a*). Using a higher power, the difference became more marked, and under a power of 350 diameters those which departed from the supposed normal character appeared as in Fig. 2, viz., a sphere as an ordinary *Volvox*, but that some of the gonidia were missing, and their places occupied by compound bodies, as at Fig. 2*b*—in this and every other respect agreeing with the figures of *Sphærosira* as given both by Ehrenberg and Busk.

Submitting them to pressure so as to rupture the cell wall, I found that the compound bodies referred to escaped; and then appeared as at Figs. 3 and 4—Fig. 3 being a front view and 4 one in profile, as seen under a power of 600 diameters. They are discoid in form, and composed of about thirty cells, flask-shaped—as Fig. 5—having a nucleus, being attached to each other by the smaller end, and furnished with abundant vibratile cilia, which can be seen in both aspects as figured. The action of the cilia imparts a slow, revolving, wheel-like motion to the group, but with very little progression. This motion can sometimes be seen while they are still within the containing sphere. In a single *Sphærosira* as many as 55 of these compound bodies have been found.

One most remarkable feature is, that while the *Volvox globator* may contain from two to seven macro-gonidia, yet in only two instances have I found more than one *Sphærosira* among them; though a very large number have been examined for this special purpose.

Another circumstance to be taken notice of is, that where a *Sphærosira* is found, although the appearance of the other macro-gonida is of the normal character outwardly, yet still a difference exists; for attached to the interior of the cell-wall are certain bodies, represented in Figs. 6 and 7—Fig. 6 showing one *in situ*, and Fig. 7 one under pressure, and magnified 600 diameters. They appear to consist of a roughly spherical mass of protoplasm, pale-green in colour, but unevenly tinted, with darker spots, having well-marked nuclei or vacuoles. These seem to me to be very unusual in character, and, taken with the *Sphærosira* which we have found occupying the same mother-cell, appear to suggest a relationship between them—possibly sexual.

Note.—Since reading the foregoing paper at the October meeting I have found the compound bodies free in the water. They have then a vigorous oscillating motion, turning so as to show in profile at each limit of its swing.

On "The Blyborough Tick."

(Argas Fischerii).

By C. F. George, M.R.C.S.

Communicated by Mr. T. Curties.

(*Read November 24th,* 1876.)

Plates XXI., XXII.

The Village Church of Blyborough, which is situated about three miles from my residence, requiring extensive repairs, it was considered necessary to pull down the greater part of the building, and when removing the roof, a large number of creatures were disturbed, which were at first taken to be bugs. By accident I heard of this circumstance, and it at once occurred to me that these supposed bugs might possibly be *Argas reflexus.* As I had a great desire to add this Arachnid to my collection of microscopic objects, I obtained a few specimens, which, on examination, proved indeed to belong to the genus *Argas,* but differed exceedingly from the descriptions of *Argas reflexus* that I had met with.

I therefore sent a living specimen to Mr. Fullagar, of Canterbury, who exhibited it on Sept. 6th, to the East Kent Natural History Society, where the creature was considered to be a young *Argas reflexus* ; its difference of size, colour, and shape were thought to be explained by its being young ; growth was considered to be sufficient to change these particulars.

Mr. Fullagar kindly sent me two specimens of *Argas reflexus* from Canterbury Cathedral ; these were the first I had seen, and a very casual examination sufficed to convince me that they were different varieties. My friend Mr. Curties took a mounted specimen to the British Museum : a similar specimen was found there, *unnamed,* said to be from the bat, and Mr. F. Smith considered *Argas reflexus* to be the *Argas* of the pigeon, and the *Argas* now under consideration to be the *Argas* of the bat.

He also states that Walckenaer describes one as nearly as possible like that in question, under the name of *Argas Fischerii.* Unfortunately, I have at present no means of consulting that work.

In Cuvier's "Arachnidæ," published in 1833, with supplementary additions by Griffiths and Pigeon, it states that *Argas Perricus*, described by travellers, under the name of the venomous bug of Miana, has been, as well as other *Ixodes*, the object of a curious notice by M. Fischer, and also gives a drawing of *Argas pipistrella*, somewhat resembling the Arachnid now under consideration, but varying in important particulars.

If it should prove that this *Argas* has not previously been described, and is *not Argas Fischerii*, I should propose for it the name of *Argas pulchella*, as it forms a very beautiful object for the lower powers of the microscope, alive or dead—dry, or in balsam.

It is almost circular in figure, having a slight projection anteriorly; it varies greatly in size, fine specimens measuring about three-twelfths of an inch in diameter. The upper surface is somewhat convex, and the edges slightly turn upwards; it is much darker in colour in the centre than at the edges, which are of a rich cinnamon. Under the microscope, and by transmitted light, the abdomen is seen to be filled with cæca, elegantly arranged, and separated from each other by circular cells, which, from their transparancy, contrast beautifully with the dark contents of the cæca.

When the animal is alive, a sort of peristaltic motion may be observed, occurring irregularly in various parts of the cæca; the action reminds one somewhat of the way in which the contractile vesicles of the Infusoria disappear.

The legs are eight in number, each terminated with a double claw, at the base of which is a pad, and it is very curious to watch the manner of using the claws and pad. If the creature is laid on its back, and a piece of thin glass placed on it, with sufficient pressure to prevent progression, but slight enough to allow it to make efforts to walk, it will be seen that the claws are widely separated, and the pad fits tightly on the glass, just as an india-rubber ball would do if pressed upon, the pad then slips on the glass, and when the leg has reached its limit of extension, the claws are suddenly brought together, forceps like, the pad in consequence becomes globular, and is thus released from the glass. I have watched the process for a considerable time, it is always repeated in the same fashion, and this seems to me to explain the manner in which some insects, with pads and claws, walk so well on perpendicular glass surfaces. The rostrum is inferior, and concealed beneath the projection of the anterior part of the body. The labium is slightly conical and barbed, the barbs having the appearance of scales attached by their anterior edge. The mandibles have the last joint short and denticulate, as in *Ixodes*. The "Micrographic Dictionary" says that *Argas* belongs to the family *Gamasea*, but the mandibles in *Gamasea* are beautifully chelate, like the claws of a lobster. The palpi, however, differ from those of *Ixodes*, and I therefore think that *Argas* ought to be considered to be a distinct family of the order *Argas*, rather than a genus of the family *Gamasea* or *Ixodea*. The spiracles are two in number, situated between the third and fourth legs.

The roof of the church was constructed about 300 years ago; it is of the style called Tudor, and formed chiefly of oak and elm, both English woods; it had, however, been patched in one or two places with pine. A good many bats were disturbed from their hiding places, making it much more probable that they introduced the Arachnid than that it came with the small quantity of pine entering into its formation. It would be very interesting to examine all old roofs that may chance to be taken to pieces, especially those of churches, and much valuable information might thus be collected.

Since writing the foregoing, I have (through the kindness of G. A. Luard, Esq., of Blyborough Hall) had the opportunity of seeing the "Apteres" of Walckenaer and Paul Gervais, where I found a very excellent drawing of both upper and under surfaces of *Argas Fischerii*, which quite convinces me that it is the Arachnid I have been describing—but all that is said of it in the letterpress is that the figures are copied from "Savigny's Egyptian Arachnida," Pl. ix., fig. 6.

DESCRIPTION OF PLATES XXI., XXII.

PLATE XXI.—Fig. 1. *Argas Fischerii*, upper side × 15, from a drawing by Mr. T. Ball.
Fig. 2. Palpi of do.
Fig. 3. Claws of second leg.

PLATE XXII.—Fig. 1. *Argas Fischerii*, upper side, from a drawing by Mr. J. Fullagar (from a living specimen).
Fig. 2. Diagram of the Cæca.

On Microscopy in the United States of America.

By Henry Crouch, F.R.M.S.

(*Read December 22nd*, 1876.)

It has been suggested to me by our Secretary that some account of the microscopes exhibited at the Centennial Exhibition lately held in Philadelphia, and also of the present condition of microscopy in the United States, would be of interest to our members; and although feeling rather diffident in offering my opinions upon the subject, from the fact of my being an exhibitor, perhaps I may be excused for doing so, in default of any remarks being offered by others better qualified, or having a more extended experience.

I propose, therefore, first to notice the instruments exhibited by makers of the different countries represented—premising that some well-known and respected makers, both American and European, were unfortunately absent—and then to ask your attention to any novelties in detail or construction that occur to me as worthy of remark, taking them in accordance with the respective value and importance of the various exhibits. The countries represented were England, America, France, Germany, and lastly Japan. With respect to those exhibited by English manufacturers, it will not be necessary for me to describe instruments so well known to you as those manufactured by Messrs. Beck, Dallmeyer, Ross, and myself, comprising the English exhibitors. It will be sufficient to observe that Messrs. Ross and Co. exhibited some twenty, Messrs. Beck about twelve, Messrs Dallmeyer two, and myself sixteen; including, with one exception, every form of stand manufactured in this country, and together being more than twice the number exhibited by all other countries included.

The American makers represented were Messrs. Zentmayer, J. W. Queen and Co., the Bausch and Lomb Optical Co. (with whom is associated Mr. Gundlach), and Mr. Wm. Wales, who exhibited a few objectives only. Messrs. Zentmayer exhibited some nine microscopes, Messrs. Queen and Co about six, and the Bausch and Lomb Optical Co. three or four, the latter having but just commenced the manufacture of this instrument.

Amongst the French exhibitors were Messrs. Nachet and Sons, who exhibited some five or six instruments. Those remaining need scarcely be specified individually, the microscopes shown being of that inferior class usually supplied to their unfortunate victims by those whom I may, perhaps, be permitted to term "Shopticians," and which, I am afraid, more often create a prejudice against, than a taste for, the prosecution of microscopic investigation.

The only microscopes of German manufacture that came under my notice were those shown by Ploessel, who exhibited a few on the ordinary Continental model.

While examining the wonderful exhibit made by Japan, I was fortunate enough to stumble over a microscope of veritable Japanese manufacture, which, however, had been damaged in transit. As a specimen of workmanship it could not be said to compare favourably with those shown elsewhere. This might possibly be due to the fact that the maker was especially unlucky in the pattern before him; evidently one of the most coarsely made and finished instruments of London manufacture. The optical portion of the instrument was, as could only be expected, of the most rudimentary character. An attempt had been made to imitate the construction of the eyepieces, and the objectives were roughly made single lenses. The maker, however, had very wisely only provided the fittings for the polariscope, the Nicol prisms being evidently too much for him.

After a careful examination, however, of the admirable educational system, some of the results of which were exhibited by the Japanese Government, there cannot be much doubt that the microscopes next placed on exhibition by Japan will be less open to criticism.

The point, however, which occurs to me as being of the most importance to note, is the direction in which the construction of the microscope is developing; whether, as we are sometimes told, very dogmatically, English microscopes are a mistake, binoculars being an especial delusion, and the Continental model that which is eventually to carry all before it. Well, comparing the respective exhibits, it is somewhat comforting to those who, like myself, have consistently held that the Jackson model and its developments are those which give the best results "all round," to find that the

English and American makers—who, I presume, like other manufacturers, make and sell what they find to be most in demand—have almost entirely adopted this form for all instruments to which accessory apparatus is required to be applied.

It is essential that this distinction should be noted, because, if you enquire of the enthusiastic supporter of the Continental model, you will find that he rarely, if ever—for his particular class of work—requires more than the most elementary form of stand, and he often knows absolutely nothing about the proper illumination of an object, the amount of dogmatism displayed being, as usual, in exact proportion to the observer's ignorance of the subject. He knows that to see something of a transparent object he must make use of the mirror, and that it is of advantage to apply a condenser when examining an opaque object. The polariscope is looked upon as altogether beneath notice, being only fit for the amusement of children. Dark ground illumination! Well, it does not do to profess absolute ignorance, but if you hand our observer a Wenham's paraboloid, and ask him to apply it, his helplessness is at once apparent.

Possibly you may think this an exaggeration, but I can only assure you that such cases have come under my notice again and again, one of the latest instances being that of an eminent German microscopist, who assisted in examining the microscopes on exhibition at Philadelphia, and who from the first loudly proclaimed the uselessness of binoculars, and the absurdities of English microscopes in general, but whom we afterwards found out had never used one, and who also had never heard of dark ground illumination. As the result, however, of his experience there, his views were considerably modified.

In comparing stands of American and English manufacture, there are one or two points of difference in general construction that are worth attention, the most noticeable, perhaps, being that in the American patterns the "limb" is generally supported upon a single pillar; whereas the English makers, with one exception, find the double uprights or pillars more often preferred. The stages of the American instruments are generally made of glass, and without concentric rotation or mechanical adjustments; whereas, as you are aware, the majority of English microscopes are now made with rotating stages, and a large proportion are also provided with mechanical adjustments. American makers have also generally adopted a mirror stem, hinged, so as to give a lateral movement to the entire fittings of the mirror, thus providing an extremely convenient method of obtaining an exceedingly oblique illuminating pencil.

Mr. Zentmayer and Mr. Gundlach also exhibited a substage arrangement, which was mounted in such a manner as to give a lateral movement to the entire substage and mirror, the advantage claimed being, that as the axis upon which it swings is so placed as to be as nearly as possible level with the upper surface of the slide upon which the object under examination is mounted, better results are obtained where an oblique illumination is required with an achromatic condenser. Messrs. Ross and Mr. Zentmayer both exhibited portable microscopes of extremely ingenious construction, but needing diagrams to render them intelligible. I may, perhaps, here be permitted to state that my own centering adjustments, with which my best stands are now provided, were claimed by two American manufacturers, but in both cases the claim was proved to be without foundation.

The accessory apparatus exhibited being of the usual character, and presenting nothing calling for especial remark, it is not necessary for me to occupy your time by giving any detailed account of it. I had, however, the pleasure of receiving many valuable hints respecting the improvement and modification of some of the accessories from Dr. Woodward of Washington, Dr. J. G. Hunt and Mr. Holman of Philadelphia, Dr. Ward of Troy, and other microscopists, which, when I have had an opportunity of carrying out, I hope to submit to your further notice.

With respect to the objectives exhibited, I cannot but feel that I am here approaching a rather delicate topic, as, if manufacturers of microscopes are a little weak upon any subject, it is upon the point of the immense superiority of objectives of their own production over those supplied by their competitors ; and I am sure, therefore, that you will agree with me in referring those requiring further information to the published reports of the judges.

Mr. Walmsley, of the firm of J. W. Queen and Co. ; Dr. Beattie, of Baltimore, and Mr. Edmund Wheeler, of London, were, I believe, the only exhibitors of prepared specimens for the microscope. The latter gentleman exhibited an excellent series, including some very fine transparent injections. Mr. Walmsley and Dr. Beattie both submitted some very excellent specimens of the double staining of vegetable tissues, a subject to which considerable attention has been devoted in the United States. I have the pleasure of submitting to your notice some very beautiful preparations of this description, mounted, and kindly presented to me by Dr. Hunt, of Philadelphia, which will be found to illustrate vegetable structure in a remarkable manner. As examples of mounting they are unsurpassed.

In a country possessing such enormous deposits of Diatomaceous earth, it is only natural that considerable attention should be devoted to the collection and preparation of these—to many—fascinating structures. Pond life, however, is a subject with which, to my surprise, I found very few microscopists whom I met in America at all acquainted, *Volvox globator* being an unfamiliar object to the majority. I cannot help thinking this is due, not to a deficiency of material, but to want of training in collecting, such as that afforded by the excursions of our Club.

Micro-photography, no doubt owing to the influence exerted by the example of Dr. Woodward, is much more extensively employed than at home, and there can be but little doubt has had considerable influence upon the construction of American objectives, especially in the increase of the angle of aperture of the higher powers. Whether this is an unalloyed advantage is, I think, legitimately open to discussion. With the opportunities I have had during the past six months, I will only say, for myself, that I think there are other and important directions in which the energies of those engaged in the manufacture of objectives can be more profitably employed.

In conclusion, I think we scarcely realise how closely and with what interest everything relating to the advancement of microscopic science occurring here is followed by our American cousins having similar tastes with our own. From the fact of my visit taking place in the summer and autumn seasons, during the greater part of which time the societies generally are not in session, I had but few opportunities of attending meetings, but I had the pleasure of meeting in course of my stay a large number of the working microscopists from all parts of the Union, and I must say I was surprised to find so thorough an acquaintance with all that is passing amongst us. I also wish to take this opportunity of tendering my hearty thanks for the boundless hospitality displayed, and the anxiety shown to render everything as agreeable as possible, in whatever direction one might happen to travel. To Dr. David Hunt and Professor Sharpless, of Boston (President and one of the Vice-Presidents of the Boston Microscopical Society) my warmest acknowledgments are due, and should any microscopist desire to enjoy an especially good time, I should strongly recommend him to spend his vacation, if possible, in the United States.

PROCEEDINGS.

August 11th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Marine Polyzoa, &c., from Ilfracombe ...	Mr. W. G. Cocks.
Stylops Spencii, male, emerging from the body of a wild bee	Mr. F. Enock.
Vertical Section of Rhinoceros Horn ...	Mr. A. H. Halley.
Flints containing Pyritised Structure ...	Mr. M. H. Johnson.
Sections of Norway Birch (*Betula alba*) ...	Mr. Sigsworth.
Sertularia bryonia	Mr. S. Turner.

Attendance—Members, 34; Visitors, 6.

August 25th, 1876—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c, President, in the Chair.

The minutes of the preceding meeting were not read, the minute book not being available.

The following donations were announced :—

"Monthly Microscopical Journal"	... from the Publisher.
"Science Gossip"	... " "
"Proceedings of the Royal Society"	... " Society.
"American Journal of Microscopy"	... " Publisher.
"American Naturalist"... ...	... in exchange.
"Darwin's Insectivorous Plants"	... by purchase.
Photograph of Mr. A. Cottam ...	... for the album.

The thanks of the meeting were voted to the donors.

The usual ballot for new members was postponed by reason of the certificates being in the minute book.

The Secretary read an additional note to Mr. Bridgman's paper, "On the Principles of Illumination," and stated that the author had partially re-written that paper for publication, omitting some of the theoretical matter, and adding further details of the mode of working.

The President having invited discussion, Dr. Matthews said that he had tried the apparatus in question, and that it appeared to him to be very similar in principle to his own illuminator, which reflected rays at any desired angle, and was perfectly under control. He considered that too great obliquity of the rays was an evil, as one shadow was cast over and interfered with another. He also considered that Mr. Bramhall's illuminator had been anticipated by the well known Amici prism with the flat surface silvered.

Mr. Ingpen exhibited and described a very beautiful reflecting microscope by Amici, which had been lent by Mr. Curties for that purpose. It outwardly resembled one he had the pleasure of describing at a former meeting, but was totally different in its principle, which was the same as that of the Newtonian telescope; the object being reflected by a small diagonal plane mirror into a concave speculum forming an image which was viewed by an eyepiece in the usual manner. These microscopes, or, as they were then called, engiscopes, were made at a time when it was doubtful whether achromatics could be improved. The definition of the instrument exhibited was extremely good, the workmanship of the stand excellent, and the ingenuity displayed in the various pieces of apparatus attached to it was very great. This instrument was made by Amici for the late Dr. Roget, and was employed by him in his well-known researches. Its date was probably about 1830.

In answer to a question by Dr. Matthews, Mr. Ingpen said he considered that the loss of light in such an instrument would probably be about 30 per cent.

The President announced that the Committee had nominated Mr. F. Kitton, of Norwich, for election as an honorary member of the Club.

The usual Notices of meetings, &c., were then announced, and the proceedings terminated in the usual manner.

The following objects were exhibited :—

Bramble Spider (*Neriëne rubella*) ...	Mr. F. Enock.
Skin of Eel	Mr. A. H. Halley.

Attendance—Members, 45; Visitors, 2.

September 8th, 1876.—Conversational Meeting.

The following objects were exhibited:—

Spirobis	Mr. Badcock.
Argulus foliaceus	Mr. Bishop.
Young Prawn (polarised)	Mr. W. G. Cocks.
Seeds of *Eccremacarpus*...	Mr. A. L. Corbett.
Pedicellaria of *Echinus lividus*	Mr. Curties.
Polynema ovulorum	Mr. F. Enock.
Tongue of *Pleuribranch*	Mr. A. H. Halley.
Hippuric Acid	Mr. F. H. P. Hind.
Diatoms from Cherryfield, Maine, U.S. ...	Mr. Ingpen.
Organic Structure of Flint	Mr. M. H. Johnson.
Fredericella sultana, &c.	Mr. E. Simpson.
Section of *Geodia*	Mr. Slade.
Stained section of *Chrondodendron tomentosum*	Mr. H. Stiles.
Section of Lachrymal Gland of Turtle ...	Mr. F. H. Ward.
Young *Talitrus* (alive)	Mr. T. C. White.

Attendance—Members, 46; Visitors, 12.

September 22nd, 1876.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the meetings held in July and August were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. Arthur C. Cole, Mr. W. H. Martin, and Mr. M. H. Stiles.

Mr. F. Kitton was also balloted for, and duly elected an honorary member of the Club.

The President called attention to some slight alterations to be made in the order of proceedings at their ordinary meetings, by which the whole of the business would be finished before the papers were read

The following donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	" "
"Proceedings of the Belfast Natural History Society"	" the Society.
"Proceedings of the Leeds Naturalists' Club"	" the Club.
"The American Naturalist"	in exchange.
"The Medical Examiner"	from the Editor.

Also three slides, from the Dundee Naturalists' Society; and four from Mr. A. H. Halley.

Photographs of Messrs Beulah, Bridgman, Hailes, and R. T. Lewis were presented to the Club album.

The thanks of the Club were unanimously voted to the donors.

The Secretary called attention to the circumstance of some slides having been presented to the Club from the Dundee Naturalists' Society. This Society had been recently established, and, as in many other instances, he had been written to to supply any information, or to give any hints which might be of use to the promoters in starting the new Society. He had readily responded to the request, and now that the Society was in working order, the Club would be gratified to find that, as a mark of appreciation and good feeling, these slides had been sent, accompanied by a quantity of *Isthmia enervis* for distribution amongst the members; and an offer was also made to collect for the Club any material which the neighbourhood of Dundee might afford, and which might be of interest. He felt sure they would be very pleased to recognise these marks of cordiality upon the part of kindred societies to whom they were in this degree related.

A paper by Mr. Bridgman, "On an Improved Anti-vibration Turntray," was read by the Secretary, and diagrams in illustration were exhibited.

The thanks of the meeting were voted to Mr. Bridgman for his paper.

The proceedings terminated with a conversazione, at which the following objects were exhibited:—

Acari of Bat	by Mr. Cocks.
Palate of *Massa papillosa*	Mr. Curties.

Proboscis of Peacock Butterfly	by Mr. C. G. Dunning.
Wings of Moth—*Argynesthia gadartella* ...	Mr. Enock.
Fredericella sultana	Mr. Hainworth.
Wing of Red Underwing	Mr. Halley.
Foraminifera	Mr. Hammond.
Stomach of Grasshopper	Mr. Moginie.
Sponge Spicules	Mr. Priest.
Stephanoceros.	Mr. Simpson.
Wing of Butterfly	Mr. F. H. Ward.
Horn of Asiatic Rhinoceros	Mr. T. C. White.

Attendance—Members, 76; Visitors, 8.

October 13th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Tiresens serra	Mr. W. G. Cocks.
Tetranocera reticulata (Marsh Fly) ...	Mr. F. Enock.
Double-stained Section of *Pelargonium* ...	Mr. W. H. Gilburt.
Young *Actiniæ*...	Mr. G. Green.
Leg and Scales of Red Underwing (*Catocula nupta*)...	Mr. A. H. Halley.
Black Marble from Galway ... Chert from Ventnor	Mr. M. H. Johnson.
Polycystina ("Challenger," 4,475 fathoms)...	Mr. W. W. Reeves.
Section of *Tilia parvifolia*	Mr. Sigsworth.
Section of *Populus nigra*	Mr. W. E. Tinney.
Scales of Swiss *Lepisma* from Engadine ...	Mr. F. H. Ward.

Attendance—Members, 71; Visitors, 11.

October 27th, 1876.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. W. H. Gilburt, Mr. D. Howard, Mr. W. G. Morris, and Mr. R. Roper.

The following donations to the Club were announced :—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	" "
"Popular Science Review"	" "
Two Nos. of "The American Naturalist" ...	in exchange.
Two Nos. of "Proceedings of the Royal Society"	from the Society.
"Proceedings of the Geologists' Association	" the Association.

"Proceedings of the Watford Natural History Society"	from the Society.
"Proceedings of the West London Scientific Association"	,, the Association.
"The Medical Examiner" (weekly) ...	,, the Editor.
"Quarterly Journal of Microscopical Science" (2 vols. and numbers to complete the series in the library)...	,, Mr. T. C. White.
"The Dawn of Life" (Dawson)	,, Mr. B. W. Priest.
Four parts of "Diatomaceen Kunde," by Adolph Schmidt	by subscription.
Four Slides—Sections of Wood, &c., from Swiss Lake Dwellings ...	from Mr. Bevington.
Thirty-one Slides—being the Educational Series of Physiological Specimens	,, Mr. Cole.
Six Slides—Insect Preparations... ...	,, Mr. Israel.

Photographs of Messrs Hammond, Nelson, Priest, and Tinney were also presented for the album; and a quantity of Pollen of Cedar of Lebanon was sent for distribution by Mr. Priest.

The President called special attention to the valuable donation sent by Mr. Cole.

A vote of thanks to the various donors was carried unanimously.

Mr. T. C. White read a paper upon the Fly Fungus (*Empusa muscæ*), in which he described its appearance and peculiarities, and illustrated the subject by a specimen exhibited under the microscope.

Mr. W. W. Reeves suggested that Mr. White might have carried the subject further with greater advantage, for if they wished to follow up the growth of this fungus they must not be content merely to watch it as found upon dead flies, this being only half its history. Let them drop the fly into water, and then see what would take place. In a short time they would see the fungus grow out and develop in a very beautiful manner. It never fully developed upon a window pane for want of sufficient moisture, but if this were supplied much more could be seen of its history. Very little was known about it, but if any one wanted to become better acquainted with it, by placing a fly thus attacked in a little water its further growth might be readily studied. Like many of this class of fungi it assumed different forms under different circumstances. It might be that the fly got into a diseased state, and settled upon the moist window pane—for it was only to be observed in damp weather. In the fifth volume of the "Quarterly Journal of Microscopical Science," p. 154, some account of it would be found; and in vol. 3, p. 55, of the early Transactions of the Microscopical Society, it was described and figured by Mr. Cornelius Varley. Mr. Reeves added that the fungus was not confined to the house-fly—it was found also on the blow-fly and several other insects.

A vote of thanks to Mr. White was duly carried.

Mr. Bridgman made some further observations upon his contrivance described at the previous meeting for reducing tremor, by means of an anti-vibration tray for the microscope table, and exhibited diagrams in illustration of additional improvements to the apparatus. He also read a paper " On a New Universal Reflecting Illuminator," diagrams of which were also referred to in illustration.

The thanks of the meeting were voted to Mr. Bridgman for his paper.

Mr. W. H. Gilburt read a paper " On the Relation between *Volvox globator* and *Sphærosira volvox*," the subject being illustrated by diagrams, and by the exhibition of the objects under the microscope.

The thanks of the meeting were voted to Mr. Gilburt for his communication.

The proceedings then terminated with a conversazione, at which the following objects were exhibited :—

Nemesia, &c. ... ... by	Mr. Andrew.
Navicula cuspidata (with new illuminator)...	Mr. Bridgman.
Odontophore of *Ovulum apertum* ...	Mr. Curties.
Section of Wood of Cactus	Mr. Dunning.
Culex (Mosquito)	Mr. Enock.
Volvox globator, containing *Sphærosira volvox*	Mr. Gilburt.
Bonnemaesonii asparagoides	Mr. Glasspoole.
Coralline (Polar)	Mr. G. Green.
Cristatella mucedo	Mr. Hainworth.
" Orbicules Siliceux " of Brongniart ...	Mr. M. H. Johnson.
Palate of Whelk	Mr. Le Pelley.
Under side of leaf of *Rhododendron Nuttalli*	Mr. R. T. Lewis.
Spiral Vessels of Castor Oil Plant ...	Mr. Martinelli.
Tracheæ of Centipede	Mr. Moginie.
Sections of Honduras " Chew Stick " ...	Mr. B. W. Priest.
Navicula cuspidata (with Bramhall illuminator)	Mr. Roper.
Entomostraca	Mr. E. Simpson.
Sections of Charred Oak from Lake dwellings at Robenhausen	Mr. Ward.
Empusa muscæ	Mr. T. C. White.

Attendance—Members, 82 ; Visitors, 6.

November 10th, 1876.—Conversational Meeting.

The following objects were exhibited :—

Brine Shrimp (*Artemia salina*)	Mr. F. Enock.
Singular distension of Sucking Stomach of Blow Fly	Mr. F. Fitch.

Lips of Wood Wasp (*Vespa sylvatica*) / Mouth of Sand Wasp (*Ammophila viatica*)	Mr. H. E. Freeman.
Section of Human Scalp	Mr. W. H. Gilburt.
Nose of Rat (injected)	Mr. J. Hunter.
Halichondria panicea and other Sponges (stained) ... ... / Basalt, from Melbourne	Mr. M. H. Johnson.
Spiral Vessels of Castor-oil Plant ...	Mr. Martinelli.
Ova of *Cimex*...	Dr. Matthews.
Stauroneis Phœnicenteron	Mr. H. J. Roper.
Section of Uni-locular Ovary of Meadow Orchis	Mr. Sigsworth.
Pupa of *Pulex felis*	Mr. J. Spencer.
Section of Basalt	Mr. W. S. Smith.
Collection of Polyzoa and Sponges ...	Mr. Swain.
Fossil Bone from Coal	Mr. S. Turner.
Section of Flint	Mr. T. C. White.

Attendance—Members, 59; Visitors, 8.

November 24th, 1876.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced, and the thanks of the meeting were voted to the respected donors:—

"The Monthly Microscopical Journal" ...	from the Publishers.
"Science Gossip"	,, ,,
"Proceedings of the Royal Society" (No. 173)	,, the Society.
"The Medical Examiner" (weekly) ...	,, the Editor.
"Memoirs of the Literary and Philosophical Society of Manchester;" and also Catalogue of Books and Vol. xv. of the Proceedings	,, the Society.
"The Quarterly Journal of Microscopical Science"	by purchase.
Twelve Slides of Insect Preparations ...	from Mr. Enock.
Five Slides of Diatoms...	,, Mr. Hailes.

Photographs of the late Dr. Harvey Betts, the late Mr. A. R. Betts, Dr. M. C. Cooke, and Mr. F. H. Ward were presented to the album (the first two being the gift of Mr. Sydney Turner).

The President announced that it had been decided by the Committee to hold the Soirée of the Club in April next; also that the Committee had voted from £20 to £25 for the purchase of books for the library—particularly "The Annals of Natural History," which would make a valuable addition to their collection of works of reference.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. W. G. Atkins and Mr. Francis Despointes.

Mr. T. Curties read a paper by Mr. C. F. George, "On a species of *Argas* found at Blyborough in Lincolnshire." The subject was illustrated by a number of drawings, and by mounted preparations, exhibited under the microscope.

Votes of thanks to the writer and the reader of the paper were unanimously carried.

Mr. Chas. Stewart gave a highly interesting lecture upon the "Histology of Skin." Commencing with the development of the simple cell, and the growth and structure of the outer layer or dermal membrane of Sponges, he proceeded to notice the covering and appendages of Zoophytes and the various Echinoderms, and to compare these with the structureless membrane of the parasitic worms. The shells and skins of the Mollusca were next referred to, and the peculiar structure of the skin of the Cuttle fish was minutely described, and the distribution and action of the curious pigment cells by means of which these creatures could change their colours were pointed out. Passing thence to the consideration of the skins of Vertebrates, the skin and scales of fish next received attention; and the Cycloid, Tenoid, and Ganoid varieties, as well as the peculiar skins of the Dog fish, were figured and explained. The skins of reptiles were next adverted to, and the remarkable development of the epidermis in the case of Turtles and Alligators was pointed out. The skins of birds and the marvellous structure of feathers next claimed attention, and some time was devoted to the illustration of the beautiful arrangement of the barbs, barbules, and barbicelles. The remainder of the lecture related to the structure and functions of the skins of mammalia, in the course of which the positions of the sudoriparous glands and other appendages were well shown. Mr. Stewart illustrated his remarks throughout by drawings made upon the black board with coloured chalks, which, together with his lucid method of description, rendered the subject of unusual interest to his audience, whose appreciation was expressed by very hearty applause.

The President proposed a cordial vote of thanks to Mr. Stewart, which was carried by acclamation.

The proceedings then terminated with a conversazione, at which the following objects were exhibited:—

Beetle (?)	by Mr. F. W. Andrew.
Section of Human Skin ...	Mr. W. J. Brown.
Sponge gemmules	Mr. W. J. Brown.
Acarus sacchari	Mr. F. Coles.
Aulacodiscus Kittoni (8 rays)	Mr. Cottam.
The "Blyborough Tick"	Mr. Curties.
Eyes of Cattle Fly	Mr. F. Enock.
Isthmia enervis	Mr. W. H. Gilburt.
Scale of Pike	Mr. A. H. Halley.
Ruscus aculeatus	Mr. Martinelli.
Three Sections of Gutta Percha Tree ...	Mr. Moginie.

Iodo-sulphate of Quinine	by	Mr. T. H. Powell.
Stephanoceros		Mr. J. Russell.
Diatoms from Toome Bridge		Mr. M. H. Stiles.
Section of Human Skin		Mr. F. H. Ward.
Isthmia enervis		Mr. T. C. White.

Attendance—Members, 81; Visitors, 14.

December 8th, 1876.—Conversational Meeting.

The following objects were exhibited:—

Sori of Fern	Mr. F. W. Andrew.
Tardigrada, &c.	Mr. Brady.
Mouth and Tongue of Saw-fly	Mr. F. Enock.
Reproductive Organs of Fantail-fly ...	Mr. F. Fitch.
Growing Point of *Pelargonium inquinans*...	Mr. W. H. Gilburt.
Iodo-sulphate of Quinine	Mr. A. H. Halley.
Nose, Cheek, and Upper Lip of Kitten (injected)	Mr. Hunter.
Flints, naturally injected with air and oxide of iron	Mr. M. H. Johnson.
Hymenophyllum	Mr. Martinelli.
Spirogyra nitide in conjugation	Mr. E. M. Nelson.
Glossiphonia biloculata	Mr. T. C. White.

Attendance—Members, 74; Visitors, 8.

December 22nd, 1876.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. John J. Hunter, Mr. J. G. Morris, Mr. C. P. Ogilvie, and Mr. Geo. Perry.

The following donations to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	" "
"Proceedings of the Royal Society" ...	" the Society.
"Proceedings of the Botanical Society of Edinburgh"	" "
"Medical Examiner" (weekly)	" the Editor.
"Rutherford's Outlines of Practical Histology"	" Mr. T. C. White.
An Album of Micro-Photographs of *Diatomaceæ*	" Mr. J. Redmayne.

The thanks of the Club were unanimously voted to the donors.

The President read a letter from the Croydon Microscopical Society, thanking the members of the Quekett Club for the assistance given on the occasion of their recent soirée.

Mr. Henry Crouch read a paper on "Microscopy in the United States of America," and also placed upon the table for inspection some beautiful specimens of double stained vegetable tissues prepared by Dr. Hunt, of Philadelphia.

The President expressed his high appreciation of the value of these inter-communications, which he thought could not fail to be of great use. With regard to the microscope from Japan, which had been mentioned in the paper, he was very glad to find that an interest in such things was being excited amongst that remarkable people. He hoped that at the next Soirée of the Club the Japanese Ambassador would be present, in which case he felt sure a deep interest would be shown in the great number of instruments and objects that would be brought under his notice.

At the invitation of the President, Mr. Hickie made some remarks (which were of a somewhat disparaging character) upon American objectives.

Dr. Matthews followed with some instances of the neglect of some of our ordinary appliances by Continental observers.

Dr. Foulerton said that in America hardly any town was found without a society similar to their own; showing how much interest was taken in scientific study. In San Francisco—which was pretty far west—there was a very excellent Microscopical Society, and some very competent observers belonging to it.

Mr. Ingpen referred to the beautiful double-stained vegetable preparations of Dr. J. G. Hunt, which Mr. Crouch had exhibited. The process of bleaching by chlorinated soda, though published several years since, did not seem to have attracted much attention till recently. Mr. Crouch had informed him that Dr. Hunt might perhaps be induced to send them a paper upon the subject.

Mr. W. H. Gilburt called attention to a specimen of *Juncus communis*, exhibited by himself, and prepared by Dr. Beattie's process, which had been described in "Science Gossip" of August last. The double staining was with magenta and purple.

Mr. Crouch said he hoped it would be thoroughly understood that in his remarks upon the productions of the American opticians, he spoke not as a maker but entirely as an individual observer. So far as he had an opportunity of forming an opinion he thought that Mr. Tolles and other American opticians turned out some work that was very good, and differed from others only in some few peculiarities. His impression was that Mr. Tolles pushed the angle of aperture too far, and, in many instances, to the positive detriment of his glasses. He had, however, seen some of this maker's objectives, which he had not seen equalled elsewhere. With regard to the microscopes of the better class, he believed that those produced in America were in every respect as good as those of English make; but the prices were far higher.

The President, in moving a vote of thanks to Mr. Crouch for his interesting paper, expressed the desire, in the name of the Club, that he would convey to Dr. Hunt their high appreciation of his beautiful specimens; and also ask him for the favour of any communication which he might be disposed to make as to the details of his process.

Mr. Crouch thought he might promise on Dr. Hunt's behalf that some such communication should be sent to the Club.

A vote of thanks to Mr. Crouch was unanimously carried.

The President said he would only add further that they should be most happy to return the hospitality which had been described by Mr. Crouch, should any American microscopists visit the Quekett Club.

Mr. T. Charters White gave a description of a specimen of *Sabella*, exhibited by him in the room. On being taken hold of in the Aquarium these creatures were found to wriggle out of their tubes and go free. They then appeared to go about tail first, and were apparently furnished with two eye spots near the tail. The body consisted of several rounded segments, and at the head were from three to five compound tentacles, and if by accident one of these got broken off, it swam about by itself as if it were an independent creature. Mr. White illustrated his remarks by drawings upon the black board.

The proceedings then terminated by a conversazione, at which the following objects were exhibited :—

Sugar Mites ... ... by	Mr. F. W. Andrew.
Section of Cherry Stone	Mr. F. Coles.
Ceranium acanthionatum (from Galway Bay)	Mr. A. L. Corbett.
Wings of Butterflies	Mr. T. Curties.
Coccoon of Larva of Vapourer Moth ...	Mr. F. Enock.
Section of Rush — *Juncus communis* (double stained)	Mr. W. H. Gilburt.
Tremolite	Mr. A. H. Halley.
Human Ovary, showing remains of a *Corpus Luteum*	Mr. J. Hunter.
Section of Toe of New-born Infant, showing first growth of nail, sweat glands, &c.	Mr. J. J. Hunter.
Palate of *Italiatus tuberculata*	Mr. Le Pelley.
Leaf of *Goniophlebium sepultum* ...	Mr. R. T. Lewis.
Sponge—*Grantia ciliata* (Ramsgate) ...	Mr. B. W. Priest.
Acari from Sugar	Mr. Sigsworth.
Alveolina—Limestone (Herault, France) ...	Mr. J. Spencer.
Section of Hair of Elephant	Mr. F. H. Ward.
Young *Sabellæ* sp (?), alive	Mr. T. C. White.

Attendance—Members, 65; Visitors, 7.

On a New Form of Section-Cutting Machine.

By Henry F. Hailes.

(Read Jan. 26th, 1877.)

Plate XXIII.

I wish to bring before the members of the Quekett Club a machine for cutting microscopic sections, which I have devised, and which, I think, may be of some interest to them.

For some time past I have been very dissatisfied with the sections that I have had occasion to cut. This was probably in a great measure due to my own want of skill, but still it appeared to me that any mechanical contrivance for this purpose must be very imperfect if it did not, to a considerable extent, compensate for any want of skill in the operator.

Not being able to meet with any machine that in my opinion fulfilled the requirements of the case (most of the recent improvements having been made in the shape of "freezing microtomes," for cutting anatomical and other soft sections), I set to work to see if I could contrive some sort of machine that would enable me to cut sections of various materials with ease and precision.

My first attempt was with a rotary knife. This was mounted upon a spindle in the same way as a circular saw, and run upon dead centres. It was furnished with a bed, and with an adjustible fence, much after the fashion of an ordinary saw. It worked very well—but, in the first place, I found that, independently of its being very troublesome and expensive to make, it was necessary to construct another special machine, in order to grind and keep in proper order the edge of the circular knife.

In the next place, I found that it required a very considerable power in order to drive it at a suitable speed, and it could therefore only be run in a heavy lathe or its equivalent. As heavy machinery and microscopic work seemed to me to be rather incompatible, I gave up my efforts in this direction, and turned my attention to the so-called "Topping machine," in order to see if I could modify it so as to make it more suitable to my purposes. I should not have referred to the circular knife at all, but that I thought my experience might be of some use to any one who might be disposed to try what can be done in that direction.

In all machines made upon the "Topping" model, it is usual to drive the material intended to be cut into a tube, from the top, or otherwise to wedge it firmly into the tube; then, by means of a screw or wedge, to drive it out again from the bottom. The result of this arrangement is, that the material at first undergoes some amount of compression, and then when this compression overcomes the resistance offered at the top of the tube, the material comes up with a jump, and you are thus unable to cut sections with any degree of precision; and after cutting some twenty or thirty slices, you may, perhaps, with good luck succeed in finding half-a-dozen thin enough to mount.

The machine which I have the honour to bring before you to-night, obviates this defect entirely, and at the same time secures some other minor advantages.

I will proceed to describe it with reference to Plate xxiii. in which Fig. 1 is a plan view, and Fig. 2 a side view of my machine, as arranged for sawing bone and other hard sections. Fig. 3 is a plan view, and Fig. 4 a longitudinal vertical section of the machine, as arranged for cutting wood or softer sections. Figs. 5 and 6 are plan and side views of the moveable block and pins, used in cutting hard sections, shown detached. A is a short tube, of about an inch and a quarter in diameter, furnished with flanges, B and B^1, one at each end. The upper one of these flanges serves as a cutting-bed or table. Inside the tube A, slides freely a second tube C, in which is placed the material intended to be cut. This tube C is furnished with two clamping screws, *c c*, which pass through a slot formed in the outer tube A, and are tapped into a block screwed on the side of the inner tube, C. Inside the inner tube C, and at its lower end, is screwed a nut or boss, D, and through this nut is passed the micrometer screw, E, provided with a milled head, *e*, and a divided collar, *f*. This screw is carefully shouldered into a cock or bracket, F, firmly screwed to the lower flange, B^1. In order to hold the machine securely to the table, it is screwed by its upper flange to a transverse bar of wood, G, which is clamped to the table by the fixed clamp, H.

The material to be cut may be packed in any convenient manner into the inner tube C, and is secured by the clamping screws, *c c*.

It will now be clearly seen that, on turning the micrometer screw E, the inner tube C will be steadily advanced upwards, carrying with it the material to be cut without any compression, and consequently without any jerking, and sections may be readily cut with a chisel or with a razor in the ordinary manner. With the machine now before you, I have cut with ease and precision sections of fresh-growing wood, $\frac{1}{1100}$ of an inch in thickness.

The upper flange of the machine, which serves as a cutting-bed, is provided with two strips of hardened steel. These form a very convenient surface over which the chisel or razor may be passed when cutting wood or softer sections, but they also serve another very important purpose—At the back of the cutting-bed, B, I secure, by means of a spring and screw, and steady-pins, a metal block, b^1. This block carries two hard steel rods, b^2 b^2, which, when in place, lie immediately over the two steel bars, b^3 (see Figs. 1 and 2), just referred to. Now, by passing the blade of a fine saw between the movable steel rods, b^2 b^2, and the fixed bars, b b, on the cutting bed, sections of bone or other material too hard to be cut with a knife or razor may be sawn off, as thin as the nature of the material will admit, and often sufficiently thin to be at once mounted. The rods, b^2 and bars b, being of hardened steel, receive no injury from the teeth of the saw.

I think it will be obvious that a machine of this kind would be useless unless carefully and accurately made, and consequently it will be rather an expensive machine as compared with others of the same class. However, I have had a couple made (besides this one of my own), and I have placed them in the hands of Mr. Baker, of 244, High Holborn, and I have no doubt, with the resources at his command, he will be able to supply any one who may wish for it with a machine at as reasonable a price as is consistent with efficiency.

On Black Moulds.

By M. C. Cooke, M.A., LL.D., A.L.S.

(*Read February 23rd*, 1877.)

Plates XXIV. to XXVII.

There is one difficulty to be encountered by those who persistently devote themselves to the study of any special subject, that, when they rise to read a paper, it is at once concluded that they are at the "same old game," and that, consequently, nothing new or interesting can be anticipated. I have hesitated myself for a long time, and resisted all efforts to induce me to present my unpopular and rather mouldy subject before the Club, lest by iteration I should weary the members of a subject, difficult in itself, limited in its students, and unpopular in its general character. After a long silence, however, I now feel that amongst the varied subjects which are brought before the Club the time has arrived when a Fungological subject may be introduced with advantage, and the promise of two years' standing may be redeemed.

As to the subject itself, I was for some time in doubt what portion of the vast range of Mycology would best meet the requirements of the Club. At first I proposed to illustrate the Potato disease; but this was soon abandoned, on the ground that so much had been written upon it during the past year or two, that if the general student were not really tired of it, at least sufficient had been done to make him acquainted with all he desired to know, as necessarily I must have repeated a great deal which had been written, and was at the ready command of all who felt any interest in the matter.

When it is remembered that there are not less than twenty thousand good species of Fungi known and described, it will be admitted that a general gossip over the whole, with a sort of running commentary on their nature, uses, classification. and structure, would occupy a long evening, and leave no satisfactory impression at its close, since all this has been compressed into a volume which any may peruse,* and the paper could only have been a skeleton of the book.

In order to *interest*, and, perhaps, to some extent, *instruct* the uninitiated of the Club in a few of the mysteries of Fungology, I have selected some examples from one of the six orders under which the whole Fungi are classified; and this order is termed *Hyphomycetes*, or "Thread Moulds," because the threads of which each individual is composed is the most prominent feature of the Fungus.

Most microscopists have some knowledge of the general features of such common moulds as *Penicillium* and *Aspergillus*, in which there are delicate branching threads forming a kind of root-fibrils, and from these arise, rather more rigid and robust, erect threads, which form a kind of stem; and sometimes this stem becomes divided into branches, the sides or tips of which are garnished with little sphærical or elongated spores, which are in reality the fruit. In such a form as this we have the type of a "mould," a microscopic tree or shrub, with root, stem, branches, and fruit, but without either flower or leaves. It is such a type which prevails in the *Hyphomycetes*, sometimes varied in one direction, sometimes in another, but in all this variety there is unity, a unity of design carried through a variety of patterns; so that in obtaining a knowledge of a few of the forms in the order, we obtain a general clue to the characteristics of the whole order, and, with the exception, perhaps, of a few somewhat anomalous or intermediate forms, become enabled at once to determine whether an unknown fungus, for the first time under examination, belongs to this section or another, which is so much knowledge acquired that may prove useful in future microscopical studies.

On the margin of this investigation, and before I proceed further with the details, it may be well to address a few words to the subject of the relative value and importance of physiological investigations, and classificatory studies.

In all branches of Natural History there are workers of two kinds: those who investigate the structure, physiology, origin, and development of a few forms, and endeavour to comprehend the whole mystery of their existence, and relationship to other manifestations of vital force, and those who devote themselves almost entirely to the study of the various forms in any one or more

* Fungi, their Nature, Uses, &c., *International Scientific Library*, published by H. King & Co.

groups, their relationship to each other, and their systematic and orderly arrangement, their affinities and their differences, and their geographical distribution. It is not uncommon to find those of the first group, the biologists, or physiologists, claiming a higher position for themselves than they accord to students of the other class, and even sneering at them as mere species-makers, or compilers of catalogues. This is not only unjust, but untrue; both are equally useful and equally essential, and should not be the subject of comparison. The work of the former is a great help to the latter, whilst without classification there could be no science. Each has his own work to do as helper to the other. If I may judge from my own experience, it is often the case that the individual has little power to control the direction of his studies after he has once started on his course. My own predilections would be in favour of more exclusively physiological investigations, but finding no systematic arrangement of the British Fungi in existence ten years ago, as the basis of operations, I set myself at first to what I conceived the most essential work, and issued the "Handbook." Then, I thought, surely it would be permitted me to pursue some course of investigation; but, on the contrary, the publication of the book increased the number and interest of the workers, and gave such an impetus to British Mycology, that at once I became drawn into and involved in a maze of correspondence, not only in the British Islands, but over Europe and America, with regard to the species contained in this book, and the two thousand soon became three thousand; so that in self-preservation and in self-defence I was driven to the study of allied species in other countries, and now I am so committed, by the study of certain groups of which I have consequently acquired a large experience, that I have no alternative but onwards, or to relinquish the study altogether. The power of circumstances over individuals in directing the course of their literary or scientific career must greatly counteract and overcome individual inclinations, however much we may flatter ourselves upon our own free agency. There is still another reason why I am precluded from absolute physiological studies. Having espoused what might be termed strong conservative views on mycological matters, I feel it my duty to science to resist, not only by words, but by work, the innovations of a modern school of Radicalism which threatened to sweep away all old landmarks, and, by wholesale manufacture of new genera and species on illogical, shifting, and unstable bases, to bring science, in so far as Mycology is concerned, into contempt. Not being able, under these circumstances, to submit to you an absolutely physiological communication, and being prevented by a regard for your patience from inflicting upon you one that is entirely systematic, you will probably be disposed to accept as a compromise something intermediate between the two, although it might prove unworthy of either.

The division of *Hyphomycetes* selected for this occasion are known as the *Dematiei*, or black moulds. The chief distinction lies in the dark colour of the threads, and the black, sooty, or dull-coloured patches in which they are collected. Nearly seven years ago I had the honour of reading a paper to the Club "On Microscopic Moulds," which was published in No. 11 of the "Quekett Journal," with illustrative figures, to which I shall have occasion to allude. In that paper I gave a kind of running commentary upon all the moulds, and pointed out the distinctions between them. It will not be necessary to cover this ground again, but refer members to the Journal in question for such points as may be omitted here. The figures given of *Mucedines*, and of Black Mould, will enable comparisons to be instituted, and a general idea obtained of the distinguishing features of the two orders or divisions.

Although it may impart somewhat of a repulsive formality, in the estimation of some, to this communication, there will manifestly be an educational advantage to be derived from adopting a sort of scientific order and arrangement in the sequence of the species to be alluded to. In pursuance of this plan, I will first remind you of a simple form of black mould which is by no means uncommon in this country, but is often found mixed up with other species. This consists of a simple, rigid, erect stem, or thread, so dark as almost to obliterate all appearance of septa; at the apex is borne a single, dark, nearly globose spore, without any transverse division. This is termed *Monotospora*, and it may well be accepted as a simple typical form of a black mould. There is the dark carbonised stem, with branching brown root-like filaments at the base, and a single spore growing at the summit. At first the tips of these threads are colourless, the upper joint swells, and gradually increases until it becomes pear-shaped, and then globose. It acquires colour, the outer membrane thickens, the spore is divided from the thread by a septum, and at length falls away. Technically and rigidly the genus is confined to those species which have globose, or somewhat globose, or pear-shaped spores, without a septum. Either the forms with septate spores which have been included within the genus must be transferred to *Helminthosporium*, or the limits of the genus must be enlarged, and all species of *Helminthosporium* with obovate or pyriform spores must be transferred to it; such, for instance, as *Helminthosporium obovatum*, and, perhaps, *H. turbinatum*. Here is one of the difficulties with which the student has to contend. No one has concentrated himself to the work of pruning and arranging the whole group in the form of a monograph; hence the different genera are but too often isolated, and do not in their characters bear a proper relationship to each other. They are a family without cohesion. Sometimes we encounter two or three genera which do not differ materially, if at all, from each other; and in some other genera we find one author holding broad views, and another very narrow views, as to its limits. This undoubtedly is a source of difficulty to the student, whilst at the same time it serves to indicate a field of legitimate work, and may serve as an incentive to master the difficulties of the situation.

Some of the species of *Helminthosporium* differ very little, if at all, from the strict interpretation of *Monotospora*, until we reach the spore. Here there is, and should still continue to be, a clearly defined distinction. One of the most interesting and beautiful species of *Helminthosporium* is one figured by Corda in his "Prachtflora" as *Helminthosporium Stemphylioides*. When in Scotland to attend the Fungus show at Perth, I remained a few hours at Edinburgh, and then, whilst passing through the Botanic Gardens, picked up two little pieces of stick which I saw were inhabited by a black mould. On one of these was the present species, not before recorded in Britain; on the other the somewhat rare *H. Rousselianum*, with the curious *Sporochisma mirabile*. Soon after reaching home Mr. Phillips, of Shrewsbury, wrote informing me that he also had found *H. Stemphylioides*. This species is so characteristic that no other is likely to be confounded with it. The threads are slender, short, and collected in bundles; the spores are very large, egg-shaped, uncoloured at each end, but with a broad band of brown about the centre. In fact, it is not a good type of *Helminthosporium*, being much more like a species of *Mystrosporium*, and when the monograph of the *Dematiei* is written will probably be transferred to that genus.

It would be impossible for me to refer in detail to the different species of *Helminthosporium*, or even to those found in Britain. This genus is the great glory and pride of those Mycologists who devote themselves to the Black Moulds, and, if it were only for their encouragement, I could have wished to have lingered over it more than I can permit myself to do. There are several good types of spore-form to be found in this genus, which might be indicated as suggestive of a grouping for the purposes of study. For instance, there is the fusiform type, illustrated by *H. fusiforme*, *H. apiculatum*, *H. velutinum*, *H. gongotrichum*, and others. There is also the folliculate type, as exhibited by *H. folliculatum*, *H. scolecoides*, and *H. rhopaloides*. There is also the type of spore very much elongated, whilst the thread is reduced to a minimum, as in *H. Tiliæ* and *H. Smithii*, and the pyriform type, as in *H. turbinatum*, *H. altum*, *H. obovatum*, &c. I might also enumerate the clavate type, as in *H. macrocarpum*, *H. appendiculatum*, &c., and the triseptate type, as *H. Rousselianum*, *H. subulatum*, and several foreign species.

This grouping, which is merely suggestive, and not the result of any matured consideration, will serve to show the great variety which exists in the form of the spore in this large genus, and it is this feature which perhaps would alone recommend them to microscopists outside the special circle of Fungologists. No finer spores can be found than those of *Helminthosporium Smithii*,* which occurs on twigs of holly, lying on the ground under hollybushes. A different kind, but still very interesting clavate or folliculate spores, occur on *H. folliculatum*, which is not at all uncommon on old cabbage stalks, cast aside to rot in the rubbish corner of a kitchen garden; whilst *H. macrocarpum*, with its large coarse opaque threads, and club-shaped spores, will undoubtedly be found on chips and sticks lying on the ground, with perhaps one or other of the fusiform spored species.

Many years ago, when Schweinitz was in North America, he found a black mould on the leaves of *Carices*, which had some resemblance to *Helminthosporium*, but, instead of the prominent, erect threads which are common to that genus, it had creeping flocci, and long erect spores. To this fungus he gave the generic name of *Clasterisporium*. It was for a long time doubted in Europe whether Schweinitz was justified in constituting a single aberrant form into a new genus, and hence *Clasterisporium* came to be scarcely recog-

* "Quekett Journal," No. 11, plate 7.

nised. Recently having seen specimens of Schweinitz's fungus, I became satisfied that it was a good genus, although a supposed new species which has been affiliated by an American botanist does not belong to the same genus. From India came a second species, which fully confirmed the judgment of Schweinitz, and not long since Mr. Griffiths Morris, of Hereford, found a third species, the finest and most imposing of all. In this latter the spores are very much like those of *Helminthosporium Smithii*, but instead of being simply borne on short erect threads, they are seated upon creeping threads, as in the American and Indian species. There is evidently an analogy between these three species and some of the long spored species of *Sporidesmium*, but there is really no affinity. The *Clasterisporium* might be characterised as a kind of *Helminthosporium*, with creeping threads, but as the threads in *Helminthosporium* should be erect, this is one justification of a distinct genus.

There is yet another interesting genus of these fungi having close relationship with the preceding, but differing in the character of the threads, as well as a feature in spore production. This is *Cladotrichum*. The black velvety patches of this mould on sticks and twigs are just like those of *Helminthosporium*, but the threads, when seen under the microscope, will be found to be swollen at the tips, which assume the form of cups, or goblets; whereas, these threads are also gouty, and swollen several times throughout their length so as to present a very singular appearance. A fine species of this genus was figured by Corda in his "Prachtflora." There is an additional distinction in this genus, and in *Dendryphium*, that the spores are produced end to end in a kind of chain at the tips of the threads and their branches. It is by no means an easy feat to accomplish to be able to see under the microscope spores so attached. The attachment is so slight that the spores separate on the least movement, and often only the basal spore can be seen fixed to the thread. When the spores are not fully matured they adhere more tenaciously, and then the structure may be seen indicated in the juvenile spores. In all the species of *Cladotrichum* which I have seen, although the threads are rigid the membrane of the spore is delicate, and, in drying, the extremities are liable to collapse.

Dendryphium is also a genus very similar to *Helminthosporium*, but less robust, the patches are not dense and velvety, but thinly scattered, and the spores, instead of being produced singly, are in chains. There are points of affinity in which these two genera approach so closely, as for instance in *Dendryphium laxum*, and *Helminthosporum rhopaloides*, that it is difficult to indicate any manifest difference except in the mode of spore production. It may generally be predicated that the threads of *Helminthosporium* are unbranched, or nearly so, and that the threads in *Dendryphium* are more or less branched in the upper portion. This may seem, at first, to be a slight difference, but it gives a peculiar character to each, which cannot but impress itself forcibly upon the mind whenever the two are compared under the microscope. In the general features of these two genera they are allied to *Helminthosporium*, but in spore production they link that genus to *Cladosporium*. If it were permitted me to pause and speculate, it would form a good topic for reflection how, in each genus, one species had tendencies in one direction and others in another, how form approximated to form, and how here, as well as in every other portion of inexhaustible Nature we encounter continuous chains of being, linked and bound one to the other, touching everywhere, and, amidst endless variety, united into one harmonious whole.

A very natural group of Black Moulds are those of which *Cladosporium*, may be taken as the type. These moulds differ from the preceding in one important feature, the flocci are not rigid and opaque or semi-opaque, there is no evident external coating, and when dry the cells collapse freely, which indicates a much more delicate cell-wall than prevails in the *Helminthosporium* type. There are four genera, to which I would direct your attention for a few moments, in this group. First of all there are those which have been classed with *Helminthosporium* as aberrant forms, such as the one found by Messrs. Berkeley and Broome on leaves of *Lychnis*, and by them called *Helminthosporium echinulatum*. Not long since my friend Mr. Phillips, of Shrewsbury, sent me a mould on the leaves of Star of Bethlehem, and this I at first referred to Berkeley's species, but on a subsequent and more minute examination I find it to be identical with a specimen I possess from the late Dr. Klotsch, marked *Heterosporium ornithogali*, Kl. MSS. The threads are long, flexuous, with thin walls, pale-brown, much divided, sometimes branched, with spores of most irregular size and form, some are elliptical and simple, others uniseptate and longer, others are again much more elongated and cylindrical, with two, three, or more septa, so that the longest are about five times the length of the shortest, and externally faintly granulated. There are intimations that these spores are produced at the tips of the threads, and concatenate. Such features are also possessed by the fungus described by Berkeley and Broome, except that there are clear specific differences in the more distinctly echinulate spores, as well as in some other features which need not be enumerated here. Manifestly these moulds do not belong to *Helminthosporium*, but to *Heterosporium*, a name very characteristic on account of the diversity of their spores. Henceforth then we may regard as British species *Heterosporium ornithogali*, Kl., on Star of Bethlehem, *Heterosporium echinulatum* (B. & Br.), on leaves of *Lychnis*, and *Heterosporium variabile*, C., on leaves of spinach, from Forden, first described in Grevillea as *Helminthosporium variabile*, and afterwards on authority of Mr. Berkeley, accepted as a variety of his species, but which differs considerably in habit, as well as in microscopical features. There are probably other species of *Helminthosporium*, as well as of *Cladosporium*, which, upon examination, may be found to belong to this genus, whilst the species named by Klotsch *Heterosporium maculatum*, is only a *Cladosporium*. These are rather more technical details than I proposed entering upon, but they seem to be essential in order to clear up some doubts, errors, and misconceptions.

Another of this group of genera consists of the well-known, and widely-distributed genus, *Cladosporium*. Perhaps one of the most cosmopolitan of Fungi is *Cladosporium herbarum*, which seems to occur all the world over, and certainly with us it is the commonest of all moulds. As to its relationship with any species of *Sphæria*, as its conidia, that is a question upon which I do not purpose to enter at all, nor the relationship which any other of the moulds under present consideration bear to other fungi. That is a wide and complex question which would occupy all the time which a paper of this kind can claim at your hands, in order to deal with satisfactorily. We must, therefore, dismiss from our minds for the purposes of this communication all doubts as to the autonomy of the several species.

Cladosporium occurs on all kinds of vegetable substances during decay. There are flocci, which are often short, septate, coloured, with thin cell-walls, in many instances fasciculate, bearing at their tips chains of spores, or rather one, two, or three spores, attached in a chain. These spores are at first without septa, but soon have a septum across the centre; occasionally there is an additional septum, but in no instance of a veritable *Cladosporium* does the epispore appear to be rough, nor are there such wide divergences in the magnitude of the spores as in *Heterosporium*. Undoubtedly, as far as the limits of species are concerned, the whole genus is in utter confusion, and there is good work for some one to investigate all the supposed species of *Cladosporium*, and embody the results in a monograph. Perhaps in the production of the Handbook, the error was rather in too great a reduction of the number of species.

One species of *Cladosporium*, with its variety, which were included in the Handbook under the name of *Cladosporium dendriticum*, I am now disposed to follow the example of continental authors, and recognise as the type of a genus as *Fusicladium*. Nearly all continental Botanists accept this genus, and I do not see that any good purpose is served by remaining singular, with no other reason than that of eccentricity. The features relied upon chiefly are the simple spores, which never become septate, and the reduced threads. This will form the third genus in the group with collapsible threads and spores. The fourth has been accepted since the publication of the Handbook.*

Cercospora certainly is allied to the foregoing three genera, but differs very widely in the character of the fruit. It is a comparatively new genus, and its species have been multiplied right and left until the distinctions have become so refined that it is very difficult to discover them. In fact, I very much doubt if the whole of the twenty or thirty species could not well be comprised within some three or four species. Many of these moulds are parasitic on the leaves of living plants, occurring on spots which have been damaged, or on leaves which have begun to fade. The mould is very minute and delicate, the threads very short, being reduced to one or two cells, but the spores are very long, slender, and thread-like, either containing a row of nuclei, or divided by septa into numerous cells. Only one or two of the supposed species have yet been found in Britain, of which *Cercospora resedæ* was detected by myself in Jersey. Many others probably occur in this country.

Any one who has examined with care a specimen of one of the common species, or varieties, of *Cladosporium*, will not fail to have noticed certain peculiar bodies mixed up with the threads which appear to have no decided relationship with them. These bodies are of the form of spores, more or less irregular

* It is difficult to see in *Scolicotrichum* any other than a mixture of species of *Cladosporium* and *Fusicladium*.

in shape, proportionately broad, and divided longitudinally and transversely by numerous septa. These are the spores of some species of *Macrosporium*, which hitherto have been maintained as a distinct and veritable genus, closely related to *Cladosporium*, but virtually distinct. Since the appearance of Tulasne's great work, this opinion has been greatly modified, and some authors contend that the spores of *Macrosporium* are but a more complex form of fruit of the *Cladosporium*, or that they are a condition of some ascigerous fungus, of which *Cladosporium* is but another manifestation. On this point I shall not now venture to express a decided opinion, as our design is rather to recognise the various forms than to determine their functions. There are several genera, or supposed genera, with spores of the Macrosporioid type. That is, large, irregular spores, with septa in both directions, dividing the spore into numerous cells. In *Macrosporium* itself there are threads of a flaccid nature, resembling those of the species of *Cladosporium*, but not so highly developed, in fact, sometimes scarcely developed at all beyond a short basal stem. The spores appear to be sometimes terminal and sometimes basal, but the spores always appear more prominently than the threads. It is difficult to meet with a specimen of the ordinary forms of *Cladosporium* in which spores of *Macrosporium* are not mixed up. In some forms of *Macrosporium* there is but little or no evidence of the presence of *Cladosporium*. It is difficult to fix the limits which may fairly be considered as constituting a species in this genus, the spores are so variable in size and form in the same specimen, but, in a few cases the distinction is so marked that there remains very little ground for doubt. Recently the Rev. J. E. Vize has sent me a *Macrosporium* which he calls *M. nobile*, with very large and characteristic spores, just such as would please the ordinary microscopist and afford an additional object for his cabinet. The species are common enough on dead leaves and stems of herbaceous plants. The leaves of cabbage, both in this country and the United States, yield a species with very long spores; it has been called *Macrosporium Brassicæ* here, and *M. circinans* there, but evidently there is no difference between them. It was long since intimated by my friend the Rev. M. J. Berkeley that there is no essential difference between the genus *Macrosporium* of Fries, and *Septosporium* of Corda, whilst *Mytrosporium* and *Stemphylium* are so closely related that it is very difficult to draw the line between them. In quite another order of

Fungi we have the genus *Sporidesmium*, to which some of the so-called species of *Stemphylium* belong. It might prove a puzzling occupation, and in some sense a suggestive one, to compare together the structure of all the genera of black moulds with these peculiar compound spores.

In the Handbook, unfortunately, by some error which I cannot now account for, the figure 248, supposed to represent *Mystrosporium* belongs to a distinct genus, that of *Blastotrichum*.

In *Septosporium*, if the original features of the genus are maintained, there should be threads resembling a *Helminthosporium*, with septate spores attached to a short pedicel, and usually generated at the base of the threads. It bears about the same relation to *Helminthosporium* which *Macrosporium* does to *Cladosporium*. Two or three species have been found in this country, and I have described a very distinct one from the United States, in which the typical character is maintained, and in these instances there is a good character to separate them from the genus *Macrosporium*.

As far as I can offer any one feature to distinguish the three British genera so closely allied, I should suggest that the spores of *Mystrosporium* are terminal, those of *Septosporium* basal, and those of *Macrosporium* are scattered. Moreover the spores of *Mystrosporium* and *Septosporium* are dark and opaque, whilst those of *Macrosporium* are translucent.

It is by no means satisfactory to define the limits of any one genus by a single character. This is a great mistake, into which young and inexperienced naturalists are apt to fall. It is by general resemblances into which all features of the individual enter that affinities are to be determined. By a comparison of all the salient features, judgment must be pronounced in favour of the greatest amount of agreement. A sound classification must be natural, and not artificial. It seems strange that there should be any necessity for urging this truism, which has long since been accepted, and yet all our modern "improvements" in classification show a tendency, not to advance, but to retrograde into an artificial system which our forefathers discarded as insufficient.

Succeeding the *Macrosporioid* group, it may be well to allude to a group of peculiar interest to those of our younger microscopical friends who are in search of curious or pretty objects This is the group with Helicoid spores, and here, I fear, that I must again trouble you with a few technical observations in order to clear the way. Mycologists need not be informed that *Helicoma* and *Helicocoryne* are two genera constructed by Corda,* that *Helicosporium* and *Helicotrichum* were two genera for which Nees† is responsible, and that *Helicomyces* is accorded to Link.‡ These five genera have all Helicoid spores, that is, elongated spores which are coiled round like the spire of a snail shell. In order to avoid confusion, it is well to fix some definite character to each of these genera. Undoubtedly *Helicotrichum* is essentially the same as *Helicosporium*, and *Helicocoryne* is so much like *Helicoma*, that I fail to detect any difference. We have thus reduced the genera to three, but as *Helicomyces* has no threads, and consists only of spores, which are parasitic on other moulds, it does not belong to our subject, but, on the contrary, to the *Torulacei*. In the "Handbook" this genus should occupy the place of *Helicosporium*, which was erroneously inserted in *Torulacei*, instead of *Dematiei*. The two genera now left for illustration are *Helicoma* and *Helicosporium*. In *Helicoma* the spores are irregular in thickness, being attenuated at the base usually, but always coarser than in *Helicosporium*, distinctly multiseptate, mostly lateral; and the threads are much more robust. In *Helicosporium* the flocci are delicate, but rigid, and the spores filiform, of equal length throughout, and generally terminal, with indistinct septa. As far as hitherto ascertained two species of each genus are British, *i.e.*, *Helicoma Mulleri*, Ca., with *Helicoma viride* (under *Helicocoryne* in the Handbook), and the two species of *Helicosporium*, long since recorded.

Externally, there is no feature by which these genera could be distinguished from other of the black moulds. They form dirty, greenish, or blackish patches on wood and bark, and are as much like a *Torula* or *Helminthosporium*, as anything else, except perhaps that the stratum is thinner, and not so decided. *Helicotrichum* is, undoubtedly rare, not only in Britain, but also on the Continent. Of the two species, *Helicosporium vegetum* is the most delicate, with very slender, simple threads, and small hyaline spores, whereas, in *Helicosporium pulvinatum*, or what seems to me to be that species—

* *Helicoma*, Corda (1837), Icon., i., p. 15.
Helicocoryne, Corda (1854), Icon., vi., p. 9.

† *Helicosporium*, Nees (1816), Syst., p. 68.
Helicotrichum, Nees (1818), Nova. Act. Leop., ix., p. 246.

‡ *Helicomyces*, Link. (1809), Berl. Mag., iii., p. 21.
Helicotrichum, Nees = *Helicosporium*, Nees.
Helicocoryne, Corda = *Helicoma*, Corda.

the threads are stouter and branched, and the spores are larger, or at least form a larger coil.

A curious circumstance may be mentioned in connection with *Helicoma*, to which Mr. C. B. Plowright, of King's Lynn, has directed my attention. He has found growing upon sawdust a *Helicoma* which differs somewhat from *H. Mulleri*, in having rather larger spores, and in the threads being accompanied by other, apparently barren threads, which are more slender, and with longer joints. In company with this *Helicoma*, and intimately associated with it, he found a species of *Sphæria* with sporidia nearly of the same size and form as those of the *Helicoma*, but straight, and not helicoid. It is a most interesting *Sphæria*, and seems to be quite distinct from any species previously described. What are the relationships which subsist between these two very widely distinct fungi is a very natural question? Some there are who would cut the gordian knot at once, and declare upon circumstantial evidence that the *Helicoma* is but the conidia of the *Sphæria*. It is true that circumstances seem to favour such an assumption, but, after all, more definite and decided evidence must be afforded before we can accept such an assumption as an established fact. Too many such assumptions are already passing current as facts, and what we require is investigators who will endeavour to trace out patiently the relationships which subsist between these associated forms. If the black mould should be termed the conidia, then the question arises, what is the *rôle* of these conidia? What functions do they perform in relation to the *Sphæria*, with which they are associated? Are they a depraved condition, or are they simply a second form of fruit? If the conidia spores germinate under favourable conditions, will they ever produce a *Sphæria*, or, on the other hand, will the *Sphæria* degenerate into a black mould? Calling them by a name, whether "conidia," or "stylospores," is only removing the difficulty a step further, but not solving it. It might prove stronger evidence if the same black mould always accompanied the same *Sphæria*, but such is not the case. *Monotospora* will at one time be found with one *Sphæria*, at another time with another, or even with an *Hysterium*. A species of *Helminthosporium* will accompany one *Sphæria* to-day and another to-morrow. In fact, we possess numerous instances of this idiosyncrasy which debars me from accepting as fact deductions from mere association. After all, the circumstance of their occurring together may be accidental, and until we know the reason why they are together, and the undoubted influence which one exerts upon the other, it is far more philosophical to be sceptical, than to accept assumptions as fact. If it cannot be shown that the presumed conidia of any one of the *Dematiei* affect the life history of any one species of *Sphæria*, or that there is any closer functional relationship than mere association, it is only raising a monument to our own ignorance, to apply to them the name of *Conidia*, when we do not know ourselves what we mean by the term so recklessly employed.

There is a small but very important group of the *Dematiei*, in which the spores, instead of being produced singly, or in chains, at the tips of the threads, or their branches, or from their sides, are generated in clusters forming, more or less, globose heads, either at the apices of the threads or their branches. These moulds are represented by two or three genera in Britain, of which *Sporocybe* is one.

Some difference of opinion seems to prevail between mycologists as to the recognised limits of this genus, which must be noticed here, lest the conclusion be arrived at that I am ignorant of the fact. *Sporocybe*, as accepted by the Rev. M. J. Berkeley* and myself,† has simple threads, terminated by a globose head of spores. Others contend that the stem may be either simple, or compacted of several threads together into a common stem. This is such a manifest and distinct difference, that I am surprised to find continental mycologists, always mad for new genera, supporting the anomaly for a single day. To have confounded *Sporocybe* with *Periconia*, and mixed the two together, rests, however, on their responsibility and not on ours, although, undoubtedly, when first established it included the two forms.‡

During the winter months almost any small portion of the stem of herbaceous plants, such as the nettle, found lying in a damp situation, will be seen to be covered with delicate black hairs, almost invisible to the naked eye, but visible under an ordinary pocket lens. This is *Sporocybe byssoides*, so common and so widely diffused that it can scarcely escape notice. In this mould the threads are rigid, erect, and without branches, the tips are thickened into a head, and upon this are borne the globose dark coloured spores, which

* Berkeley's Outlines of Fungology, p. 343.

† Cooke's Handbook of British Fungi, p. 566.

‡ Fries (1825), Sys. Orb. Vet., p. 170; Corda Icones, iv., p. 29, "Stipes simplex erectus, flocciformis, septatus;" also Corda Ic., v., p. 15. Berk. Outl., p. 343. Cooke. Hdbk., p. 566.

entirely cover the swollen tip, and form a round capitulum. The mass of threads do not form such a dense black stratum as is common in *Helminthosporium*, but only in sufficient number to cause the affected portion of the thread to appear a little darker to the unaided eye. The stems and leaves of grass are less commonly inhabited by a smaller species. The threads in all the species are not unbranched, for in *Sporocybe alternata* they have alternate branches, and in a smaller species, both found on paper and millboard, they are much branched in an irregular manner. The last named is *Sporocybe minima*,* which causes sooty patches on damp paper, and has very small globose spores.

Damp paper and millboard will also furnish another mould, which would appear to the naked eye as the same ; but which will be found on examination to offer a distinct mode of formation of the capitate head. This is termed *Stachybotrys atra*. An examination of the tips of the threads will show that they are there compounded of a number of lobes, each of which is terminated by a spore. This is the main distinction between the two genera. Perhaps, as a rule, the spores are proportionately longer in *Stachybotrys* than *Sporocybe*. It is somewhat curious that so many of the species in these two genera should be found growing on damp paper.

More rarely examples are to be found of a mould, with the spores clustered together so as to form a distinct head, although by no means a compact one, belonging to the genus *Acrothecium*. As far as I am aware only two species have been found in this country, and those very rarely. The threads are erect, stiff and unbranched, and the large septate spores are arranged in a radiating manner about the tips. In some respects it agrees with *Helminthosporium*, except that the septate spores are aggregated at the tips of the threads.

Here might be noticed a curious mould which hardly accords with any of the artificial divisions adopted for the purposes of this communication, in which the spores are compound, or formed of three or four arms united at the centre in a triradiate manner. This is *Triposporium*, a figure of which was given in the preceding communication published in the Journal of the Club. The genus *Camptoum* must also be included here.

It was doubtless an error to include amongst the *Dematiei* the genus *Œdocephalum*, which was so placed in the Handbook, on authority of previous authors. At that time I had seen no speci-

* Grevillea, vol. v., pp.

mens; but having done so, I am now strong in the belief that it belongs to the *Mucedines*.

Having now traversed the whole of the ground over which I purpose to pass upon the present occasion, it becomes advisable to gather together the fragments into as compact a form as possible; and this can best be done by arranging the groups in a tabular form, so that the student may see at a glance the relations which they bear to each other, and be enabled to place an unknown mould in its proper place. Advisedly all those having a compound stem have been excluded, in order to bring within reasonable limits a rather large Order.

Threads simple.

Spores not collected into a distinct head—

A. globose or obovate . . . . *Monotospora.*

B. elongated, straight.

(*a.*) Threads rigid or dark coloured.

1. Erect, not capitate.

Spores single . . . *Helminthosporium.*

" concatenate . . *Dendryphium.*

" triradiate . . . *Triposporium.*

2. Erect, apex swollen.

" " cup shaped . *Cladotrichum.*

3. Creeping . . . . *Clasterisporium.*

(*β.*) Threads flaccid, usually pale.

1. Spores concatenate.

" simple . . . *Fusicladium.*

" uniseptate . . . *Cladosporium.*

" variable . . . *Heterosporium.*

2. Spores single.

" bacillary . . . *Cercospora.*

C. multicellular.

4. Threads rigid or dark coloured.

Spores basal . . . *Septosporium.*

2. Threads flaccid.

Spores terminal . . . *Mystrosporium.*

" scattered . . . *Macrosporium.*

D. helicoid.

Threads rigid or dark coloured.

Spores terminal . . . *Helicosporium.*

" lateral . . . *Helicoma.*

Spores collected in a terminal head—

A. Threads capitate.

Apices simple	. . .	*Sporocybe.*
„ lobate	. . .	*Stachybotrys.*

B. Threads not capitate.

Spores simple	. . .	*Camptoum.*
„ septate	. . .	*Acrothecium.*

It might have been interesting to have pointed out how some of the moulds under notice possess analogies in other Orders, as, for instance, in the *Coniomycetes*, where there are no threads. It will be sufficient to suggest *Triposporium elegans* and *Asterosporium Hoffmanni*, *Helicosporium vegetum* and *Helicomyces roseus*, *Septosporium atrum* and *Sporidesmium polymorphum*, *Macrosporium echinellum* with *Stigmella Montellica*, *Mystrosporium Spraguei* with *Sporidesmium* of the *antiquum* type, and *Clasterisporium* with *Sporidesmium* of the *insidiosum* type. These, however, are analogies, and not affinities.

This communication must not be closed without a few practical observations, with the view of assisting those members who may be desirous of pursuing this branch of investigation.

The Black Moulds, or *Dematiei* are a very natural and well-defined group of Hyphomycetal Fungi. It is by no means difficult to find them, and when found a little care will soon enable the student to place them in their proper genera. Undoubtedly autumn and spring are the best of seasons to search for them, but no time is wholly barren. The places are variable, and experience will in such matters prove the best guide. It is useless looking for them except upon decaying vegetable substances, such as old rails, felled trees, chips lying on the ground, rotting twigs, and such materials, which have for some time been at rest, and in a moist condition. An old hedge, a thick old hedge of the antique type, with a mass of half decayed twigs, leaves, and grass, collected about the base of the hedge plants, is a good locality. With a crooked stick many a profitable half hour may be spent at such a spot. The rotting twigs should be scratched out from around the bottoms of the stems of the black thorn, hedge maple, hawthorn, and such plants of which the hedge may be composed, and every stick looked over and thrown aside if useless. If black, sooty, or velvety patches are found, these will probably be caused by a black mould, and in such cases each twig must be wrapped by itself in a piece of paper and consigned to the vasculum. Sometimes the patches are dense, and so black that the naked eye at once detects them: in others, the threads are so scattered that a lens will have to be used. When a delicate specimen, with erect, black threads, is found to which pressure would certainly prove fatal, it is always desirable to be provided with a small box or two in which to place them. In default of this, a pin thrust through the twig, and this fastened into the hat-crown, as an entomologist would impale a butterfly, will be found a good plan for carrying home the specimen uninjured.

Such delicate black moulds are to be found on the dead stems of nettles and other herbaceous plants, on dead clematis, honeysuckle, and ivy, and, if carried home carefully, may be transported many miles, with the spores still clustered at the apices of the threads: but to ensure this they must be treated as a delicate insect would be treated, and kept from contact with other substances, and not violently shaken. In a wood, where the brush is cut down every few years, little chips and twigs will be found on the ground, partly covered with grass and leaves on which black moulds are flourishing. The old stumps again will have little twigs and chips entangled about the base, which the wind has been powerless to drift about, and these, also, are to be examined: but, after all, commend me to the thick old hedge. A friend of mine had an iron fork or rake, with two bent prongs, constructed to be carried in the pocket, and used to draw out the rubbish amongst thorns and brambles in a dense hedge, and this fork has brought out many good things. It is just such a spot on which I found *Cladotrichum uniseptatum*. Wherever there are old rails or palings, the more dilapidated the better, in a damp sheltered situation, large black patches of mould are almost certain to be found, and even a piece of old sacking, left to rot in a ditch, should never be passed without an inspection. Above all things, a good wood-yard is a perfect paradise for a mycologist. A good practical mycologist of my acquaintance once found in a single excursion in a wood-yard the unprecedented number of upwards of seventy species of Fungi, but such success rarely falls to the lot of any one individual. The rubbish corner in a large garden, where all sweepings, cuttings, trimmings, cabbage stalks, artichoke stems, and asparagus stems are cast aside to rot, is a good hunting ground, and even a stack of faggot wood is not to be despised, when it can be found. It is usual to repair hedges by thrusting in cut branches of hawthorn, sloe, maple, and other plants to fill up the gaps made by predatory boys. These branches never grow, and the ends which are thrust into the ground, not only help to fix them, but also to keep them moist, and help to develope the black moulds. Such a spot should be examined. These hints will, however, probably be sufficient to indicate the kind of places most favourable in which to find black moulds, and how to carry them home. The next point is how to examine them when we get them there. I always prefer, in the first instance, to attach date and localities to the spoil of the day, before examination, which provides for another hunt if any spot proves unusually productive, and localises a good thing, the precise spot for which might be forgotten if not done at once. It is always useful to add, whenever it is possible to do so, the name of the stick, twig, or leaf on which the mould occurs, whether sloe or maple, holly or hawthorn, nettle or thistle.

Having prepared for examination, it may be premised that in the case of Moulds no previous soaking or damping is desirable, although this is essential for the Ascomycetous fungi. It is a good method always to look at a specimen first with a pocket lens, then with a two-inch objective, and lastly with a quarter-inch. For the latter, of course, some preparation is necessary, and to accomplish this it may be well to detail my own method. In order to ascertain, first of all, the true character of the mould, a preliminary examination is made by taking off a small quantity of the mould on the point of a sharp knife, and transferring it to a glass slide. A very minute drop of water first placed in the centre of the slide is sufficient to cause the mould to leave the knife and adhere to the slide, but not sufficient to spread over it, and cause the spores to leave their attachment to the threads. It is essential to ascertain always how the spores are attached to the threads, whether singly or in clusters, whether terminal or lateral; and inasmuch as the contact of moisture is sufficient to cause them at once to break from their supports, the examination can only be performed before the mould is moistened. In order to do this the microscope should be placed erect, the small fragment of mould on the slide covered with thin glass, and then submitted to the quarter inch objective, dry. It will be conceded at once that a most imperfect view will thus be obtained of the mould, but by the exercise of care and patience it will not be impossible to make out all essential particulars as to mode of attachment. Moulds are so microscopical in their details that a less power than 320 diameters will hardly give a satisfactory result. I have tried several methods to obtain readily, as an opaque object, a good view of a small fragment of mould by a one-third or one-fourth objective. By having an objective constructed, specially for the purpose, with the metal reduced to a minimum, so that the point should be as small and obstruct light as little as possible, I hoped to have been able to direct sufficient light upon the mould to view it as an opaque object, at least with sufficient distinctness to recognise the great features of growing habit; but all these efforts have resulted in a practical failure, and I have been compelled to revert to the old imperfect method.

Having satisfied myself with the preliminary observation, a little spirits of wine is placed at the edge of the covering glass, and allowed to enter by capillary attraction, and invest the whole of the mould. Of course the spores will at once all leave their attachment, but with the knowledge obtained at the preliminary examination, it will not be difficult now to determine both the genus and species of the mould under examination. For what reason use spirits of wine? it may be asked. The answer is that unless alcohol, or benzine, or ether, are employed, small bubbles of air will cling persistently about the mould, and no effort will remove them. The threads appear to resist pertinaciously water and glycerine, and determine to float upon them. Thus far, then, we are enabled to examine a mould; but it may be thought advisable, imperfect as such an object must be when immersed in any fluid, from the speedy displacement of the spores, to have it permanently mounted for future reference and comparison. Such a mounted object will always show the character of the threads, and the size and septation of the spores, and being already mounted to hand, a new mould may at once be compared, whilst under examination, with the spores and threads of twenty or fifty other species, within a few minutes; whereas, if every one had to be examined anew, a great waste of time and labour, to say nothing of reducing the specimens by a recurrence of examinations, would take place. I can, therefore, strongly recommend permanent mountings as tests, or types, for comparison, and I count my own collection of such objects by thousands. They are not attractive, perhaps, not always pretty, not well displayed, not available for a public soirée or a private tea party, but they are practically invaluable for scientific work, and by their aid a most important element is obtained, at least to a scientific man, who finds that life is all too short, a great *economy* of time.

The method which I have pursued for permanent mounting has been a rough and ready one, just sufficient to obtain the objects in view, and nothing more. I remove a small fragment of the mould, or other object, on the point of a dissecting knife, place it in the centre of a slip of glass, add a small drop of spirits of wine just enough to saturate the mould, separate the threads with a needle, if necessary, and then, as all the superfluous spirit will have evaporated, drop a small drop of pure glycerine on the object. A square glass cover (I always use 5-eighths) is placed on the object, and pressed down. If a proper sized drop of glycerine has been estimated, this will just spread out to the edge of the cover; if too *much*, it will flow out at the edges, and may be wiped away with a camel hair pencil; if too *little*, then more can be insinuated at the edges until the whole is filled. A brass clip then holds the object in its place. The edges of the thin glass must next be cemented to the slide. This I accomplish by the use of gum dammar dissolved in benzole, luting the edges with a small brush. The clip is kept in its place for 24 hours or more, until the dammar is sufficiently dry to permit of its removal, but before the slide is laid down it is indispensable that a label should be attached, with the name of the object, the source whence obtained, and all other information necessary to secure its ultimate utility and authenticity to its fullest extent.

As to the glycerine and the dammar, are these the best substances for the purpose? From present experience I should say that they are. With glycerine I have found no shrinking and no alteration in size or colour of the sporidia over a period of several years; I have suffered no inconvenience from the growth of parasitic moulds upon the preparation; I have noticed no instances of the spores themselves commencing to germinate after having been mounted, and if the mounting has been properly performed, and ordinary care observed to keep the slides flat, and prevent unfair usage, no leakage, or at most not more than one per cent. which might be attributed probably to some slight imperfection in the mounting.

The advantages possessed also by the gum dammar dissolved in benzole, are now so widely and generally estimated, that it is scarcely necessary to enumerate them. It may be observed, however, that in using it as a cement where glycerine is employed, there is a very great advantage in the readiness with which the dammar adheres to the glass independently, or in defiance of the little glycerine which will always hang about the covering glass or the slide. This is worthy of consideration, since, in most instances, cements will roll up and retreat before the slightest smear of glycerine, and their success depends so largely on the practically rare condition of the glass being chemically clean.

The mechanical details being now disposed of, some suggestions as to the application of the objects obtained for the purposes of systematic study may not be out of place. Your work does not end with fifty new objects mounted, catalogued, and placed in the cabinet. Thus far it has been mechanical; one man may pride himself on being a better mechanic than another, but still only a mechanic, he has made his tools, he has prepared his materials, but until he brings these under the control of his intellect, they remain as unused tools, as unemployed material.

No longer a boy, but with a quarter of a century of experience at close microscopical work, I may be permitted a little of the garrulity of age, and to assume the privilege of advising younger men. Forty years ago I purchased my first microscope as a scientific toy, with my boyish coppers. Had it continued a mere toy it would have been thrown aside long ago. This leads me to a subject which has more than once been urged in this place, and must, at the risk of repetition, be urged again. What are we doing with the marvellous instrument which has been placed in our hands, for the instruction of ourselves and the progress of the age in which we live?

To answer this question, each for himself, leads us to the reflection what are the uses of the microscope, and we find practically that they are two, that of a *toy* and of a *tool*. A child is pleased with a watch; he hears it *tick*, and, in his estimation, *that* is the perfection of a watch, he will amuse his fellows with it, and the faster the hands will go round the better he likes it, but above all its manifestation of power will delight him, there is a mystery which he cannot comprehend involved in the constant tick, tick, tick! The matured child has no less respect for the watch, but for a different reason—to him it is no longer a *toy*, but an instrument, a servant, a power, a *tool*. By means of it his business affairs are regulated, his minutes economised, and its tick serves him in counting the pulsations of the sick and dying, and may aid in countless ways for human good.

Is there no analogy between the watch and other scientific instruments—between the watch and the microscope? Without personal insinuation, may I not affirm that in the hands of hundreds the microscope fulfills no higher purpose than the watch in the hands of a child? Its marvels, its mysteries, fill with astonishment and delight. There is the *tick*, and nothing more. Setting aside all professional men who employ the microscope of a necessity in their profession, what proportion of the rest ever go beyond the age of childhood, the era of toys? Because it is popular, because it furnishes employment for leisure hours, because it is an amusement amongst friends, or because some one else has purchased a microscope, are amongst the reasons why many a one commences, and its continuance is too often in the same spirit. Let us look amongst ourselves, and enquire what are *we* all doing with the microscope—what work do *we* get out of it?—and if compelled to the confession that we get none, then it is only a *toy*.

A person, for instance, has a microscope—he is fond of it—uses it every evening after the toils of the day are over—can manipulate it well—has a happy knack of controlling the light. He has also a collection of objects, all of which he examines with pleasure, adding to them occasionally, either by his own industry or the kindness of a friend. In his family circle such an one is exemplary. His objects are exhibited and explained to his family and his acquaintances, and many an impromptu lecture is elicited on the marvels of minute life. He goes out on Saturday with the excursion, and brings home *Volvox* or *Stephanoceros*, or a red *Hydrachne* or *Hydra viridis*, and thus year after year he pursues the same quiet course, trying to see the *Volvox* roll over and over to the best advantage. Or it may be that he is possessed of a more energetic temperament, and must endeavour to mount thinner and cleaner sections of wood or muscular fibre than any one else, or he will spend evening after evening in the vain endeavour to mount something, which the experienced mounter will sell him for a shilling, and much better done, simply because it is a specialty. And thus, over the whole range of microscopical research, he will flutter like a butterfly over a garden of roses, alighting here and there, but finding no rest. I would not condemn such a man, if what he is doing seems to be right in his own eyes, but a friendly hint may be of avail, if it only induces him to ask of himself the question, Am I using the microscope as a toy, or am I flattering myself with the delusion that I am using it as an instrument for the advancement of Science?

Turn aside with me if you please, to watch a strange-looking man always found lurking about streamlets, ditches, ponds, puddles, and such watery localities; ever and anon stooping and dipping, and then retiring with plenty of small spoil corked up in small bottles, to amuse himself with them at his leisure. This man, although alone on the marsh, or moor, enjoys his excursion; there is a pleasure and interest in it which the casual excursionist cannot comprehend. And why? You may be sure that the secret is in the *man*; he is steadily pursuing some one object, he has a fundamental motive, his energies are being controlled and directed in some given direction, and hence knowing what he requires, and where to seek it, he pursues his excursion, as he follows his business, with *method*, and consequently with *success*. Follow him to his home, and his microscope; you will not find him encumbered with a large and complicated instrument, but with a small and simple one, just suited to the work it has to perform, his cabinet of objects simply reflects the image of his hobby. Perhaps there are no "young oysters," "elytra of golden beetle," "Topping's hair of Indian bat," "proboscis of blow-fly," "scales from a butterfly's wing," or "section of bullrush," but there are many of the one special subject of his study. Consult his library, it is not a large one, but contains all he requires, just because he circumscribes his studies. Talk to him, he is not devoid of general information on general microscopical subjects, but, if by chance you should advert to the one special object of his study, then will you discover yourself not in the presence of a student, but of a master, and whilst you feel compelled to bow with respect before one who at once establishes his supremacy by learning to do one thing well, you cannot but remember that it was just such concentration which enabled John Ralfs to produce his British Desmidiæ, John Denny, his volume of *Anopleura*, William Smith his British Diatomaceæ, George Johnson his British Zoophytes, and last, not least, our late venerable friend, Dr. Bowerbank, his British Spongiadæ, and would enable others to achieve a similar success in other directions.

The arguments in favour of special studies, of the habit of concentration in study are strongly on the side of the student. A smaller library will be required, and the best books in a special subject might be purchased for the same cost as a number of general ones, a thorough mastery may readily be obtained as the result of a constant experience with the same class of organisms, co-operation of others will follow the knowledge that a special field of work has been entered upon. Satisfaction will result from the self-consciousness that sound and not superficial knowledge is being acquired. Respect for his work's sake, and deference to his opinion, are sure rewards to be anticipated, and ultimately, not only must such an one be in a position to contribute to the advancement of science, to become an honour to the club of which he is a member, but everywhere to meet with the encouragement which the best and highest authorities of the age will freely extend to an honest and thorough worker in any definite department.

Returning from this digression to the mode by which the collected specimens of black moulds are to be turned to advantage, I would suggest that a casual glance through a number of these will at once suggest their points of agreement and divergence, and hence the bases of their systematic classification. All are possessed of threads, and naked spores, but these differ, and their differences assist in the grouping together of allied forms into genera. Some threads have their spores borne at the base, others at the apices, others at the sides. Some have simple spores, others multiseptate. Then by a comparison of the figures and descriptions in the Handbook of British Fungi, a knowledge may be obtained of the characteristics of the principal genera. Next, the differences which subsist between very similar forms, those which are termed specific differences, and so commencing by giving a recognised name to distinguish one from another. Having thus laid the foundation for work, each or any of the individual forms may form the subject of investigation. For instance, how does it grow, what the conditions of its life, through what stages do the spores pass, how do they germinate, how does the plant reproduce itself, how may it be cultivated, what is its relationship to other forms—all these are directions in which investigation may legitimately proceed, and as little or nothing is known, is sure to produce results which others will be glad to learn. That which is applicable to these organisms, is also applicable to very many others. It matters little whether we call them white moulds, black moulds, Desmids, Confervæ, Acari, Poduræ—a similar course is available for all.

There is one other point to which no allusion has yet been made, viz., the drawing and measurement of microscopical objects. Trustworthy drawings made to a definite scale, are always valuable, and will be when names of genera and species become antiquated, and systems of classification are all modified and changed, if not passed away. Although claiming no special superiority for the method so extensively adopted by myself, I will briefly describe it. All drawings are made to an uniform scale, by means of a Nachet camera. This peculiar form has the advantage of being used with the microscope oblique. It is permanently attached to the eyepiece, and when any object is presented on the field which it is considered advisable to draw, it needs only to turn down the camera and draw it without moving object, microscope, or light, in the slightest. A tripod collector's microscope always stands at the same angle, and the image drawn on the table beneath is always precisely of the same scale, so that this scale once accurately determined is always the same. All measurements can be made from the drawings, with the previously constructed scale, and this uniformity is practically so useful that the eye becomes accustomed to appreciate the dimensions, and can estimate within $\frac{1}{5000}$th of a millemetre, without using the scale. As this method has been adopted by several microscopists, from my example, with satisfaction to themselves, I may fairly assume that it is one which, for simplicity and practical utility, commends itself to the notice of members of the Club. As a matter of detail, it may be mentioned that copies of the Nachet camera have been manufactured by Mr. Swift.

And now, gentlemen, permit me to thank you for the patience with which you have listened to the details of a subject foreign to your own pursuits, and to express a hope that the illustrations and the arguments adduced from them may attain their desired effect. That some one or two may be led to see the error of their ways, and be converted to this doctrine of the Conservatism of Force. That, setting before themselves a definite and decided career, which shall be alike honourable to themselves, useful to others, and of advantage to Science, they may, by persevering endeavour, become *Master* in some one of the workshops of Science, and not as heretofore only illustrations of the homely proverb, "Jack of all trades, and master of none."

DESCRIPTION OF PLATES XXIV. TO XXVII.

FIG.

1. Monotospora sphærocephala, *B. & Br.*, from Britain.
2. Helminthosporium stemphylioides, *Corda*, from Edinburgh.
3. ,, rhopaloides, *Fres.*, from Forden.
4. ,, fusiforme, *Corda*, from Forden.

FIG.
5. Dendryphium ramosum, *Cooke*, from Britain.
6. Triposporium fructigenum, *Rabh.*, from Germany.
7. Cladotrichum uniseptatum, *Cooke*, from Dartford.
8. Clasterisporium caricinum, *Schwz.*, from United States.
9. ,, maculatum, *Cooke*, from India.
10. ,, vermiculatum, *Cooke*, from Hereford.
11. Fusicladium pyrorum, *Lib.*, from Britain.
12. Cladosporium profusum, *Rabh.*, from Germany.
13. Heterosporium ornithogali, *Klotsch.*, from Shrewsbury.
14. Cercospora resedæ, *Fckl.*, from Jersey.
15. Heterosporium variabile, *Cooke*, from Forden.
16. Septosporium velutinum, *Cooke*, from United States.
17. Mystrosporium Spraguei, *B & Curt.*, from United States.
18. ,, aterrimum, *B & Curt.*, from United States.
19. Septosporium maculatum, *Cooke*, from United States.
20. Macrosporium nobile, *Vize*, from Forden.
21. ,, Brassicæ, *Berk.*, from Britain.
22. ,, Scolopendri, *Cooke*, from Britain.
23. Helicosporium vegetum, *Nees*, from Britain.
24. ,, Ellisii, *Cooke*, from United States.
25. Helicoma Mulleri, *Corda*, from Britain.
26. ,, Curtisii, *Berk.*, from United States.
27. Sporocybe byssoides, *Fries*, from Britain.
28. Stachybotrys lobulata, *Berk.*, from Britain.
29. Sporocybe minima, *Cooke*, from Nottingham.
30. Acrothecium obovatum, *Cooke*, from United States.
31. Camptoum curvatum, *Link.*, from Britain.

All the figures drawn to an uniform scale of 500 diameters, except the additional portions of figs. 2, 28, & 30, which are further enlarged.

On the Absence of Stomata in Certain Ferns.

By W. H. Gilburt.

(*Read March 23rd*, 1877.)

The group of Ferns referred to in this paper are those commonly known as the filmy ferns, comprising the three genera—*Hymenophyllum*, *Trichomanes*, and *Todea*—a group containing forms, perhaps the most delicate in appearance, structure, and constitution of the whole family.

These ferns are assumed to possess stomata in common with all plants (save Fungi and Lichens) living under sub-aërial conditions, at least I have found nothing to the contrary in any of the authorities consulted, among which have been most of the best and latest: in fact, the teaching of the English Text-books may be summed up in this—"That all plants have stomata except such as are wholly cellular, and those whose leaves are wholly submerged:" the first exception referring to Fungi and Lichens, the second to those plants whose leaves are developed and always remain under water. Sach, however, goes a little further, and says, when speaking of Mosses, "their leaves are composed of a single layer of cells, and are, therefore, of necessity without stomata." He also, in an earlier part of his work, when treating of the *Hymenophyllaceæ*, states that the lamina of their fronds is composed of a single layer of cells, making no remark however, concerning stomata, possibly assuming that, as in *Selaginella*, while absent for the same reason as in Mosses from the lamina, they would be found along the midrib and venation.

In examining these ferns two methods have been employed—first, by decoloring and staining to view them as transparent objects, and thus, to make out their structure, so far as cell-walls and vessels are concerned, undisturbed; the other, by examining their surfaces, and making sections of every part and in all directions while in a fresh and natural condition.

The following are the species which have been examined :—

Hymenophyllum Asplenoides.
,, *hirsutum.*
,, *flabellatum.*
Trichomanes radicans.
,, *alatum.*
,, *tenerum.*
,, *Membranaceum.*
Todea pellucida.
,, *superba.*
,, *Fraseri.*
,, *Hymenophylloides.*

Leaves of all kinds are generally understood to possess a cuticle which is continuous over all their parts. This encloses the several layers of parenchyma and the vascular system. The cells of this cuticle are usually thick-walled and colourless, taking no part in the plant's economy, simply preserving a suitable hygrometric condition within the substance of the leaf by preventing too rapid evaporation, communication with the atmosphere being kept up by means of the stomata and inter-cellular spaces ; the first of which are always situate in the cuticle, being formed by a modification of some of its cells.

Now the first fact to be noticed in the structure of these ferns is that they have no cuticle : neither on the lamina of the frond, the venation, or the stipes, and that in all three genera, the outermost cells are the active ones, and no inter-cellular spaces are to be found.

As already stated, Sach refers to the fact that in *Hymenophyllum* the lamina of the frond is composed of a single layer of cells : this also proves to be the case in three of the species of *Trichomanes* which have come under my notice, being tabular in form, becoming longer and altered in outline over the venation, and looking in section very like a string of beads.

In *Trichomanes membranaceum*, however, we have a somewhat more complicated structure. The cells in this species are more or less cylindrical, being flattened where they join each other. The frond consists of from one to three layers of cells, or from two to four, the number depending apparently upon the amount of vigour at the time of development, the larger and more vigorous looking fronds possessing the greater number. The venation in the fronds of this fern is linear and radial from their base, and the thinnest part (or where one or two cells only in thickness, as the case may be) is always midway between the veins, the greater number being those immediately surrounding them.

In *Todea* we have again another variety of structure, there being one layer of cells at the margin, increasing to two immediately, and then to three as we get farther towards the veins. The intermediate layers of cells are much larger, and are roughly hexagonal in outline, when the frond is viewed by transmitted light.

The superior and inferior layers of cells in both *Todea* and *Trichomanes membranaceum* are very largely supplied with chlorophyll, while the intermediate layer contains little, if any; showing that, at least far the largest share of work, in the elaboration of the crude sap of the plant is performed by these exterior thin-walled cells.

There is one feature worth noticing in *Todea pellucida*, *i.e.*, in those parts where the three layers of cells exist, the superior and inferior ones take on the irregular wavy outline of the ordinary cuticle cell, though having no other character in common. Here it would appear that we have indications of an approach to the more highly developed and differentiated fronds of other ferns.

In the stipes of these species there is also a variation from what we generally find in the same parts of other ferns. Commencing from the outside we find a single layer of chlorophyll-containing thin-walled cells. Next in order we have a layer of close-fitting, greatly elongated cells, very small in diameter, and with walls much thickened, but apparently without markings. These cells, as we work towards the middle of the sections, gradually increase in diameter, and decrease in thickness and length, till we come to the woody bundle which occupies the centre.

All the cells are cylindrical in form, the ends being usually set together at nearly right angles to their greatest length, and all except the outer layer, at this time of year, are filled with starch, and in none but the outer thin-walled layer have I found a trace of chlorophyll. This arrangement holds good as the stipes passes into the midrib and throughout its ramifications.

Thus from a consideration of the structure of these Ferns we may fairly conclude; there is no place for stomata in their tissues, and no purpose they could serve in the economy of the plant.

Note.—Since reading the above, my attention has been called to a monograph on the *Hymenophyllaceæ*, published at Prague in 1843, by Prof. Dr. Karl B. Presl, in which he refers to the absence of stomata in this genus.

In the case of *Todea*, however, I have not been able up to the present time to find any note of their absence having been before observed.

A Contribution to the Life-History of Botrylloides.

By T. Charters White, M.R.C.S., &c.

(Read April 27th, 1877.)

Plate XXVIII.—Lower Part.

To treat of the Natural History of the whole of that division of the Mollusca known as the Tunicata, with the fullness its interesting character deserves, would be impossible in the limits of a short paper, or within the time allotted to me; but the members of this Club, who are doubtless well informed of the characteristics of this class, will perhaps allow me to call their attention for a few moments to some particular observations I have been enabled to make, and which I beg to offer as a contribution to the life-history of one species, viz., *Botrylloides.*

It was in the early part of the year 1876, that I discovered in my aquarium a patch of *Botryllus* on some *Ulva latissima*, and wishing to examine it more conveniently, I brought the *Ulva* close to the front glass, and allowed it to remain there. After a few weeks I observed that one corner of this patch had become attached to the glass, and my interest was the more increased, since the fact of the possession of locomotive powers in this class of the Mollusca had not been noted by previous observers, except in their young and larval condition, and I watched more closely than before to determine if it really moved, or if it increased by subsequent development, and could so reach the glass, and to my gratification I found that, while it came more on to the glass, it retained its original size, an observation which, after some two months, was confirmed by the patch having transferred itself entirely to the glass front of the aquarium, where I hoped to be able to investigate its mode of progression as well as the general economy of its life-history; but owing to the thickness of the glass, the imperfect illumination of the object, and the want of transparency of the gelatinous mass in which the zooids were imbedded, very little could be made out in its then condition, but the following observations were readily noted :—The mass or patch was of irregular shape, about the dimensions of a florin (Fig. 1), having its borders marked by numerous capes, headlands, and bays, while scattered throughout its substance were freely distributed a great number of granular bodies, that under the low magnifying power of a pocket lens, appeared like calcareous spicula, aggregated into little groups. The *Tunicata* were disposed irregularly throughout the coasts of this patch, and not in accordance with the stellar arrangement generally figured in *Botryllus*, but in small knots of from four to six zooids, sometimes a zooid would occur singly; from the numerous headlands springing from the borders of this patch, pseudopodic processes could be observed stretching out like the tent ropes of a marquee, but these were not fixed permanently, but would be found altered from hour to hour, and from day to day.

Long and patiently I looked at my specimen, trying by every contrivance suggested to my mind, to bring my microscope to bear on my colony, that I might learn more of its internal economy, and that I might study some of the secrets of its reproduction and development, but without avail. The most I could see was the contraction ever and anon of the branchial sacs of the enclosed *Tunicata.* Meanwhile my patch, without increasing in size, was slowly moving up the front of the aquarium, whether by means of its amæboid pseudopodia, or by any other means, I could not discover, but it nevertheless had moved a distance of nine inches. It had now been about four months performing this journey, when a thinning took place in the centre of the patch, which thinning increased daily till the patch became an open ring, and this ring then became narrower, at the same time that it extended itself to about three inches in diameter, the tent ropes still forming a marked feature both within and without the ring. Now sometimes a single *Tunicata* would be seen at the end of one of these pseudopodic processes, and I would look forward to an approaching opportunity of isolating it for microscopical examination, but only to find that after a few hours it would be drawn back again into the general mass. At length the ring began to break up into detached portions (Fig. 2), and I was then enabled to take one of these islands (Fig. 3), and make a careful microscopical investigation into what I had patiently waited for months to ascertain—viz., by what method of locomotion this mass was able to transport itself from the bottom of my tank to the top.

The first observations I was fortunate enough to make, related to the character of the granular bodies distributed throughout the sarcode of the investing tunic. In looking at them with a pocket lens only, they appeared sometimes in small groups, and at other times dispersed and scarcely perceptible. But under the microscope I could easily distinguish a rolling movement in them; they were fusiform in shape, and granular in structure, and were placed upon the exterior of the sarcode, as they could be seen projecting from the surface, when the edge of the mass was in focus. What their office may be, I cannot pretend to determine, as they are apparently unconnected with even a fibre of the body, but they have the power, or the sarcode that bears them possesses the power, of bringing them together in groups, when they look like spicula with a pocket lens, and again of scattering them abroad over the mass so widely that two will scarcely be touching.

While making drawings with the camera lucida of these bodies, and the character of the sarcode, an interesting fact was presented to my notice. Having traced round the border of the small patch under observation, when I had reached my starting point, I found that the border was projecting in one part beyond my tracing, and more than that, its character was altered, an oblique light revealed the presence of very transparent vesiculæ of an uniform size, and so clear that by a full illumination they were invisible, rolling very slowly and gradually from out the side of the patch, with a movement so barely perceptible, that it was only by repeatedly drawing its outline on paper that I could estimate its advance. This, then, evidently was its mode of locomotion, and the sarcode mass was endowed with amæboid properties. After a while the fusiform granules before alluded to became rolled over this projection, and it bore the same appearance as the rest of the patch, while new projections were forming in other directions.

The general appearance of the patch would not lead to the inference of its being highly organised, but from faint areolar markings visible in its internal structure, one might conclude that it was made up of similar vesiculæ, as referred to above; but great difficulty is experienced in gaining a clear insight into its internal characters by the immense number of diatoms with their brown endrochrome adhering all over the surface, which effectually obscure the view.

I feel it is not necessary before the members of this Club to enter into an anatomical description of these *Tunicata*, because all those familiar with the admirable details embodied in Dr. Carpenter's work on the Microscope, must be sufficiently acquainted already with that subject, and therefore you will perceive that in the observations I have laid before you this evening, I have for the present limited them to a few, and apparently, meagre details, bearing upon what I have personally seen; but it is my intention, if I can get materials sent me, to continue my observations, with a view to laying another short paper before you, when I can do so with profit to you; but in the meantime I would urge upon all, who may have the opportunity, to follow out these investigations for themselves, as I can promise them a rare harvest of interest in doing so, for whether as pretty and attractive objects for the microscope, or from a point of deeper interest, viz., the close relationship that exists between this class in its larval condition with the vertebrata, the *Tunicata* will amply repay the time and attention expended on their study. Then again they are the hosts of many interesting and peculiar-looking crustacean parasites, who take up their abode within the mantle or sac of some of the ordinary *Ascidians*, and which would well repay the collection and mounting. Then the test or mantle contains many forms of spicula not unlike those of the *Gorgonia*, which may be studied. I have placed under my microscope, this evening, a slide illustrating the character of these spicula, but while such objects as these may be of special interest to the collector of microscope specimens, I would say do not be content with the acquisition of these but pass on to the far more interesting study of the life-history of this class, and if only one or two meagre and disjointed observations can be made, yet, if truly made, and accuracy be sought for for itself alone, when these isolated contributions are put together they will help to make at last one harmonious whole. With these last words I ask your acceptance of this short communication, as one such contribution to the life-history of the *Tunicata*.

PROFESSOR GUISEPPE DE NOTARIS.

Guiseppe De Notaris was born on the 5th of April, 1805, at Milan, of a noble but impoverished Italian family. He became a student of medicine in the University of Padua, where he obtained his degree in 1830, and practised for a short time in the hospitals at Milan. But his bent towards botanical studies had displayed itself even when a student, and in 1832 he received his first appointment as Assistant-Professor of Natural History to the Lyceum of St. Alexander in that city. After receiving several minor appointments, he was, in 1839, located at Genoa as Professor of Botany to the University; and in that town he resided for thirty-four years. During the whole of this time, while receiving honourable distinctions from almost every scientific society in Europe (culminating in the foreign membership of the Linnean Society of London in 1872), he obtained but little recognition from his own Government, and was in constant pecuniary straits which were perpetually interfering with the publication of his valuable botanical works. Indeed, at one time, but for the encouragement and assistance of a private friend, he would have abandoned a scientific career in despair. In 1867 he was offered, but declined, the chair of botany in the University of Turin; but in 1872 accepted the same post in the University of Rome. There he died on the 22nd of January, of the present year, at the age of 72.

De Notaris's publications extend over almost every department of Botany; and it is only possible to refer to the most important, all of which belong to Cryptogamy. In Bryology, his first work (and the earliest of all his publications) was his "Synopsis Muscorum Mediolanensium," published in 1834. This was followed the next year by his "Pugillus Muscorum Italiæ novorum vel minus cogintorum," and, in 1837, by his "Specimen de Tortulis Italicis," a most important work in establishing the principles of bryological laxonomy. In 1838 he published his "Sylloge Muscorum Italiæ;" and in 1859 his great work "Musci Italici," which would long before have seen the light but for his want of means. His "Epilogo della Briologia Italiana," published, to its immortal honour, at the expense of the University of Genoa, received from the Academy of Sciences at Paris the great distinction of the Desmazières prize. His work may be said to have introduced a radical reform into the study of cryptogamy, as may be seen by comparing the first and second editions of Schimper's great work, "Briologia Europæa." De Notaris's bryological labours closed with his "Musci Napoani."

In Hepaticology we find his earliest work, "Primitiæ Hepaticologicæ Italianæ," containing descriptions of ninety-two species. In 1853 he published "Appunti per un nuovo Censimento delle Epatiche Italiane;" and very recently contributed to the "Nuovo Giornale Botanico Italiano," an account of Beccari's Hepaticæ from New Guinea.

In Mycetology, De Notaris published, in 1839, "Micromicetes Italici novi vel minus cogniti." Subsequently we find monographs of the Italian "Excipulæ," and "Spheriaceæ;" a revision of the "Discomycetes" and of the "Pyrenomycetes," besides numerous other lesser publications.

In Lichenology he was not idle. His "Framenti Lichenografici" first called the attention of botanists to the spores of lichens as furnishing characters for their classification. Other publications related to the *Parmeliaceæ*, to *Sticta*, to *Peltigera*, to *Abrothallus*, and to *Stereopeltis*.

In Algology his series of publications commences with his "Algologiæ maris ligustici specimen," containing descriptions of 125 species, many of them new. This was followed by his "Nuovi Materiali per l'Algologia del mar Rosso." In 1861 he published critical notes on the genera *Hormosiphon* and *Nostoc*, and in 1867 his "Elementi per lo Studio della Desmidiaceæ Italiche."

[Abstracted from a biographical notice—"Guiseppe de Notaris, sua vita e sue opere," in the "Opinione" of Rome.]

Professor de Notaris was the first elected of the Foreign Honorary members of the Quekett Microscopical Club in October, 1867.

The following are the principal of Professor de Notaris's writings:—

Synopsis Muscorum Mediolanensium.
Musci Mediolanenses collecti et editi 1834
Mantissa Muscorum ad Floram Pedemontanam 1835
Pugillus Muscorum Italiæ novorum vel minus Cognitorum.
Specimen de Tortulis Italicis.
Sylloge Muscorum Italiæ 1838
Musci Italici 1859
Cronaca della Briologia Italiana 1864 1867
Epilogo della Briologia Italiana.
Musci Napoani, in Acad. Sci., Turin.
Primitiæ Hepaticologicæ Italicæ 1830
Appunti per un nuovo Censimento della Epatiche Italiane ... 1853
Scapanie e Jubulee Italiche 1863
Jungermannicanarum Americanarum 1854
Della Sarcoscyphus in Comm. Critt. Ital. 1861
Epatiche raccolte Beccari.
Micromicetes Italici Nuovi 1839
Sulla tribu dei Pyrenomiceti.
Monografia delle Excipule.
Prime linea Pirenomiceti isterinei.
Schema di Classificatione d Sferiacei Ital.
Proposte di Alcune Rettificazioni dei Discomiceti.
Frammenti Micologici.
Nuove reclute per la Pirenomicetologia Italica.
Sferiacei Italici.
Frammenti Lichenografica.

Nuovi caratteri di alcuni generi della tribu d. Parmeliaceæ.
Osservazioni sul genera e Sticta 1850
Osservazioni sulle tribu delle Peltigere 1850
Abrothallus novum lichenum genus 1845
Sulla Stereopeltis 1861
Caratteri dell Opegrapha poetarum... 1861
Historia Fucorum maris ligustici.
Algologiæ maris ligustici specimen.
Nuovi materiali per l'Algologia del Mar Rosso.
Hormosiphon e Nostoc 1861
Elementi per lo studio della Desmidiacee Italiche 1867
Florula Caprarie... 1839
Repertorium floræ ligusticæ 1843
Isias novum Orchidearum genus.
Agrostographyæ ægyptiacæ fragmenta.

PROCEEDINGS.

January 12th, 1877.—Conversational Meeting.

The following objects were exhibited:—

Mildew (*Penicillium glaucum*)	Mr. F. W. Andrew.
Spicules of *Gorgonia massribulata*, arranged	Mr. Curties.
Podura scales, with $\frac{1}{8}$ objective and dark ground	Mr. Dunning.
Cordylura Spinimana	Mr. Enock.
Leaf of Fuchsia, stained	Mr. W. H. Gilburt.
Wing of Hornet, polarized	Mr. A. H. Halley.
Lobe of ear of White Rat, injected ...	Mr. Hunter.
Desmacidon œgagropila...	Mr. M. H. Johnson.
Hippophœ rhamnoides	Mr. Le Pelley.
Polycystina, selected	Mr. Moginie.
Sections of House-fly	Mr. E. T. Newton.
Abdominal Viscera of Ant	Mr. E. T. Newton.
Textularia, &c , alive	Mr. T. C. White.

Attendance—Members, 72; Visitors, 8.

January 26th, 1877.—Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced, and the thanks of the meeting were voted to the donors:—

"The Monthly Microscopical Journal" ...	from the Publishers.
"Science Gossip"	,, ,,
"The Popular Science Review	,, ,,
"Proceedings of the Royal Society" ...	from the Society.
"Proceedings of the Geologists' Association"	,, the Association.
"The American Naturalist"	,, in exchange.
"The American Journal of Microscopy" ...	,, in exchange.
"The Medical Examiner" (weekly) ...	,, the Editor.
"How to Choose a Microscope" ...	,, the Publisher.
"The Analyst"	,, the Publisher.
"Monograph of British Annelids" (by subscription)	,, the Ray Society.
"Annals of the Belgian Microscopical Society"	,, the Society.

"Schmidt's Atlas of the Diatomaceæ" (2 parts) ... ... } by purchase.

"Where there's a Will there's a Way" ... from Mr. T. C. White.

2 Slides of Sections of *Eucalyptus globulus* "

5 Slides of Sponges ... ... " Mr. Priest.

A letter received from the Belgian Microscopical Society, expressing a wish to establish friendly relations and exchanges of proceedings, &c., was read to the meeting.

Mr. T. C. White made some remarks upon some slides of *Eucalyptus globulus*, which he had presented to the meeting. The stem of this plant was round, but the pith square. This point was further illustrated by sketches on the black board, showing that the young end of the stem had also a square form.

Mr. H. F. Hailes exhibited and described a new form of section cutting machine, which he had devised to meet all general requirements. Sectional drawings were made upon the board in illustration of the working arrangements of the apparatus.

The President complimented Mr. Hailes upon the result of his ingenuity, and considered this to be the steadiest and best section cutting machine he had yet seen.

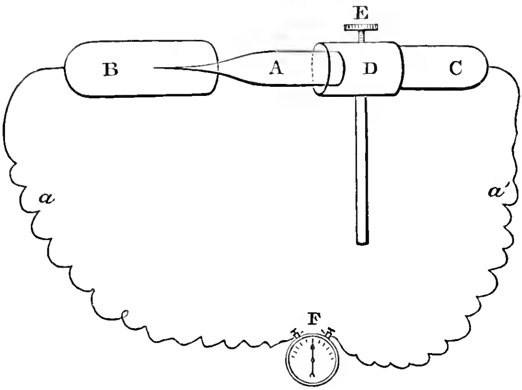
Mr. B. T. Lowne said that all who were in the habit of cutting sections must be aware that there was great difficulty in doing so when they had soft substances to deal with, and especially when these were at all elastic. He had always found great difficulty in making thin sections of nerve tissue, unless it were hardened, which might be done by chromic acid, but which sometimes made it too hard, and in most cases might be thought to alter the natural appearances. He had also always found a difficulty in making such sections all equally good and of the same thickness. He had sometimes had to make a number of sections of spinal cord, and it was important to his enquiry to use the whole of them, and to have them numbered in consecutive order; but he found it very difficult to do this, though it would have been easy with such a machine as that introduced by Mr. Hailes. Such an instrument must be highly useful, and he should certainly recommend it.

Mr. Ingpen said that most of their number who saw this new machine would at once appreciate its beauty and utility. Its principle was in some respects the same as that devised by Dr. Hoggan, who fastened hard tissues to a table moving backwards and forwards in a dove-tailed groove, with a contrivance for preventing the saw from diverging either way, while soft tissues were forced through a square box. That was a very expensive machine if well made. There were one or two points in its construction of which Mr. Hailes had made legitimate use, and the machine before them was one which he felt sure would be found extremely useful for the purpose for which it was intended.

Mr. Hailes quite agreed with Mr. Lowne's remarks as to soft sections, but he thought that was little more than a question of packing. The machine was not, however, specially made for soft substances, but rather, as he had stated, "for general purposes." Mr. Williams's machine, he considered, was almost perfect for soft substances. He thought himself perfectly justified in adopting some of Dr. Hoggan's ideas, and improving upon them, for Dr. Hoggan came there and threw down the challenge to any one to improve upon his model if he could. Dr. Hoggan's machine was necessarily expensive, from the way in which it was required to be made, but his own was quite of simple construction, in being made of tubes sliding into one another, and such tubes could be got ready-made anywhere. Dr. Hoggan's machine had the same defect as most others—that of packing the substances tightly into a tube, and then forcing them forward by jerks.

Mr. Ingpen exhibited to the meeting an ingenious contrivance by Mr. Swift for giving a final and perfect correction to the centering of an objective. It was a small adapter screwed into the body of the microscope, into which the objective was screwed as into the ordinary nose-piece. This little apparatus had two small screws, giving a lateral motion in two directions, by means of which perfect centricity might be attained. All persons who used high powers must have been troubled by the difficulties they met with in getting accurate adjustments, and this little piece of mechanism supplied them with what they needed—means of final adjustment of the optic axis.

Mr. B. T. Lowne addressed the meeting "On the Application of the Microscope to Physical and Physiological Research." He said he was sorry to come before them in one sense as a defaulter, for he had intended to exhibit a piece of apparatus which he had adapted to his microscope, and which, to a certain extent, might be said to mark an epoch in Microscopic Science. Unfortunately, however, in packing it up to bring it to the meeting, he happened to break it; but although unable to show it on that occasion, he hoped to do so at the Soirée, together with some other things of much interest. The microscope was, as they were all well aware, an instrument admirably adapted for measuring minute objects and minute spaces, but it had only quite recently been used to measure minute variations of force. In the application to which he had referred it was used to measure very small quantities of electrical force. The apparatus was made by Lippmann in Germany, and although it had been in use there for four or five years, it was quite unknown to English Physicists, until it was brought under their notice by means of the Loan Collection of Scientific Instruments at South Kensington. It was called an electrometer, and its most delicate portion consisted of a glass tube drawn out to an extremely small capillary tubular point at one end, the bore of which should not exceed the $\frac{1}{250}$ in., and if it were as small as the $\frac{1}{350}$, it would be better still, and it was this small extremity which he had the misfortune to break before coming to the meeting. Mr. Lowne then, by means of a diagram drawn upon the black board, described the apparatus as consisting of the glass tube (described above), A, the tapering extremity of which passed into a vessel (B), and the other end was attached to a metal vessel (C) by means of a piece of india-rubber tubing (D). The tube (A) was then filled with mercury, which could be forced up the taper end, or allowed to run back by turning the screw (E) as required; a pressure of 15lb. being sufficient to force it out about ½in. This apparatus was put under the microscope with a 1in. objective focussed



upon the capillary tube, and a micrometer scale in the eye-piece; the air was then forced out of the tube, and then the mercury was allowed to run back till it coincided with the zero point on the scale. It was then ready for use, and when the terminal wires (*a* & *a′*) were put into contact with anything electrical, the mercury was displaced, and the amount of displacement was read off upon the micrometer scale. The motion of the mercury in the tube was very rapid, it just darted forward and returned to its original position, but that was quite sufficient to enable the observer to note the exact position to which it reached along the scale. The equivalents of the markings on the scale could be determined by placing a galvanometer in the circuit (F), and comparing its indications with those of the mercury, and the amount of pressure could be readily ascertained by a barometer tube. The troubles attending the use of an extremely delicate galvanometer (such as alone would be of any value in measuring very small currents) were well known to all who were in the habit of using such instruments, one of the greatest being the length of time required to get a proper indication in consequence of the time occupied by the needle in swinging to and fro before coming to rest; but the little instrument he had described instantly indicated the amount of electrical force and with a degree of precision which could not fail to be appreciated by all whose investigations required such aid. Another application of the microscope was to make it indicate the energy of the action of light of various degrees upon the retina. He had made this the subject of a communication to the Royal Society,* and would endeavour briefly to convey the substance of it to the meeting. He took some engravings and put them under the microscope, and magnified the lines, and then carefully measured the relation between the light and shade, and afterwards compared them with the appearance of the same lines at a distance, and with various shaded surfaces and the

* See Proceedings Royal Society, 1877.

shades cast by lamps. It was obvious that the sensation of brilliancy varied according to the proportion of white to black, and that it was capable of being expressed arithmetically. It was also evident that a half illuminated surface did not give anything like the same degree of sensation. The theory was that as when gravity acted on a pendulum, the force required to swing it was in proportion to the square root of the gravity; so it was quite likely that light imparted a certain amount of motion to the retina, by the energy passing from the particles of ether to the particles of the retina, and that the periodic times of those vibrations or swings would vary in proportion to the square root of the intensity of the light. These appeared to be very likely analogies, and it might be looked upon as a very pretty physiological theory, and one which had been arrived at by the use of the microscope. He thought they were getting on in the use they made of their instrument, and he looked forward to a time when it would become an important help both to the chemist and the physicist as well as to the physiologist.

Dr. Matthews proposed a vote of thanks to Mr. Lowne for his address, to which he felt sure all had listened with intense interest. He thought there was one omission, and should be very glad if Mr. Lowne would supply it, by stating what was the form of force employed?

Mr. Palmer did not observe any means of regulating or correcting for temperature.

Mr. Lowne said he did not indicate the nature of the force, or go into that question further, because he was rather afraid of becoming, like his tubes, a "long bore." The force had nothing to do with the heating of the fluid, and no current whatever passed through it. The only correction necessary to be applied was that ordinarily applied to the barometer, and this was so small as to be hardly worth mentioning.

The President then proposed votes of thanks to Mr. T. C. White, Mr. Hailes, Mr. Lowne, and Mr. Ingpen for their communications.

Votes of thanks were unanimously carried.

The President said he had been requested to announce that the Soirée of the Greenwich Microscopical Society would be held on the 14th of February, at which the co-operation of members of the Quekett Microscopical Club was invited. At their next meeting Dr. M. C. Cooke would give them a lecture on "Black Moulds."

The Secretary said that having had a good many complaints as to the papers and meetings not being properly announced, he wished to state that as they frequently could not get promises of papers or their titles until the last moment, it was not always possible to announce them beforehand; but if given to him not later than the preceding "Gossip night," the announcements would always appear in the "Echo" of the Monday before the ordinary meeting, in the diary of the "Echo" the day before the meeting, and in the eight Journals, which regularly inserted notices of scientific meetings for the week, viz., "The Academy," "The Athenæum," "The British Medical Journal," "Iron," "The Lancet," "The Medical Times and Gazette," "Nature," and "The Pharmaceutical Journal."

The proceedings terminated with a conversazione, at which the following objects were exhibited :—

Stomata of *Aucuba*	Mr. F. W. Andrew.
Spinnarets of Spider	Mr. T. Curties.
Wood Spider (*Clubiona amarantha*), male...	Mr. F. Enock.
Longitudinal Section of Stem of *Pelargonium*	Mr. W. H. Gilburt.
Head of Gnat	Mr. A. H. Halley.
Toe of White Rat, injected	Mr. J. Hunter.
Transverse Section of Foot of New-born Infant	Mr. J. J. Hunter.
Hoof of Zebra	Mr. Le Pelley.
Astromma Aristotelis	Mr. W. Moginie.
Ptilota elegans...	Mr. E. M. Nelson.
Lagenæ	Mr. B. W. Priest.
Rare Fungi—1. *Myxotrichum carnii* ... 2. ,, *cervinum* ... 3. *Syzygites megalocarpus* ...	Mr. W. W. Reeves.
Spinal Cord of Sheep	Mr. F. H. Ward.
Marine Entomostraca	Mr. T. C. White.

Attendance—Members, 78; Visitors, 7.—Total, 85.

February 9th, 1877.—Conversational Meeting.

The following objects were exhibited :—

Seed of Maize...	Mr. F. W. Andrew.
Drumstick hairs from throat of Snapdragon	Mr. T. H. Buffham.
Diatoms from Santa Monica	Mr. A. L. Corbett.
Organs of Mouth of Dragon-fly	Mr. F. Enock.
Hairs of Sea-mouse *in situ*	Mr. F. Fitch.
Tick of Red Deer (*Lepatœna cervi*) ...	Mr. H. E. Freeman.
Cirri of Barnacle, polarised	Mr. A. H. Halley.
Section of Rat's tongue, showing papilla, &c.	Mr. J. J. Hunter.
Structure of Ivy leaf	Mr. Ingpen.
Crystal of Calcite ,, Carbonate of Lead } polarized	Mr. M. Hawkins Johnson.
Venation in the Endopleura of Haricot Bean	Mr. Martinelli.
Dolerite from Limestone, with Foraminifera	Mr. G. J. Smith.
Section of *Eucalyptus globulus*	Mr. M. H. Stiles.
New Centering Nosepiece	Mr. Swift.
Papillæ of Mucous Membrane of mouth double stained	Mr. F. H. Ward.
Dental Exostosis, polarized	Mr. T. C. White.

Attendance—Members, 74; Visitors, 5.

February 23rd, 1877.—Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced, and the thanks of the meeting were voted to the donors :—

"The Monthly Microscopical Journal"	... from the Publishers.
"Science Gossip"	... " "
"Proceedings of the Royal Society"	... " the Society.
"The American Naturalist" ...	... in exchange.
"The Medical Examiner" (weekly)	... from the Editor.
"Annual Report of the Geologists' Association"	" the Association.

The following gentlemen were balloted for, and elected members of the Club :—Mr. Edward Crofton, Mr. James Death, jun., Mr. W. A. Delferier, and Mr. J. M. C. Johnston.

The President announced that the Soirée of the Club would take place on April 13th, also that communications had been received from the Tower Hill Microscopical Society, and the South London Entomological Society, requesting the co-operation of the members of the Q. M. C., on the occasions of their forthcoming Soirées.

Mr. Ingpen said it would be remembered that at their last meeting he exhibited and described a new nosepiece, devised by Mr. Swift, for the exact centering of objectives upon the achromatic condenser. He wished now to add, that in addition to the apparatus itself, Mr. Swift proposed to draw a cross upon the front surface of the condenser, to indicate its exact centre. This would not spoil the condenser in the slightest degree, but would enable the optic axis to be most accurately found.

Dr. M. C. Cooke read a paper on "Black Moulds," which he illustrated by a number of diagrams, and a large collection of coloured drawings. Specimens of four of the Typical Genera, of the order *Dematici*, were exhibited under the microscope, by Mr. Reeves, in further illustration of the paper.

The President proposed a vote of thanks to Dr. Cooke for his paper, which he considered of great value, not only on account of its having been read, but as forming a part of their transactions, to be read at their leisure in their Journal.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Beaded ridges on pollen of *Lilium Auratum*	Mr. T. H. Buffham.
Volvox globator and *Conochilus volvox*	Mr. W. G. Cocks.
Leaf of *Deutzia gracilis*	Mr. A. L. Corbett.
Amphitetras antediluviana	Mr. Cottam.
Microgaster glomeratus	Mr. F. Enock.
Leaf of *Pelargonium*	Mr. W. H. Gilburt.
Spicules of *Gorgonia pluxaurella* ...	Mr. A. H. Halley.
Auditory Meatus of Child	Mr. J. J. Hunter.

Tail of White Rat	... ...	Mr. Moginie.
Fossil bone from Coal Shale	... ...	Mr. E. M. Nelson.
Collection of *Aulacodisci*	... ...	Mr. Powell.
Fungi (in illustration of Dr. Cooke's paper)		Mr. W. W. Reeves.
Pleurosigma quadratum	... ...	Mr. H. J. Roper.
Section of Jasper	... ...	Mr. W. S. Smith.
Herapathite	... ...	Mr. T. C. White.

Attendance—Members, 92; Visitors, 6.—Total, 98.

March 9th.—Conversational Meeting.

The following objects were exhibited:—

Spicules of Sponge (*Cliona celata*)	...	Mr. F. Coles.
Lophopus crystallinus	... ...	Mr. C. G. Dunning.
Scorpion fly, *Panorpa communis*...	...	Mr. F. Enock.
Leaf of ivy, stained	... ...	Mr. W. H. Gilburt.
Male organs of *Notonecta*	... ...	Mr. H. G. Glasspoole.
Skin of Sole	... ...	Mr. A. H. Halley.
Apex of ventricle of Heart, injected	...	Mr. J. J. Hunter.
Tongue of young rabbit, injected	...	Mr. W. W. Jones.
Granite from Norway	... ...	Mr. W. Moginie.
Planorbis corneus, embryos in egg	...	Mr. E. T. Newton.
Fossil Fish bone	... ...	"
Transverse section of tibia of a large ant (*Camponotus*)	... ...	"
Soundings (Arabian Gulf, 930 Fathoms)	...	Mr. B. W. Priest.
Caudal bronchial plate of pupa of *Agrion puella*	... ...	Mr. J. C. Sigsworth.
Granite, Mourne Mountain, Ireland	...	Mr. G. J. Smith.
Section of Forest Marble from Melksham...		Mr. W. L. Smith.
Podura scale, with 1-12th inch immersion...		Mr. J. Swift.
Polycystina (selected by Mr. Topping)	...	Mr. T. C. White.

Attendance—Members, 67; Visitors, 10.

March 23rd, 1877.—Dr. Matthews, F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations were announced:—

"Science Gossip"	... from the Publisher.
"The Monthly Microscopical Journal ...	" "
"Proceedings of the West London Natural History Society"	" the Society.
"The American Naturalist"	in exchange.
"The Medical Examiner" (weekly) ...	from the Editor.
"Reports of the Proceedings of the Belgian Microscopical Society"	" the Society.

Photographs for the Album by Mr. G. C. Drew and Mr. J. D. Hilton.

The thanks of the meeting were unanimously voted to the donors.

The following gentlemen were balloted for, and duly elected, members of the Club:—Mr. J. H. Keene, Mr. H. T. Kluht, and Mr. F. K. Morrell.

Four gentlemen were nominated for election at the ensuing meeting.

The Chairman announced that the Annual Soirée of the New Cross Microscopical Society would take place on April 10th, and asked for the co-operation of such members of the Quekett Microscopical Club as could make it convenient to attend.

The Chairman read the following communication from the Rev. J. Bramhall, on the subject of the "Blyborough Tick:"—"I was much interested in Mr. George's paper and illustrations of the 'Blyborough Tick,' and have no doubt about its connection with the Bat. In 1875 I found, in a seat in my church, one of these creatures in company with two genuine Bat bugs. Another tick was brought to me, having been taken from the shawl of a lady who sat in the same seat; indeed, this led to my examination of the seat, which for some time had been constantly covered with the excrements of bats. In order to put an end to this nuisance, our churchwardens took up a portion of the lead on the roof above the seat, and, in a very small space, took out from between the lead and boards of roof no less than 287 bats of various kinds—large, small, and eared, I believe. Unfortunately I was from home at the time, and all the 'vermin' were destroyed—a fact which greatly vexed me when I heard of it, as no doubt I should have obtained a large quantity of both ticks and bugs. The shape of the creature, together with the markings, and form, and locality of the spiracles, make me sure it is the same as those found by Mr. George at Blyborough. I marked mine 'Ixodes of Bat,' but shall alter it to *Argas Fischerii*, as that seems to be its true appellation. Some years ago a friend gave me a small 'parasite of bat,' which I take to be a young *Argas*. I believe he took it off the bat. It has only six legs, and the shape of the body is rather different to the adult insect. I expect the fourth pair of legs would be produced from the shoulders, and so fill up the circularity of the body. This one is mounted, after soaking in turpentine only, and shows the cæca perfectly. I rather spoiled those I found by too much liq. pot., as all the contents of the body are gone; still, it is a beautifully marked skin, and shows the spiracles. The flea of the bat is worth mounting, and so is the bug, which is a delicate form of our detested enemy the B. flat. I can see very little difference between the pigeon bug and the B. flat, though I am told there is a difference. What is the best work on Ticks?"

Dr. M. C. Cooke said it might be worth mentioning in connection with the remarks in the letter as to the number of legs, that most of the creatures of that family had six legs in the early stages of their lives, but that after the second moult they had eight legs. Enquiry was made as to some work of reference on the subject of Ticks. He did not think there was anything better than Koch's "Deutschlands Crustaceen." There was also a very good work in French—Walckenaer's "Apteres"—one of the "Suites de Buffon."

Mr. W. H. Gilburt read a paper "On the Absence of Stomata from Certain Ferns."

The Chairman said he had seen some of the specimens prepared by Mr. Gilburt, and they certainly appeared to bear out all that he had stated; but he should like to call attention to them again, because this plan of differentiation by diverse staining did wonders in enabling the structure of vegetable tissues to be made out in a manner which no other process would do. In the present case, however, the elimination of all colour had done more even than staining. It would be remembered that some very beautiful specimens were lately exhibited in that room which had been brought by Mr. Crouch from America, and prepared by Dr. Hunt.

Mr. Ingpen said that Mr. Gilburt had brought with him some specimens of these preparations for exhibition under his microscope.

The Secretary called the attention of members to the arrangements in progress for their forthcoming Soirée, which he was very anxious should be made a great success. They would have placed at their disposal the usual amount of accommodation, with the addition of the South Library. Mr. Charles E. White would take the names of any members present who would exhibit objects, and he should himself be very glad to receive communications or suggestions from any persons as to the arrangements, and also anything that could be suggested in the way of additional attractions.

Mr. T. C. White communicated to the meeting the results of observations upon a curious organ found attached to a species of Marine *Cyclops*. He said that doubtless many of the members might remember that upon several evenings he had exhibited an *Entomostracan*, having a brown ring-like appendage attached to the under surface of its body at the juncture of the sixth and seventh rings. He had never seen any similar organ in any of the *Entomostraca*, either freshwater or marine, that had come under his notice in something like twenty years' experience; neither was it figured in Baird's "Entomostraca." He had submitted it to several members and to a few naturalists outside the Club, but could get no light thrown on its nature and office. He had found a great number of *Entomostraca* in his marine aquarium, and believed them to be a species of *Canthocamptus*, the majority having this organ attached. When first seen the appendage was slightly brown in colour, having no visible contents, but lately the ring-like tube was filled for about four-fifths of its extent by a substance that was of a granular character. He therefore placed it under a $\frac{1}{8}$ objective, and by pressure ruptured it, when spermatozoa flowed from it and filled the field with their active movements, proving, without doubt, that it was a spermatophore. The exhibition of this organ having excited much curiosity and discussion at the previous conversational evenings, he thought that having determined its nature he needed no apology for bringing it forward as a casual communication that evening.*

The Chairman was sure that the members must have felt greatly interested by the communication which Mr. White had made; for his own

* See plate xxviii., upper part.

part he could not sufficiently commend the perseverence which had led to the discovery of the nature of these organs.

Votes of thanks to Mr. Gilburt and Mr. T. C. White for their communications were unanimously passed.

Announcements of meetings, &c., for the ensuing month were then made, and the meeting terminated with a conversazione, at which the following objects were exhibited:—

Cocoa-nut	Mr. F. W. Andrew.
Sand Wasp	Mr. A. L. Corbett.
Synapta sargiensus	Mr. T. Curties.
Gill of Herring	Mr. C. G. Dunning.
Spinnerets of Spider	Mr. F. Enock.
Frond of *Hymenophyllum hirsutum* ...	Mr. W. H. Gilburt.
Ova of Horse Fly	Mr. J. W. Goodinge.
Optic Nerve, &c.	Mr. J. J. Hunter.
Leaf of *Pomaderris apetala*	Mr. R. T. Lewis.
Stomata of Holly	Mr. Martinelli.
Selected Diatoms from Santa Monica ...	Mr. Moginie.
Lichmophora flabellata, in its natural mode of growth, and *Hydrosera Triquetra* ...	Mr. W. W. Reeves.
Villi of Intestine of Mouse	Mr. E. Richards.
Pleurosigma formosum (shown under Swift's cheap ¼-in.)...	Mr. J. A. Smith.
Nachet's Camera Lucida adapted to the English Microscope	Mr. Jas. Swift.
Periwinkles hatching	Mr. T. C. White.
Parasite of Tropic Bird (?)	Mr. J. Woollett.

Attendance—Members, 76; Visitors, 10.—Total, 86.

Conversazione.

By permission of the Council of University College, a Conversazione was held in the Museum, and the East and South Libraries, on Friday, the 13th of April. About 1,050 ladies and gentlemen were present. 120 microscopes were brought by the members of the Club, and 60 by members of the South London, the Croydon, the Sydenham, the Greenwich, and the New Cross Societies. The leading London Opticians also kindly lent their assistance, as on former occasions.

The following is a list of the objects exhibited by our members and those of the above-named Societies, so far as could be obtained from the table tickets, many of which, however, were not returned to the Stewards, or were left unfilled:—

Sections of Whalebone	Mr. W. Addis.
Eye of Lace-wing Fly ... ... *Conochilus volvox*	Mr. J. Alstone.

Parasite of Salmon ... ... Sponge Spicules, &c.	Mr. F. W. Andrew.
Foot of Fly	Mr. J. Atkinson.
Scales of *Pieris Alexis*	Mr. H. A. Auld.
Micro-photographs of Diatoms, &c.	Mr. J. Bayne.
Relics of the Ancient Swiss Lake Dwellings at Robenhausen	Mr. W. A. Bevington.
Section of tongue of Puppy ... ... *Heliopelta*	Mr. G. Bird.
Hydra vulgaris	Mr. W. Bishop.
Hydra vulgaris	Mr. C. E. Blomfield.
Campanularia volubilis	Mr. H. Brady.
Palate of Whelk	Mr. A. Brett.
Volvox globator, &c.	Mr. J. W. Brigstock.
Rastelia lacerata ... ... Antennæ of *Gad-fly*	Mr. G. Browne.
Spicules of *Synapta*	Mr. W. Bugby.
Section of Syenite	Mr. R. Catchpole.
Foraminifera	Mr. A. Clarkson.
Cristatella mucedo ... ... *Fredricella sultana* ... ... *Carchesium polypinum* ... ... *Volvox globator*	Mr. W. G. Cocks.
Spinal cord of Cat (stained) ... Section of tongue of Rabbit ...	Mr. A. C. Cole.
Section of Betel Nut ... ... ,, ,, Upas Tree ... ... ,, ,, Shell of Calabar Bean ...	Mr. F. Coles.
Arcyria ferruginea, a New British Fungus ...	Dr. M. C. Cooke.
Foot of *Dytiscus* ... ... Polycystina, &c.	Mr. A. L. Corbett.
Stictodiscus sp.? a new Diatom from Haiti ...	Mr. A. Cottam.
Section of eye of Moth	Mr. J. H. Crossland.
Petal of *Corea*	Mr. P. Crowley.
Platino-cyanide of Magnesium, &c.	Mr. T. Curties.
Leaf of *Rhododendron Madeni*, &c.	Mr. E. Dadswell.
Head of Wood Gnat	Mr. G. Dannatt.
Tingis cardui	Mr. T. W. Dannatt.
Vegetable Ivory ... ... Feather of Guinea-fowl, &c.... ...	Mr. A. Dean.
Bones from Mouth of Star-fish ... Polycystina	Mr. F. Doeg.
Lophopus crystallinus	Mr. C. G. Dunning.
Head of Hunting Spider	Mr. F. Fitch.
Crystalline Silver	Rev. T. W. Freckelton.
Spiral fibre and sphœraphides in Rhubarb stem	Mr. H. E. Freeman.

Daphnia	Mr. C. J. Fricker.
Colorado Beetle	Mr. G. H. Fryer.
Sori of Elk-Horn Fern	
Arachnoidiscus on Coralline, &c. ...	
Dichroic Liquids, &c.	Mr. G. Gardiner.
Hydra viridis	
Coniatus tamarissi	Mr. F. W. Gay.
Fruit of *Bryum murale*	Mr. E. George.
,, ,, *Bartramia pomiformis* ...	
,, ,, *Grimmia apocarpa* ...	
Section of Rush (double stained) ...	Mr. W. H. Gilburt.
Leaf of Fuchsia (stained)	
Collection of Marine Algæ	Mr. H. G. Glasspoole.
Fern Album	
Section of *Eucalyptus globulus*, &c. ...	
Stylops Spencii	Mr. J. W. Goodinge.
Section Brain of Cat	Mr. C. A. Gould.
Sarcoptes scabii, &c.	
Iodo-sulphate of Quinine, &c.	Mr. H. R. Gregory.
Mignonette	Mr. W. Gregory.
Polycystina (arranged)	Mr. A. de S. Guimaraens.
Hydra vulgaris	Mr. J. H. Hadland.
Sheep Tick	Mr. H. F. Hailes.
Tongue of *Nassa reticulata*	
Skin of Sole	Mr. A. H. Halley.
Scale of Pike	
Foraminifera from London Clay	Mr. A. Hammond.
Leaf of Rhododendron	Mr. G. Hardess.
Corethra plumicornis	Mr. J. D. Hardy.
Tongue of *Chiton emarginatus* ...	
Sunstone from Norway	Mr. W. S. Harvey.
Coniatus tamarissi	Mr. F. W. Hembry.
Skin of Sole	Mr. A. M. Hicks.
Gnat in Spider's web	Mr. G. Hind.
Gall bladder of Eel	Mr. W. S. How.
Intestine of Rabbit, &c., &c.... ...	
Eozöön Canadense	Mr. D. Howard.
Cyclosis in *nacharis*, &c.	
Hair-bulbs in skin of Horse	Mr. W. H. B. Hunt.
Leaf of *Symphytum officinalis*	Mr. J. E. Ingpen.
Foraminifera from Sponge sand	Mr. W. Ingrams.
Sclerenchyma of Peach	Mr. B. D. Jackson.
Canthocamptus minutus	Mr. J. S. Johnson.
Egg of *Culex pipiens*, &c.	
Flints naturally injected by air and by oxide of iron	Mr. M. Hawkins Johnson
Anatomy of Green-bottle Fly	Mr. E. F. Jones.

Toe and Claw of young Rabbit injected Selected Diatoms	Mr. W. W. Jones.
Cemiostoma stitella ... ... *Lithocolletis cramorella*	Mr. E. Kiddle.
Section of "Chew stick" ... ... " " Liver of Hedgehog ...	Mr. C. J. Kindon.
Scales of Eel ... ... Section of Whalebone	Mr. F. J. Kitsell.
Cuticle of *Alyssum*	Mr. H. M. Klaassen.
Coralline from South Australia	Mr. H. Lee, junr.
Fantail Fly (*Dolichopus*) ... ... Antennæ of *Orgyia antiqua*, &c. ...	Mr. J. R. Leifchild.
Leaves and Hairs of *Pomaderris apetata* " " *Goniophlebium sepultum*	Mr. R. T. Lewis.
Vallisnaria spiralis	Mr. J. Locke.
Leaf of *Deutzia* ... ... Wing of *Erycina Julia*	Mr. T. M. Loftus.
Palates of Periwinkles	Mr. H. Long.
Young *Hippocampus*	Mr. E. Lovett.
Spicules of *Holothuria cucumaria*	Mr. C. Manners.
Head of Silk-worm Moth	Mr. W. K. Marriott.
Stomata of Mexican Aloe ... ... *Ruscus aculeatus*	Mr. A. Martinelli.
Tail of Butter-Fish...	The President.
Stone of Egyptian Pyramid... ... Section of Dolerite, Polarized ... " " Jasper, Polarized, &c., &c....	Dr. Matthews.
Head of Male Musquito	Mr. K. McKean.
Stephanoceros Eichornii ... ... *Melicerta ringens*, &c.	Mr. J. W. Meacher.
Young oysters, &c.	Mr. J. Menzies.
Diatomaceæ	Mr. G. A. Messenger.
Head of *Squamosis*...	Mr. A. Milledge.
Young Sea anemone	Mr. J. Nelson.
Retina of Lobster	Mr. E. T. Newton.
Part of eye of Rat ... ... Ova of Toad, injected	Mr. C. N. Peal.
Conochilus volvox, &c.	Mr. G. Pearce.
Spores of *Equisetum*	Mr. T. H. Powell.
Chryosora from *Hydra tuba*	Mr. B. W. Priest.
Section of Cane ... ... Quill of Porcupine, &c.	Mr. T. Purdue, junr.
Tongue and Lancets of Gad-fly ... Gizzard of *Dytiscus marginalis*, &c....	Mr. G. E. Quick.
Section of Eye of Cockchafer, &c.	Mr. W. G. Ranger.
Feather of Humming-bird ... ... Native Copper, &c.	Mr. F. Reeve.

Skin of Trunk-fish (Japan) showing scales *in situ*	Mr. W. W. Reeves.
Platino-cyanide of Magnesium, &c.	Mr. W. W. Reid.
Section of Human Kidney, &c.	Mr. E. Richards.
Raphides of *Echinocactus visnaga*	Mr. T. Rogers.
Section of Stag's Horn, &c.	Mr. C. S. Rolfe.
Section tail of white Rat ... ... Salicine, &c.	Mr. J. Rowlett.
Volvox globator	Mr. W. Rushton.
Stephanoceros Eichornii ... ... *Melicerta ringeus*, &c.	Mr. Jas. Russell.
Brown *Stentor*, &c.	Mr. Jos. Russell.
Specimens of Liassic and Oolitic Fossils; Recent Shells and Minerals, Decomposed Glass, &c.	Mr. T. D. Russell.
Graphoscope and Photographs	Mr. H. Lee Rutter.
Plant Bug	Mr. G. W. Saul.
Viscid Lines of Spider's Web ... Tongue of *Rhingia*	Mr. R. Sedgwick.
Toe of White Rat ... ... Challenger Soundings, 390 fathoms, &c.	Mr. H. L. Sequeira.
Section of leaf of *Psamma arenaria*	Mr. J. C. Sigsworth.
Odontophore of *Octopus* ... ... ,, ,, *Nassa* ... ... ,, ,, *Cyclostoma*	Mr. J. Slade.
Head of *Tænia* ... ... *Cystercercus cellulosa*	Mr. W. Smart.
Polytrema rubra ... ... Cinibar ore with native Crystals, &c. ...	Mr. A. Smith.
Cuxhaven Diatomaceæ ... ... Feet of House-fly, &c.	Mr. James Smith
Hunting spider (alive) showing the eyes ...	Mr. J. A. Smith.
Tongue of Honey-bee	Mr. R. A. Smith.
Spores of Fern	Mr. W. B. Smith.
Cinchonidine	Mr. W. S. Smith.
Scales of Fern	Mr. J. H. Steward.
Monogram of selected Diatoms	Mr. J. H. C. Steward.
Gutter Life	Mr. C. W. Stidstone.
Section, shell of Hen's Egg	Dr. H. J. Strong.
Stephanoceros Eichornii	Mr. D. J. Stuart.
Mosses, Algæ, &c.	Mr. E. B. Sturge.
Wing of *Chrysochita Lincella*	Mr. A. D. Taylor.
Larva of Day Fly	Dr. F. Taylor.
Viscera of Wasp, showing ovaries, sting, poison-bag, &c.	Mr. T. Terry.
Lipeurus (parasite of goose)	Mr. W. A. Tinney.
Exotic Fern, &c.	Mr. J. Thompson.

Small Intestine of Turkey	Mr. W. Trickett.
Section of Clematis, double stained, &c. ...	Mr. H. Turner.
Sertularia, &c., polarized	Mr. S. Turner.
Section of Pepper stem	Mr. J. F. Underwood.
Marine Polyzoa	Mr. J. S. Walker.
Rotifera	Mr. J. W. Walker.
Meridion circulare ... ... *Achnanthes brevipes*	Mr. J. G. Waller.
Sections of Charred Oak and Wooden Pile from Lake dwellings of Robenhausen	Mr. F. H. Ward.
Circulation of blood in Tail of Gold Fish ...	Mr. A. Warner.
Wing of White Plume Moth	Mr. Warrinton.
Catkin of *Populus niger*	Mr. J. Watkins.
Circulation of blood in Tail of Gold Fish ...	Mr. T. E. Way.
Drawings of Microscopical objects ...	Mr. Tuffin West.
Melicerta and *Vorticella*	Mr. W. West.
Tongue of Wasp ... ... *Pycnogonum* (a marine crustacean) ...	Mr. T. C. White.
Drum of ear of Frog	Mr. J. Woollett.
Gutter Life (*Euglena viridis*), &c.	Mr. J. W. Worster.

Among the large number of excellent professional exhibits, the following were particularly noticed :—

Mr. BAILEY.—Microscope, with solid Tripod Stand, &c. New Folding Microscope, with large stage. Rock Sections, &c.

Mr. BAKER.—A number of Binocular Microscopes showing living objects *i.e.*, *Lophopus*, *Cristatella*, *Stephanoceros*, *Melicerta*, and other specimens of "Pond Life."

Messrs. R. and J. BECK—Various stained vegetable preparations, and crystals of pure "Dental Gold," under numerous forms of Microscopes, including their new "Economic" Microscope.

Mr. BROWNING.—Automatic Spectroscope, with dispersion of 24 prisms, showing spectrum of gold. Various forms of Stephenson's binocular microscope, &c., &c.

Mr. COLLINS.—Microscopes newly planned, having the Harley arrangements on the Jackson model.

Mr. CROUCH.—New series of first and second-class Microscopes—new $\frac{1}{2}$, $\frac{1}{5}$, and $\frac{1}{10}$ objectives—new Centering Stage and Nose-piece.

Mr. ENOCK.—A collection of insects, mounted without pressure, showing internal structure, &c.

Messrs. HORNE and THORNTHWAITE.—Microscopes, Table Polariscope, Model of the Eye, Sections of Crystals, showing uni-axial and bi-axial systems, specimens of unannealed glass, &c.

Messrs. JAS. HOW and Co. (by Mr. G. J. Smith).—Popular Binocular and Students' Microscopes. Sections of Rocks—Igneous, Sedimentary and Metamorphic, &c.

Mr. HUNTER.—Four Microscopes, under which were exhibited a large collection of Histological and Miscellaneous Objects.

Mr. G. H. King.—Several fresh-water aquaria, with Japanese gold-fish, and other interesting objects.

Mr. Moginie.—Large Microscopes—Portable Travelling Microscopes—Portable Lamps—Revolving Stereoscope, with 36 glass stereographs of British, Continental, and American Scenery.

Messrs. Murray and Heath.—Microscopes—New Medical Microscope—Patent adjusting Graphoscope—Sea-side Microscope—Paper Transparencies, &c., &c.

Messrs. Powell and Lealand.—Cyclosis in *Vallisnaria* under 1-16th inch Immersion Objective. *Conochilus volvox.*

Messrs. Ross and Co.—Microscopes on the Ross and Jackson Models; also a complete set of Microscopical Apparatus.

Mr. Steward—Large Microscope—Botanical Microscope—Case showing Microscope with very complete set of apparatus and object Cabinet—New and simple form of Botanical Microscope, &c.

Mr. Swift.—Microscopes—New Travelling Microscope—New Adjusting Nose-piece, for centering the Objective to the Achromatic Condenser, &c., &c.

Mr. Edwd. Simpson, President of the Sydenham Microscopical Society, delivered a very interesting lecture called "Sketches of Pond Life," and illustrated by a large number of drawings, in the Mathematical Theatre.

Mr. G. J. Smith (James How & Co.) exhibited at intervals, during the evening, by means of the oxy-hydrogen apparatus, in one of the dark rooms, Views of Scottish Scenery, Statuary, Photomicrography, Experiments with Polarized Light, &c.

A band, under the leadership of Mr. R. W. Barratt, performed a selection of operatic and other music, during the evening, in the Flaxman Hall.

April 27th.—Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The President expressed the great regret which he felt at his unavoidable absence from their last meeting; he need not mention that illness was the cause, this being known generally amongst them. But it was to him a matter of great desire to be present at all the meetings, and he could assure them that nothing but illness or very important engagements would ever keep him from the chair.

The following gentlemen were balloted for, and unanimously elected, members of the Club:—Mr. George Draper, Mr. Henry Gilbertson, Mr. A. C. Pearcy, and Mr. George Thorpe.

The President said they had received notice of the establishment of the Borough of Hackney Natural History Club, which had started with 47 members, and under favourable prospects. He need not assure them that the sympathies of the Quekett Club would always be extended to this kindred society, and that their best wishes would be offered for its success. He had also received an invitation to join the Watford Natural History

Society on the 5th of May, on which date they had arranged for a field meeting.

The following donations to the Club were announced :—

"The Monthly Microscopical Journal" ...	from	the Publisher.
"Science Gossip"	,,	,,
"The Popular Science Review"... ...	,,	,,
"The Quarterly Journal of Microscopical Science"	by	purchase.
"Lines of Animal Life"	,,	Mr. Higgins.
Parts of "Grevillea," from the commencement	,,	Mr. Cottam.
"Proceedings of the Royal Society" ...	,,	the Society.
"Proceedings of the Belgian Microscopical Society"	,,	the Society.
"Proceedings of the Natural History Society of Glasgow"	,,	the Society.
Photograph for the Album	,,	Mr. John Locke.
6 Slides—Injected and Stained Sections ...	,,	Mr. A. C. Cole.
1 Slide—Spicules of an Ascidian ...	,,	Mr. T. C. White.
"Micrographia Acarinæ," 9 vols. ...	by	purchase.
Walckenaer's "Apteres"	by	purchase.

The thanks of the Club were voted to the donors.

The President called especial attention to the very valuable works mentioned at the end of the list of donations as having been added to the library. They had been purchased from Dr. M. C. Cooke, who had been kind enough to offer the Club the refusal of them, and they would be found as works of reference to be of great value, and such, indeed, as any scientific society in London would be proud to own.

The Secretary stated that he had heard from Mr. Bridgman, of Norwich, who said that he had at last succeeded in getting a tinted glass of the kind he had been so long desiring. He hoped they should soon have a paper upon the subject, which would be sure to be interesting, as Mr. Bridgman was well known to be extremely critical upon such matters.

The Secretary gave a short account of two of the Field Excursions of the Club from notes contributed by a member of the Excursion Committee. The excursion on March 24th was to Barnes; the weather was showery, numerous objects were found. That on April 7th was to Snaresbrook; the weather was very fine, and the excursion was highly successful. Twenty members went, and they got a great number of very beautiful objects, including *Stephanoceros*, *Melicerta*, &c., and the ponds were reported to be in good condition. He hoped in future to be able to give a report of each excursion, which would certainly increase the interest of the members in them, and perhaps induce more persons to take part in them.

Mr. T. C. White read a paper "On some Personal Observations on *Botryllus*," illustrating the subject by drawings.

The President expressed the pleasure he had felt in listening to Mr. White's paper, and said it appeared to him that the fact which had been mentioned as to the movements of *Botryllus* was quite new. He had seen a good deal of this organism, but had never himself noticed the movement, and it was a most interesting observation. He hoped that the subject would be followed up, especially as there was no great difficulty in procuring specimens—*Botryllus* being one of the organisms most freely developed in all Marine Aquaria. He should, on his part, be happy to do what he could to assist Mr. White in procuring whatever specimens he required.

Mr. Charles Stewart said he had listened with great pleasure to Mr. White's very interesting communication, more especially so as through Mr. White's kindness he had been afforded an opportunity of seeing for himself what had been described. One could not watch all the changes which took place in the whole creature, but in a small fragment he could see well the process of motion, as it was carried on by means of the pseudopodia. He hoped that Mr. White would follow up the observations he had so successfully commenced. With regard to mounting these organisms, the spicula parts made very pretty objects, and by taking the creature from the salt water and plunging it into methylated spirit, it would be killed immediately with all its little mouths open, and would become sufficiently hardened by the spirit to enable sections to be cut. Such sections should not be made *thin;* they would be much better if made thick and mounted in cells. Horizontal sections made in this way, and mounted so as to place the sectional portion towards the observer, were very interesting objects.

The thanks of the meeting were voted to Mr. White for his communication.

Announcements of excursions and meetings for the ensuing month were then made, and the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Young *Hippocampi*, in four stages of development	Mr. C. Collins.
Salicine	Mr. A. L. Corbett.
Professor Abbe's diffraction plate ...	Mr. H. J. Crouch.
Jaw of Rat	Mr. C. G. Dunning.
Tenthredo variata	Mr. F. Enock.
Frond of *Asplenium bulbiferum*	Mr. W. H. Gilburt.
Fused Santonine	Mr. H. R. Gregory.
Intestine of Rat	Mr. J. J. Hunter.
Navicula Jamaicensis	Mr. H. J. Roper.
Sting and Poison Bag of Bee	Mr. J. A. Smith.
Spicules from Mantle of Ascidian ...	Mr. T. C. White.

Attendance—Members, 85; Visitors, 8.—Total, 93.

May 11th, 1877.—Conversational Meeting.

The following objects were exhibited:—

Stylops Spencii (Parasite of Wild Bee) ...	Mr. F. Enock.
Megalotrocha velata	Mr. W. Gilbertson.

Leaf of *Deutzia gracilis*, stained... ...	Mr. W. H. Gilburt.
Nose of child, stained	Mr. J. J. Hunter.
Lichmophora flabellata	Mr. Ingpen.
Pollen of Arum	Mr. Martinelli.
Stomata of Hyacinth	Mr. Martinelli.
Longitudinal Section of Ant	Mr. E. T. Newton.
Spiracles of *Dytiscus marginalis*... ...	Mr. R. G. Pearcy.
Ovarium of *Spongilla lacustris*, with spicules in situ...	Mr. W. W. Reeves.
Cellepora, alive	Mr. T. C. White.

Attendance—Members, 57.

On the Staining of Vegetable Tissues.

By W. H. Gilburt.

(Read May 25th, 1877.)

Histological study, whether animal or vegetable, is largely dependent for success upon the methods employed in the preparation of the subject under examination.

Animal histology has now, for some time, occupied the attention, and claimed the interest, of a great number of Microscopists ; doubtless, owing to the improved modes of preparation which have been introduced into that department of research ; especially the various processes of staining and injection.

Vegetable histology, on the other hand, has, in England, been almost neglected, possibly owing to the want of methods which could differentiate the vegetable tissues, as perfectly as those employed upon animal tissues.

The want, however, is now in a fair way of removal, and consequently we may hope that the subject will attract more students than it has hitherto.

To certain American Microscopists, belongs the honour (so far as I know) of first devising the means for bleaching, and staining, parts of plants, so as to render them transparent.

The first notice we have of the subject in any English publication, is in "Science Gossip," for January, 1875, by Dr. G. D. Beatty, of Baltimore. Two other papers by this author appeared in the same magazine, one in April, 1875, the other in May, 1876 ; the last one giving the results of his experience up to that date.

In the latter paper, which is by far the most complete, directions are given for decolouring and staining leaves and sections in various media, but chiefly in aniline colours.

Another paper on this subject appeared in the "Monthly Microscopical Journal," for January, 1876, by Mr. M. H. Stiles, his method differing slightly from that of Dr. Beatty ; the bleaching fluid being different, and the strength of the staining fluids reversed.

Now, by following Dr. Beatty's process closely, we shall obtain some very interesting slides for the microscope; but this is not enough for those who seek improved methods of preparation, in order to facilitate their studies. This being my feeling, I have during the past year endeavoured, by somewhat modifying the process, to render it more valuable; and with some success, so far as leaves and petals are concerned, the part of the subject to which I have given the greatest attention. Not that the modification effected is very great, but in this, as in many other things, a slight alteration may make a considerable difference in the result.

In employing these methods, let it not be supposed that there are many difficulties to be overcome, or great manipulative skill required; on the contrary, although the instructions, when read, appear complicated, yet when once they have been worked through, nothing can well be easier, or, when mastered, prove more helpful, or give a greater interest in the study of vegetable histology. By their use we can obtain an insight into structure, such as can be had by no other means.

The staining fluids which I have used with success have been alcoholic solutions of blue and magenta anilines.

The magenta solution is made by dissolving a quarter of a grain of the crystals in one ounce of alcohol.

The blue by dissolving one-sixth of a grain of the crystals in one ounce of alcohol, to which has been added, two drops of nitric acid.

Both solutions should be filtered when first made.

I have tried two or three makes of blue, but find none so good as that recommended by Dr. Beatty, viz., Nicholson's soluble blue pure.

Finding it difficult to procure these aniline colours in crystals, I at first used Judson's dyes, and found them answer very well, especially for stem sections. Good solutions of these will be made by adding half a drachm of the dye as sold, to one ounce of alcohol, and to the blue two drops of nitric acid, as in the other solution.

If Judson's dyes are used, the blue solution will occasionally require filtering.

In order to prepare tissues for staining, it is first necessary to bleach them. This may be effected in the case of soft green stems, in alcohol; the use of which, where it will discharge the natural colour, considerably abridges the process. It also has this further advantage—by its use most of the cell contents are preserved, such as starch, chlorophyll granules, &c., and the nucleus, where it exists, can be seen after staining.

If the stem is at all brown, a solution (recommended by Mr. Stiles, and which I have proved), of chloride of lime, may be used. A quarter of an ounce of chloride is put into a pint of water and well shaken, this is to stand till quite bright, pour off the fluid, which is then ready for use. For stems this solution generally answers, but it is not near strong enough for leaves: as not only do they require bleaching, but all the cell-contents dissolved and removed, in order to render them transparent: and as the solution about to be described answers equally well for stems as leaves, and acts more rapidly, it will perhaps be convenient to use only the following solution of chlorinated soda, directions for the preparation of which were given by Dr. A. Milne Edwards, in the "American Naturalist," for May, 1869.* I have prepared it as follows:—

To one pint of water add two ounces of fresh chloride of lime, shake or stir it well two or three times, then allow it to stand till the lime has settled. Prepare meanwhile, a saturated solution of carbonate of soda—common washing soda. Now pour off the clear supernatant fluid from the chloride of lime, and add to it, by degrees, the soda solution, when a precipitate of carbonate of lime will be thrown down: continue to add the soda solution till no further precipitate is formed. Decant and filter the clear solution, which must be kept in a well-stoppered bottle, and in the dark, otherwise it speedily becomes useless.

Those who do not care to take the small amount of trouble required to prepare their own bleaching fluid, can purchase it at most manufacturing chemists, but it will not be so strong, and it will be at twelve times the cost.

In the staining of sections of stems, petioles, &c., let me again recommend in all possible cases, the use of alcohol for bleaching, for the reasons already given.

Sections bleached in the chlorinated soda, must, when white, be washed in clean water for twenty-four hours, changing the water four or five times, and adding to the last but one a few drops of nitric acid, at the rate of eight or ten drops to the half-pint, the last washing being in clean water.

From water transfer them to alcohol, in which they must remain for an hour or more.

Sections may be stained in two colours with advantage. This may be done in two ways—either by alternate or single immersion.

* See also Monthly Microscopical Journal, Vol. I (1869), p. 361.

For the first, transfer the section from alcohol to magenta dye, in which let it remain for about twenty minutes, then soak in alcohol till the colour is removed from the parenchyma: next place it for about one minute in the blue dye, shake it in alcohol for a few seconds, then in absolute alcohol for a few seconds: from this remove to oil of cloves, in which allow it to remain till quite clear: after which place it in clean oil of cloves for about ten minutes. It is now ready for mounting in balsam, the best form of which to use is balsam in benzole.

Dr. Beatty recommends the use of benzole after the oil of cloves, in order to hasten the drying of the slide: but this most certainly injures all soft tissue, and therefore I have not used it: but instead have adopted the following plan:—

Removing the object from the oil of cloves, and draining away as much as possible, I place it on a glass slip, and covering it with a small quantity of balsam, allow it to stand for a short time protected from the dust. The effect is this—the balsam being denser than the oil which occupies the cells, endosmose is at once set up, and a large proportion of the oil is given out by the tissue, the balsam taking its place. By tilting the slip, this mixture of oil and balsam very readily runs off. Then drop on carefully at one side of the object some fresh balsam, put on the covering-glass and leave to dry. Do not apply heat.

For staining by single immersion, to twelve drops of the blue dye add seven of the magenta, and thoroughly mix. Into this purple colour place your section for about one minute, remove to alcohol; shake well for a few seconds, then proceed as by former method.

It matters not which process is employed, the result is always the same; and we must conclude that true selection takes place.

The disposition of the colours is invariably this—the magenta goes to the woody fibre, vessels, and bast tissue: the blue to the parenchyma, cambium layer, and medullary rays: the pith and suberous layer of the bark being usually neutral.

In other words, according to the generally received doctrine concerning the circulation of the sap, those parts which are concerned in the distribution and appropriation of the elaborated sap, take blue, the remainder consisting of mature material, taking magenta.

In very young stems, the pith also, without doubt, takes an active part in the plant's economy; consequently it then stains blue; and from this we have all gradations, till just that portion next the medullary sheath is tinted with the colour, and eventually, when the pith practically becomes inactive, it is neutral, refusing all colour, or taking both.

These facts stand good in all cases, whether the section is bleached in alcohol or in the soda solution, or stained when fresh cut, without any preparation whatever. Neither does it matter how the colours are presented, whether magenta first, or the reverse, by single or alternate immersion.

In preparing leaves for staining, the bleaching process must be carried farther than with sections; as before stated, not only must the colour be discharged, but all the cell-contents removed; therefore they must be left in the soda solution till quite translucent. The time occupied in the process varies according to the texture of the leaf, from a few hours to a week or more. When very delicate leaves are to be bleached, it will be well to dilute the bleaching fluid with one third its bulk of water, otherwise disintegration may set in before the process is complete. Leaves, if large, should be cut into pieces, rather larger than required for mounting.

The process for washing is just the same as that given for sections; after which they must be placed in alcohol.

In staining leaves the question naturally arises, which of the two colours given is the best to use? The answer must entirely depend upon the purpose for which the preparation is required. If it is desired to exhibit the structure of the lamina, then blue should be used, because, if the colour be good, it marks out the cell-walls far more distinctly than magenta; and, moreover, the latter colour, if occupying the whole field of the microscope, would be most injurious to the sight, if worked with for long. There is also the difficulty of fixing magenta, unless it is passed through benzole instead of oil of cloves. This of course may be done, but it always produces a more or less injurious effect upon the tissue.

In using the blue dye, no definite time can be given for immersion, it altogether depending upon the density or permeability of the tissue. Dr. Beatty recommends that two solutions should be prepared—a quarter and a half-grain solution, and that the leaf should be transferred to the stronger if not stained sufficiently in the weaker one in half-an-hour. To this, however, there is the objection, that sometimes far too much colour will be taken up in parts, which must then be washed out, leaving generally a very mottled appearance, while, if the solution I have used be adopted, the object may remain in it for twelve hours without requiring the removal of any colour. Experience also shows, that, as a rule, far better results are obtained by the use of dyes of small intensity, although more time may be required.

I would therefore advise the use of the solution as given in the earlier part of this paper. The object should be left in it till equally stained, then remove from the dye into alcohol, and brush the surfaces with a camel-hair pencil ; next, place it in absolute alcohol for a few minutes, from thence into oil of cloves till quite clear, then into clean oil of cloves for ten or fifteen minutes, or until ready for mounting ; for which use balsam in benzole as for sections.

Preparations stained in the blue may be left in oil of cloves for a week or more without injury. When mounting, in order to facilitate drying, adopt the plan given for sections.

Magenta dye may be used in the study of the vascular system of leaves, as here its fugitive character is of great value, for by its use vessels may be stained, and the parenchyma left colourless. For instance take a young leaf or frond which has been prepared for staining, and let it be in the magenta for an hour or two, transfer it to alcohol, and the colour is very quickly discharged, but, upon examination, it will be found that the spiral and other vessels are beautifully stained.

Again, it may be desirable to stain the immature fructification of a fern, so as to leave all else colourless. This may readily be done by placing the preparation in magenta for about ten minutes, then washing in alcohol till colour is removed from the lamina, it will then be found that the sporangia are delicately stained, and the spores of a deeper tint.

This method is also applicable to ovaries, the readiness with which this colour is given up by the tissues enabling us to use it so as to leave the ovules stained, while the wall of the ovary is colourless.

These are only given as examples ; other instances will suggest themselves where this colour and method will be of value.

Dr. Beatty, in his paper, advises the use of mature leaves, not the very young, nor the old. Now it will be at once apparent, that a large amount of interest attaches to the development of tissues and organs, and that this can only be studied while the leaf or organ is in a very young state. A considerable difficulty was at first experienced in fixing the colour in very young tissue, the ordinary method of washing, &c., discharging the colour almost immediately. This at last I found could be overcome by taking the stained specimen from the dye with the forceps, and holding it for a second or two in absolute alcohol, and then putting it direct into the oil of cloves. Nearly all the colour was thus fixed, and in such a preparation the development of stomata, &c., could be distinctly traced.

In ferns, also, by the use of the three methods here given, a series of preparations may be made, which shall exhibit the development of the fructification from the first differentiation of the cell onward to the ripe sori.

In the double staining of leaves there is no advantage, seeing that we can differentiate every part with a single colour, and the attempt to stain in two colours, while occupying more time, adds nothing to the beauty or value of the preparation.

Having thus given in detail the processes employed, let me hope that many of our members will take up the subject of Vegetable Histology; and, in the use of the methods, secure pleasure and profit to themselves, and add at least some small amount to the sum of knowledge.

P.S.—Since reading the above I have found that a paper on this subject was published prior to the one first quoted. This was written by Dr. C. Johnston, of Baltimore, and published in the Monthly Microscopical Journal, Vol xi. (1874), p. 184.

W.H.G.

The Ordinary Condenser Improved, or "Circular" Illumination Superseded.

By W. K. Bridgman, L.D.S.

(*Read May* 25, 1877.)

During the working out of the mechanical arrangements for the "reflecting illuminator," it was very soon discovered that no inconsiderable portion of the superiority of its illuminating effects was derived from conditions equally applicable to almost every other form of condenser; and which could be adapted to most, if not all, of those already existing, so as to give to the majority of objects, commonly seen with the medium and lower powers, but more especially such as were dependent on stereoscopic effect and the total absence of haze or glare, a clearness and distinctness of detail very far in advance of what is obtained in the ordinary way.

With the highest powers it is well known that almost everything depends on the illumination; this being the chief difficulty, as the very slightest variation may either *make*, or *wholly mar*, the effects. In proportion, however, as we descend in the scale, so does this great nicety of adjustment seem to be less needed; and with a very large proportion of observers, so long as there is *light enough*, and that not too overpowering, little further is heeded. But let an equal amount of attention be paid to the illumination for the lower powers as for the higher, and the result will be found amply to compensate for any extra trouble it may involve.

Let some well-outlined object be placed under one of the medium powers, and be illumined with *direct* light, or light thrown up centrally with the optical axis, and it will go in and out of focus with a hazy outline *expanding equally in all directions.*

But let the mirror be turned to one side so as to throw the light obliquely across the object, and the outline will then *expand only on one side*, and that in the opposite direction to the course of the illumination.

Now, if the illumination of the object and the seeing it with the object-glass and eyepiece were separate and independent actions, such an effect would not be produced; but the object would remain stationary under both conditions. The true state of the case is that the illuminating rays, impinging upon the object, pass through the body of the instrument in one continuous or unbroken line, projecting forward the image of the object until it reaches the eye; hence, whatever degree of obliquity is given to the illuminating rays, it must of necessity affect the results given by the object-glass, and thus, whether the plane or the concave mirror be used, the effects will differ in proportion.

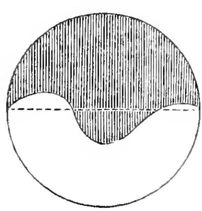
In the experiment with the painting seen in the graphoscope, it was shown that when the illuminating ray, *reflected from the surface*, entered the eye, nothing could be seen but the glare of the light itself, the detail of the picture being totally invisible. This same law, necessarily, applies equally to the direct ray reflected by the mirror up through the centre of the optical system. The central portion of every lens, presenting more or less surface at right angles to the course of the ray, suffers this to pass without refraction, or bending out of its course, and hence it carries with it only the glare of the light as it did in the graphoscope. This effect, however, decreases of course in proportion as the zonal ring, admitting the rays, recedes from the centre, the refraction being greatest at the exterior margin.

It was also explained that it is *not* the direct or reflected ray which the eye takes cognizance of as rendering an object visible, but that it is the *transverse vibrations* GIVEN OFF LATERALLY which enter the eye and produce the sensation of vision. Now, in accordance with this law, rays of light may be reflected or refracted from objects *at too* SMALL *an angle* for any of these lateral vibrations to reach the eye, and consequently the objects will be *invisible*. The extent of this angle is a disputed point, but it is supposed to be about equal to a half-wave length; but what more immediately concerns us in the present case is that in proportion as the angle approaches to 180°, or to a straight line, the more of these lateral vibrations enter the eye, giving the greatest possible distinctness to the object: hence in this lies the chief reason of wide-angled object glasses having more light and giving greater distinctness of vision, although it must necessarily be at the expense of "depth of focus" or penetration.

In the application of these facts in connection with the illuminating pencil, it will readily be understood that while the *marginal* rays are forming an image of the object, the *central* rays pass through, and, entering the eye, tend to obscure the image by the glare and overpowering effect which they produce. It will now be most unmistakably clear that it is the *central*, or "*glare*" rays, which have to be stopped out, not the marginal rays which give the image; hence it will be equally obvious that the shutting out of these rays by diminishing the aperture through which the light is admitted, either to or from the lens of the condenser, is *altogether wrong in principle*, and diametrically opposite to the course which both theory and practice suggest; consequently all such ingenious contrivances, like the "iris" or "contracting diaphragm," are misplaced ingenuity, from seeking a remedy in the wrong direction.

A consideration of the preceding facts long ago drew my attention to the possibility of obtaining a more successful arrangement, and after a fair trial of all the various condensers, from the elaborate "Gillett" down to the ordinary "kettledrum," and in combination with all kinds of stops or diaphragms, I was ultimately led to the conviction that the form represented in Fig. 1 (and which was

Fig. 1.



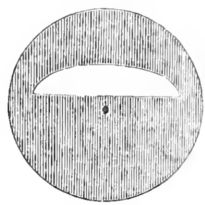
described in the M.M. Journal at the time*) gave by very far better results than I had been able to obtain by any other means. The middle projection effectually cut off the central rays, while the indentation in the line admitting more light than the opposite side was intended to compensate for the loss by the reflections in the prism, &c.

This arrangement continued in use until quite recently, when, in manipulating with the Reflecting Illuminator, it was then discovered

* Vol. ix. (1873), p. 57.

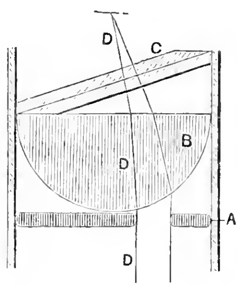
that by cutting off the opposite portion of the cone of rays, and taking a parallel strip transversely between the centre and the circumference, a still better result was obtained; and this being applied to the hemispherical condenser, it was found to be equally as effective in refraction as by reflection, and the result of experience has since been to indicate the form and dimensions shown in Fig. 2 as affording the most satisfactory effects.

FIG. 2.



This diaphragm should be placed directly beneath the lens as in Fig. 3*—the curved line forming the upper edge of the slit is neces-

FIG. 3.



sary to compensate for the unequal surface or curvature of the lens above it. It should be so proportioned that when seen from above in the direction of the ray, the two sides of the light should be as nearly parallel as possible. The slit represents in the original a position of about one-sixteenth of an inch above the centre and a width of between two and three-sixteenths at its widest part. It should be arranged transversely, or parallel with the direction of the

* Fig. 3. Vertical section of Condenser—A the diaphragm or stop, B the hemispherical condensing lens, C two thicknesses of tinted glass placed vertically to the cone of rays, D.

tubes and eyepieces, and on the upper half of the stage opening, so that the light may illuminate both tubes equally.

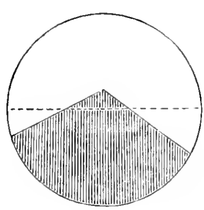
In its fixings it will require only the ordinary up and down rack-work, and a means of centreing, or a movement of about half-an-inch or less, so as to carry the slit backwards and forwards *vertically* when the instrument is inclined for use. This movement, should there be no rectangular sub-stage, may be readily effected from a centre, or turning on a pivot, the distance to be traversed being so small that a *radial* direction will scarcely at all interfere with its performance.

In using, the lamp is best placed in front, a little to the right. After placing an object on the stage and getting an approximate focus, the prism should be drawn out and the light well centred to the field; then replace the prism and, if rightly set, both fields will be equally bright. Next, search for the best part of the flame and adjust the condenser to its position, moving it outwards or inwards until the best effects are obtained. A very little practice, with careful attention, will soon render its use familiar and certain. It will, of course, be important to see that the mirror is perfectly central with the axis, and at such a distance as may be suitable to the intensity desired.

In the present instance, the lens is about one inch in diameter; but it has also been tried, with equally good results, with lenses about one-third the size—the *proportions* of the slit remaining the same.

In using a lens, in conjunction with a polarising prism, this opening will not afford sufficient light for the purpose, and it has been found desirable to extend the aperture to something more than the half-circle, as in Fig. 4. An angle of about 145° has been ob-

FIG. 4.



tained (by using a collapsing and expanding contrivance) as the most efficient angle, and giving an equal amount of light from the margin to that which has been stopped out in the centre, rendering objects beautifully stereoscopic and clear.

The next consideration is as to the *quality* of the light. The dazzling and detail-obliterating glare of the sun's noonday rays is well known to be exceedingly trying as well as injurious to the eyesight, and the concentrated rays from a lamp or even of daylight is only a question of degree as to its inapplicability to distinct vision, as well as to the safety of the eyesight. It has frequently been remarked that visitors, on first looking into an instrument, have exclaimed, "*Oh, what a brilliant light! it dazzles the eye so that I can see nothing else yet,*" and which is unfortunately but too commonly true to the letter. Instead of the light being made subordinate to the object, it is too often the chief thing which arrests the attention. An artist, painting a picture, takes care to subdue his background and make it the means of leading the eye towards his principal object, and the same ought to be done in the microscope. The brightness and the tint of the field should be unobtrusive, and serve to throw the object into distinctness, and cause the eye to be immediately attracted to it, leaving the light itself to make its presence known by feeling rather than by appealing to the eye.

With the reflecting illuminator the silvery whiteness was subdued by the yellow of a small portion of gold as an alloy; but with refraction, the only course open is by means of a tinted transparent medium, and for this purpose *blue* glass has been commonly employed, although it is highly objectionable in more ways than one. Having tried all the tints of the spectrum, and a variety of combinations in addition, it has been found, practically, that there is no other tint to at all compare with the neutral tint occurring between the green and the yellow, with a very slight predominance of the former. This gives a beautifully cool and agreeable tone to the background of the field; at the same time that, by absorbing the excess of light, it reduces bright sunshine to clear daylight, and materially improves the distinctness of definition.

My own experience leads to the conclusion that by very far the best place for the tinted glass is *between the lens and the object*; but if it be made to rest upon the face of the condenser, so as to have its surfaces parallel with the plane surface of the latter, it will, by its refraction, materially interfere with the definition; its proper position being, as shown in the diagram (Fig. 3), at right angles to the course of the ray after it has left the condenser. In this direction the rays in their passage through it will be unrefracted, and, consequently, not in the least detrimental to the definition. Possibly, by cementing it down with Canada balsam to the plane surface of the condensing lens, it might be equally advantageous; but this remains to be tried. Its next best place will be immediately above or below the diaphragm.

Now, when so much nicety in the perfection of the illuminating pencil is essential to its well-working, it is most surprising that such a thoroughly unscientific arrangement as the introduction of ground glass, which breaks up the integrity of the rays, and scatters them in every direction, should, in the present day, be tolerated even for a single moment; but it is to be hoped we have seen nearly the last of it. Let any such object as the *Heliopelta Metii*, for instance, be closely examined under the tinted glass properly adjusted, and then let it be quickly transferred to the ground glass in the place of the other, and much of the detail will be found to be lost or greatly obscured, and as the present arrangement admits of almost universal application, and may be adopted at very little cost, and giving such very superior effects, I have no hesitation in pleading in its behalf for an unbiassed trial. There has been some difficulty in obtaining the exact tint, and which has delayed the completion of these remarks; but having at last succeeded, I have forwarded a specimen for comparison, as it is important that neither too much green nor too much blue and *no* violet should be present; while as to the thickness of the glass, it seems preferable to employ a thick glass lightly tinted instead of a thinner substance more deeply shaded. With one thickness of the present sample, a most agreeable effect will be obtained in the daytime, by taking bright light from opposite to the sun; but with a gaslight or mineral-oil lamp, it will require two thicknesses to sufficiently neutralize the dazzling brilliancy, whether the light be taken direct or reflected from the mirror. Where, however, two thicknesses are required, these should be cemented together with Canada balsam, and also a piece of flat covering glass should be cemented upon each outer side, as affording a better surface, and one that will not easily be dulled by friction in cleaning.

PRESIDENT'S ADDRESS,

Delivered at the Annual Meeting, July 27th, 1877.

Gentlemen,—When I began to consider on what subject I should speak to you this evening, I became more than ever conscious that in the many admirable addresses of my predecessors in the chair, all the leading subjects have been appropriated, and that it becomes increasingly difficult year by year for the President to find a topic on which he may usefully descant.

The machinery of our Club is in such excellent order, and its work goes on so evenly and smoothly, that we are almost unconscious of the lapse of time until each successive annual meeting reminds us that another year has passed away. I think, therefore, that, as an artist stands back from his easel to obtain a better view of the general effect of his work, we, as a body of friends associated together in a favourite study, and desiring improvement, may advantageously pause, at the conclusion of another session, to consider the use we have made of our opportunities, and to review our position as a club of microscopists.

Looking at the first page of the "Microscopic Journal," commenced thirty-six years ago (in 1841), and edited by Daniel Cooper, I find the first words there printed as follows :—"As microscopic research," says the Editor, "is for the most part an amusement rather than a profession, it cannot be a matter of surprise that many resort to it as a means of intellectual pastime which is sure to terminate in beneficial results. General knowledge may be acquired by observation—recondite science by application alone; and the existence of the former in the mind of the apparent tyro, by industry and perseverance, imperceptibly produces the latter." After this he proceeds to summarise the progress of microscopical science in England for the preceding fifteen years, and as this just completes half a century to the present time, I turned to his remarks to see if

I might there find recorded a few facts and occurrences, notice of which might help me to suggest to you a course of thought which you could follow for yourselves. As I do not wish that my address shall be an elaborate production, I shall allude very briefly to these facts, and shall be content if I can offer to you a few ideas which may not be too trifling for you to think about at your leisure.

At the instigation of Dr. Goring, in 1824 and 1825, Tulley constructed the first achromatic objectives made in this country, which were termed by him the "triple object glasses." About the same time Selligue was at work in France, Fraunhofer at Munich, and Amici at Modena.

In 1830 an important paper on achromatic object glasses, by Joseph Jackson Lister, was published in the "Transactions of the Royal Society." This was an eventful period in the history of the construction of microscopes, and the influence of that communication extends downwards to the present day.

In 1832 Messrs. Cooper and Carey constructed an oxy-hydrogen microscope, and scientific men were invited to a private view of it at 21, Old Bond street, in February, 1833. It was afterwards publicly exhibited, and greatly stimulated popular interest in microscopical science, which already numbered amongst those devoted to it, Robert Brown, Bauer, Solly, Lister, Cuthbert, Pritchard, Goring, and others. One of the most distinguished of this corps of pioneers was my kind old friend, Dr. Bowerbank, who, in the journal referred to, received a well-merited encomium. The writer says :—"It must on all sides be agreed that every praise and commendation the world can bestow are due to the indefatigable exertions of Mr. Bowerbank, who, by his well-known liberality in promoting the cause, has at length succeeded in diffusing that growing taste for microscopic research in the Metropolis characteristic of the present age. To this gentleman's liberality in opening his house weekly for the purposes of microscopic illustration is in a great measure to be attributed the first dawn of encouragement to the rising scientific generation. Ever ready, ever desirous, and ever interested in the tyro's cause, he must have created in the minds of those seeking such valuable aids, every regard and esteem ; and especially when we consider that the limited means of investigators formerly, and even at the present day, have not allowed them such splendid instruments and practical facilities in their manipulation which the fortune and talents of Mr. Bowerbank enable him so amiably and freely to dispense to those who seek his advice and assistance." These words were written thirty-six years ago. Their truth no one can better estimate than myself. To Dr. Bowerbank's encouragement, advice, and introductions, given to me as a young microscopist, I owe the confirmation and increase of my early love of this branch of science. I afterwards enjoyed the privilege of his intimate friendship, and the desire to be worthy of his generous appreciation of me as a practical naturalist, has been one great incentive to me to work with an earnestness of purpose and a love of my subject which has led to my having so far gained your approbation as to be placed by you in the position I now hold. The grand old veteran passed away only four months and a half ago. He died almost with his weapons in his hands. He had just completed the fourth volume of his work on the *Spongiadæ:* only one plate remained to be drawn by Mr. Dinkel—only one microscopic section of a sponge to be illustrated. The slide on which he had mounted this was found, after his death, on the stage of his Tulley's microscope—the instrument by means of which he had made all his researches, and which he had used daily until he laid down his arms to rest in his last sleep. The decease of so eminent a man—one of the founders of "The Microscopical Society of London"—would be worthy of notice in an address of the year to any battalion of his followers. I venture to believe that I have not gone too far in relying on your sympathy with my personal feelings of affectionate reverence for him.

To return to the date when the testimony which I have quoted to his services in the cause of science was published in the "Microscopic Journal." About this time, to Mr. Powell and Mr. Ross, as makers of microscopes, was added Mr. Smith, and, after him, many who need not be enumerated. The time arrived when the Microscopical Society of London was inaugurated, and the first paper in the first number of the "Microscopic Journal" is "On the Structure of Fossil Teeth," by Professor Owen, F.R.S., Presisident of the Microscopical Society. As a record of microscopical work and progress, we have Cooper's Journal for 1841 and 1842 and the first three thin volumes of the "Transactions of the Microscopical Society of London," extending from 1840 to 1851. Then, in 1853, commenced the "Quarterly Journal of Microscopical Science," which has been continued uninterruptedly down to the present day. In 1869 the "Monthly Microscopical Journal" first came into existence as the organ of the Royal Microscopical Society, and for eight years the two journals have been continued contemporaneously. It will be evident that such unbroken records will give us a most interesting and complete history of the progress of microscopical science from the very commencement of the existence of the Microscopical Society. Their pages are full of valuable information, and I strongly advise all our younger members to examine and peruse them. Although the Natural History Society of Dublin had turned its attention to microscopical subjects, and the Literary and Philosophical Society of Manchester had not neglected them, yet there was no society solely devoted to the use of the microscope, except the Microscopical Society of London, down to the year 1865. On the 14th of June in that year, eleven gentlemen held the preliminary meeting of the Quekett Club, and as the formation of the Microscopical Society of London was one landmark in the history of British microscopy, so the establishment of the Quekett Club was another not less important, but different in its character and results.

It is interesting to look back from our present standpoint to some of the intimations which are offered in the first report of our Club. "Field excursions have not been forgotten," this report says; "two experiments have been made under the superintendence of Mr. M. C. Cooke (Vice-President) and Mr. W. W. Reeves. The first excursion was to Hampstead, when about twenty members and their friends attended, and an excellent collection of objects was made." This was the first Quekett excursion. Afterwards we read that the second excursion was to Darenth Wood and Northfleet Marshes, when about the same number attended. It is *not* stated that afterwards a cold collation was provided, which was the origin of the excursion dinner.

Of the first *Soirée*, on the 4th of January, 1867, it is reported that "Unfortunately a frost of almost unparalleled severity prevailed, which rendered locomotion of all kinds nearly impracticable."

I do not know who read the first paper to the Club, but presume it was that first mentioned in the first annual report, on "Work for the Microscope," by Dr. M. C. Cooke.

Another important event was the publication of the first number of our Journal, in January, 1868.

And now, gentlemen, having reminded you of a few of the memorable events of the past with respect to the dissemination of the use of the microscope and the founding of the societies most instrumental in that direction, permit me for a few moments to direct your attention to the literary aids which were at the command of the microscopists of 1840, that we may properly appreciate the difficulties and disadvantages under which they laboured as compared with ourselves.

If we are in difficulty, we have a host of friends to consult in books and treatises on the microscope—our Quekett, Carpenter, Beale, and others—but of these the first edition of Quekett was not published till 1848, that of Beale till 1854, that of Carpenter till 1856. Chevalier's first edition, in French, appeared, it is true, in 1839, and Dujardin's "Manual" in 1843; Goring and Pritchard's "Microscopic Illustrations" dates from 1830, their "Micrographia" from 1837, and "Manual" from 1839. So that really the literature of the subject was either contemporaneous with the establishment of the Microscopical Society, or succeeded it.

Fancy, if you can, the microscopists of those days with Baker's treatise, the "Micrographia" of the elder Adams, the essays of the younger Goring, Pritchard's "Illustrations" (then a new book), and little besides! Ehrenberg's great work on the "Infusoria" only dates from 1838, and that is in German; Pritchard's appeared in 1834, and his edition of 1845 embodied the results of Ehrenberg's work. There was no Microscopic Dictionary till 1856, no Smith's "Diatomaceæ" till 1848, no Hassall's "Freshwater Algæ" till 1845, no Kützing till 1844. Greville did not begin his marvellous papers on the "Diatomaceæ" till 1855, nor Walker-Arnott till 1858. Johnston's "Zoophytes" dates from 1838, and Dujardin's from 1841. It matters not in what direction we turn, we arrive at the same result—that from 1840, with the first Microscopical Society and the first Microscopical Journal dates the era of the microscope in Britain. All the microscopists before that were pioneers, who cleared the way for us, and who deserve our respect and esteem; but from that date our literature, as well as our instruments, has been steadily developed.

That exceedingly valuable periodical the "Annals and Magazine of Natural History" only commenced its first series in 1838, and from that period to the present an immense amount of work due to the use of the microscope has been recorded in its pages. In like manner, the "*Annales des Sciences Naturelles*" commenced its second series in 1834 (the first series is scarcely devoted to microscopical work), and these two journals are almost microscopical publications, for they contain many most valuable contributions to our knowledge of minute organisms. Now, almost every standard scientific book teems with the results of microscopical investigations. No one would think of competing in any scientific examination without some knowledge of the minute anatomy, &c., which the microscope reveals, and medical men consider the microscope as essential a professional instrument as lancet or forceps.

This, gentlemen, is some of the evidence of progress during the past thirty-six years. We have taken a retrospective view of the past; we are pretty well acquainted with the present; what are our hopes and plans for the future? It seems to me that all the evidence, however circumstantial, is in favour of the assumption that the full and rapid development of microscopy in this country is due to the establishment and operations of the Society which was constituted at the beginning of that which I have styled the microscopical era, and those which followed in the same direction. If this be so, a large amount of responsibility rests upon those who are to carry on the work, and, consequently, a share of that responsibility rests upon us. Under these circumstances, we cannot do better than emulate our predecessors. Their work was done in a quiet and unassuming manner, as ours is being done; and the most pleasing and gratifying observations we read about them are those concerning the good fellowship which existed amongst them, and the free extension of help one towards another. We have not to face the difficulties which they had to encounter. We have magnificent instruments, which they had not, and we have the testimony of Ehrenberg himself that the preparation of his great works on the Infusoria and Micro-geology was accomplished by means of a microscope inferior in capability to one which could now be purchased for £5. To our hands, and to those of the members of kindred societies, the work of the future is entrusted, and let us hope that we shall so accomplish it that our successors may be able to pass like encomiums upon us as we confer on those who preceded us; that they may be able to say that we knew our work, and did it to the best of our ability, with good feeling and good-fellowship.

My remarks have hitherto related more to the general history of the rise and progress of microscopical science in this country than to any especial influence of the Quekett Club, or any especial regard to its functions and achievements. I cannot, however, close without a word or two concerning the specialities of the Club, or those features which particularly characterised it when it came into existence, but which are now happily emulated by others. One of these is the very moderate rate of annual subscription, which brings the advantages of the Club within the reach of all moderately educated persons. When you consider that a magnificent room is ready for your meetings twice in the month, well lighted and admirably situated, that you receive almost quarterly a valuable journal gratuitously, that a large collection of microscopic objects is at your disposal, that you have already a very respectable library, that occasionally you have a *Soirée* (to which you can invite a friend) unsurpassed for interest and utility by that of any other society, even with a subscription of four times the amount—I think you will agree with me that one feature of the Club is cheapness.

Another point of which I would remind you is, that a high scientific standard is not demanded for the papers and communications which are read from time to time at our meetings. I wish to impress upon the members generally that we do not absolutely demand novelties and new discoveries in our papers, so much as an examination and verification of old facts, seen with new eyes, and illustrated by new methods. The plainer, simpler, and less elabora e the papers are, the better do they serve the purpose of the Club. The majority of our members are, in every respect, qualified to communicate to us their views in some section of the very wide range of subjects which come under our cognizance, if they would but take courage to do so, and give us the benefit of their experience. I would therefore urge that short and conversational papers are another feature of the Club which I earnestly hope that a larger number of members will recognise. The informal and social character of the concluding half-hour of our monthly meetings, and the whole of our "gossip" nights, is one which needs only to be mentioned, since it is a feature highly appreciated, and one which continues to be as prominent and vigorous as ever.

The value of a scientific library is so great that arguments are unnecessary to prove that this is an important adjunct to the Club. Although it is not so extensive as we hope it may become, it is already an excellent feature, and one which admits of almost unlimited improvement. Growing demands upon the library now in existence will afford to the committee the best evidence that it is appreciated, and give them the strongest inducements for its augmentation.

A large cabinet of objects for consultation and reference is little inferior in value to a library; certainly in connection with books it is an undoubted acquisition; and large as this collection may be, I plead for its extension on many grounds, but chiefly on its utility in the present, and its interest in the future. How highly we should value, for instance, objects presented to us, say only ten years ago, by members now dead. Those who follow us will probably similarly value our work; therefore every member should make it a point to present at least one slide to the Club with this thought in his mind. I may advocate this also from another point of view. Certain studies occupy men at certain periods of their life. For instance, the staining of vegetable tissues is at present a prominent subject of experiment. Twenty years hence how important and historically valuable will be a series of slides mounted by the methods now coming in vogue, and which then no money will purchase.

This suggests to me another matter worthy of attention. There are many little inexpensive contrivances which the practical microscopist is constantly using, such as clips, finders, collecting bottles, &c., &c., which are so common to us that we think nothing of them. Each and all of these may be superseded and go out of date, and thirty years hence no one will know anything about them. It deserves consideration whether the Quekett Club should not collect from its members such unconsidered trifles, with labels attached, signifying the uses and date of each. Even if consigned to a trunk, and not looked at for many years, they would then have just such an interest as some of the more primitive contrivances of thirty years ago now have for us.

I now pass to the last feature to which I purpose especially adverting, viz., the summer excursions. Gatherings of this kind, even if they produce no immediate scientific results, are conducive to a social benefit which this Club would be the last to ignore. If only a dozen men meet and shake each other by the hand, every such event strengthens the friendship of members for each other, and consequently adds to the strength of the Club. Twelve intelligent men cannot meet together in harmony for a common intellectual object without reacting on each other with a beneficial result. The Quekett excursionists will tell you that they have every reason to be pleased with their experience of this feature of the Club. Those who do not avail themselves of these gatherings cannot calculate how much they lose by their abstention.

In conclusion, I would refer to three circumstances in the life of John Quekett, which may be regarded as typical of the tone and objects of the Club which bears his name.

(1) Whilst he was still a youth he constructed a microscope, which was made up of materials furnished by a common roasting-jack, a lady's old-fashioned parasol, and pieces of brass purchased at a neighbouring marine-store dealer's, and hammered out by himself. With this rough instrument he made several important discoveries.

(2) During his after-life, by patient and intelligent investigation, he accumulated a series of microscopical preparations, mounted by himself, which were considered so valuable that they were purchased by the Royal College of Surgeons, and form more than the nucleus of the collection of that Institution.

(3) One of his last pleasurable acts was to arrange a party for "Music and Microscopes," as he phrased it. The party did not take place, for, when the day appointed for it arrived, he was too ill to receive his friends, and soon afterwards died.

I venture to draw from these incidents a lesson for ourselves. (1) Let our younger members be hopeful and self-helpful. If they cannot afford costly instruments, let them work contentedly with less expensive ones, and especially let them acquire the habit and the skill to make for themselves any simple apparatus they may require. (2) Let it be remembered that a series of microscopic objects, mounted by a man for himself, merely as an intellectual pastime, perhaps, may lead him to become a real student of science, and will assuredly do so if he prepares them in illustration of his favourite subject, and in conformity with a predetermined plan. (3) Let me insist that a man may be an ardent student, a laborious and painstaking worker, and even a great master in science, without being pedantic or morose; and that, as John Quekett, at the close of his distinguished career, proposed as a pleasant *melange*, "Music and Microscopes," so we, as members of the Quekett Club, shall be rendered none the less vigorous or successful in the pursuit of knowledge by the genial interchange of social amenities, and the enjoyment of friendly intercourse.

By bearing these things in mind, and acting on them—by following the example of Dr. Bowerbank in the frank and unreserved communication of any information we possess—by passing on to young beginners the kindness that we have received from our seniors—and by making the best use of privileges and advantages far greater than those possessed by the microscopists of 1840, we shall secure the prosperity of the Club, increase the pleasure and happiness of its members individually, and do the best in our power for the microscopists of the future.

PROCEEDINGS.

May 25th, 1877.—Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. G. L. Baker, the Rev. J. Bramhall, Mr. Geo. Carr, Mr. A. C. Coxhead, Mr. O. Croft, Mr. G. W. L. Marshall-Hall, the Hon. Sackville F. H. Lane-Fox, Mr. H. V. Knaggs, Mr. R. G. Veasey, Mr. F. Yates.

Six gentlemen were proposed for membership.

The following donations to the Club were announced :—

"The Monthly Microscopical Journal" ...	from the Publisher.
"Science Gossip"	,, ,,
"Proceedings of the Belgian Microscopical Society"	,, the Society.
"The Medical Examiner" (weekly) ...	,, the Editor.
"Proceedings of the Royal Society" ...	,, the Society.
"The American Naturalist"	in exchange.
"The American Journal of Microscopy" ...	,, ,,
"Annual Report of the Smithsonian Institution	from the Institution.
One Slide	Mr. Tatem.
One Slide	Mr. Topping.
Seventy-two Slides of *Foraminifera* ...	Mr. H. F. Hailes.

The President, in proposing a vote of thanks to the donors, called special attention to the valuable present received from Mr. Hailes. The addition of six dozen mounted specimens of *Foraminifera* to their cabinet was a very valuable acquisition, and placed them in possession of a collection not equalled by any of the higher Societies. Mr. Hailes had further promised to add other specimens to this collection as opportunity afforded him the means of so doing, and it was hoped that if any members possessed *materiel* which contained *Foraminifera* they would forward portions of it to Mr. Hailes, who had expressed his willingness to mount specimens of them.

The thanks of the meeting were unanimously voted to the donors—a special vote of thanks being at the same time accorded to Mr. Hailes.

A paper by Mr. W. K. Bridgman, "On some Improvements in the ordinary Condenser," was read by the Secretary, the subject being illustrated by diagrams. The paper also described the endeavours of the writer to procure a tinted glass which should be the most suitable for toning the field of view under strong illumination, and he had been led to the conclusion that a tint between the green and the yellow was greatly superior to any other. A number of specimens of glass of the tint described were sent by Mr. Bridgman for distribution amongst the members.

Mr. Ingpen said he had tried to put into practice what Mr. Bridgman had described, but had not been quite successful, doubtless owing to his not having cut out the diaphragm exactly as was shown in the diagram. The glass he had tried, and found it to be certainly a most charming tint, and far superior to the blues which were generally used for the purpose. Placed under the spectroscope, it gave faint absorption bands in the blue and green, and a darker band in the red just where it joined the yellow; it was a most comfortable ground for the eye to rest upon, giving a cool grey field of view; it was the result of the careful investigations of a gentleman who had given many years of study to such critical subjects, and he felt sure it was worthy of general adoption.

The thanks of the meeting were unanimously voted to Mr. Bridgman for his communication.

Mr. W. H. Gilburt read a paper "On the Staining of Vegetable Tissues," specimens of the process being exhibited in the room.

Mr. Ingpen said he was glad to find that this subject had been fairly launched in the Club, for he had been trying to bring it under the notice of the members for some time. They must all have admired the preparations by Dr. Hunt and Mr. Walmsley, which had been exhibited, and Mr. Gilburt had shown some of the most interesting specimens which they had yet seen as they were prepared for the scientific investigation of the tissues, and not merely as pretty show objects. The addition to the knowledge of vegetable histology to be gained from specimens prepared in those ways was very great, the only drawback being the apparent complexity of the process. He preferred glycerine jelly for mounting specimens for general study, though it was difficult to get rid of air-bubbles, and he also found aqueous solutions of the dyes preferable in some cases. There could be no doubt as to the great practical value of bleaching and staining as an aid to histological research.

Dr. Matthews wished to emphasise the use of *weak* solutions. He had been for some time experimenting upon the process, and found that he had been using the dyes too strong, and consequently he found a halo of dye surrounding the object after being mounted. He had tried to obviate this by soaking the specimens in various menstrua, and had tried turpentine, benzole, and others, but whenever he mounted them from a strong dye they showed this defect. When, however, a weak solution was used, the mounts were quite perfect, and he felt he could not too strongly urge the necessity for using weak solutions.

Mr. James Smith said he was going to suggest whether some preparation of glycerine jelly or glycerine might not be used with advantage as a medium for mounting, but Mr. Ingpen had already mentioned them. One important advantage was that all preparations of glycerine and gelatine were perfectly miscible with water; another point was that glycerine jelly had a somewhat lower refractive index than balsam, and therefore the more transparent portions of these objects would be easier seen when mounted in it. He should like to ask the question whether any member knew a way of mounting specimens in glycerine jelly without air-bubbles when no heat was used ?

Mr. Stiles said he had given some attention to the subject, and had been much interested in it ; he noticed that Mr. Gilburt mentioned having used chloride of soda, and he would suggest the use of hyposulphide of sodium, as being better calculated to assist in the elimination of the chlorine. To get rid of bubbles out of the tissue he found it quite effectual to place the specimens in a little spirit and water—one part of alcohol to three parts of water—and then put them under the air-pump for about an hour. As an improvement upon oil of cloves, he had used oil of cajeput, and found that it produced better results. He had recently obtained some of this oil which had been redistilled, and was purer and lighter in colour than that ordinarily sold. Oil of cajeput had also the advantage of being cheaper than oil of cloves. In addition to the magenta and blue dyes he had also used a mixture of picric acid and carmine, and found that the picric acid attacked the woody fibre, and that the carmine became associated with the pith and the bark. No heat should be applied whilst mounting.

Mr. Ingpen thought the advantage of glycerine jelly was that it could be used without a cell; there was a further advantage that an aqueous solution of the dyes could be used if desired, in which case the tissues were less liable to undergo distortion. In using the jelly very little heat was sufficient, for when once melted it could be used with a heat not much exceeding that of the hand.

Dr. Matthews mentioned, as a caution, that invariably on the mixture of alcohol with other fluids, there was an extrication of air-bubbles. If the specimens were first put into water and then into glycerine jelly this difficulty would not arise.

Mr James Smith said that a mixture of half glycerine and half picked gum arabic in water was a very good medium ; it was beautifully clear and answered the purpose admirably.

Mr. Sigsworth recommended also a mixture of glycerine and camphor-water.

The President, in proposing a vote of thanks to Mr. Gilburt, expressed the opinion that the very practical paper which he had read would be of great use to the Club.

A vote of thanks to Mr. Gilburt was unanimously carried.

The Secretary reminded the members that at the next ordinary meeting nominations of gentlemen to fill four vacancies on the Committee would have to be made. The nominations of President and Vice-Presidents would also be made then, as that would be the meeting previous to the Annual Meeting in July.

Notices of Meetings and Excursions for the ensuing month were then made, and the proceedings terminated as usual with a conversazione, at which the following objects were exhibited :—

Leaf of *Iris*	by Mr. F. W. Andrew.
Lichmophora flabellata (stained)	,, Mr. W. J. Brown.
Utricularia vulgaris	,, Mr. T. F. Buffham.
Beetle—*Cicendula*, Sp. (?) from Barnes Common	,, Mr. W. G. Cox.
Series of double-stained Vegetable Tissues, exhibited for Mr. Walmsley of Philadelphia	,, Mr. A. C. Coles.
Fern Leaf	,, Mr. C. Collins.
Triceratium disciforme, from Colon	,, Mr. A. Cottam.
Stictodiscus Californicus	,, Mr. T. Curties.
Organs of Mouth of Oil Beetle—*Melöe violaceus*	,, Mr. F. Enock.
Frond of *Polystichum angulare*, showing early stage of fructification ... ... Double-stained section of stem of *Pelargonium*, polarized	,, Mr. W. H. Gilburt.
Anditory Meatus of Child	,, Mr. J. J. Hunter.
Lichmophora, mounted in saturated salt, exhibited for Mr. Tatem ... ... Ditto, stained with aniline blue and with logwood	,, Mr. J. E. Ingpen.
Wax casts of passages excavated by Parasites in an oyster shell	,, Mr. M. H. Johnson.
Pediculus vestimentis	,, Mr. R. T. Lewis.
Diatoms selected from South American mother-of-pearl shell...	,, Mr. W. Moginie.
Aulacodiscus Jutlandicus, from the Cemenstein Mors, Jutland	,, Mr. T. H. Powell.
Fern from Corsica—*Nothocloena maranta* ...	,, Mr. W. W. Reeves.
Heliopelta—opaque	,, Mr. H. J. Roper.
Fusilina Limestone, from Russian Carbonifefous Formation	,, Mr. J. Slade.
Section of Peterhead Granite...	,, Mr. W. S. Smith.
Transverse Section of Stem of *Eucalyptus globulus*, double stained	,, Mr. H. Stiles.
Medusæ, born in aquarium	,, Mr. T. C. White.

Attendance—Members, 86 ; Visitors, 13.

June 8th, 1877.—Conversational Meeting.

The following objects were exhibited :—

Cuticle of *Iris*	Mr. F. W. Andrew.
Dodecahedral granules of pollen of Stitchwort	Mr. T. H. Buffham.
Atypus Sulzeri—Trap-door Spider	Mr. F. Enock.
Proboscis of Butterfly	Mr. J. W. Goodinge.
Section of Human Kidney	Mr. J. J. Hunter.

Circulation of blood in Gold Fish, by new American Syphon-slide	Dr. Matthews.
Collection of *Aulisci*	Mr. T. H. Powell.
Human Mammary Gland, with milk globules *in situ*	Q. M. C. Microscope.
Cuticle of *Gasteria insifolia*	Mr. J. C. Sigsworth.
Section of *Syenite*, from Malvern	Mr. W. S. Smith.
Young *Terebella*, alive	Mr. T. C. White.

Attendance—Members, 55; Visitors, 2.

June 22nd, 1877.—Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced, and the thanks of the meeting voted to the donors.

"The Monthly Microscopical Journal"	from the Publishers.
"Science Gossip"	" "
"The American Naturalist"	in exchange.
"Proceedings of the Zoological Society of Philadelphia"	from the Society.
"The Medical Examiner" (weekly)	" the Editor.
"Annual Report of the West London Scientific Association"	" the Society.
"Proceedings of the Royal Society"	" "
Two Slides of Parasites	" Mr. Freeman.
Six Slides of Stained Vegetable Tissues, by Mr. Walmsley	" Mr. A. C. Cole.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. P. G. Cunliffe, Mr. R. W. Hill, Mr. F. Oswin, Mr. J. W. Reid, Mr. Chas. Stewart, and Mr. G. E. Weddall.

The President announced that as the next meeting would be the Annual Meeting, at which elections for Officers and Committee were made, it would be necessary at the present meeting to nominate gentlemen to fill the vacancies. In accordance with the bye-laws the Committee had made the following nominations :—As President—Mr. Henry Lee; as Vice-Presidents—Dr. Matthews, Mr. T. C. White, Mr. Frank Crisp, Mr. E. T. Newton; as Hon. Treasurer—Mr. F. W. Gay; as Hon. Secretary—Mr. J. E. Ingpen; as Hon. Foreign Secretary—Dr. M. C. Cooke.

The President then requested the members of the Club to nominate genmen to fill four vacancies upon the Committee, caused by the retirement, in rotation, of four of its present members.

The following nominations were then made :—

Mr. W. H. Gilburt,	proposed by	Mr. Priest	and seconded by	Dr. Matthews.
Mr. Parsons,	"	Mr. Bevington	"	Mr. Dunning.
Mr. Priest,	"	Mr. Sigsworth	"	Mr. Waller.
Mr. E. Simpson,	"	Mr. Hind	"	Mr. Terry.

Mr. T. Spencer, proposed by Mr. T. C. White and seconded by Dr. Matthews.
Mr. Chas. Stewart, „ Dr. Matthews „ Mr. T.C White.

It being necessary that the accounts of the Society should be duly audited before the next meeting, Mr. Hainworth was appointed Auditor on behalf of the Committee; and Mr. Dobson having been proposed by Mr. Moginie, and seconded by Mr. Hind, was unanimously elected Auditor on behalf of the members.

The Secretary read a letter which had been received from Mr. Fullagar, stating that having found some curious bodies amongst the *débris* of some sponges, which he was unable to identify, he had sent some specimens to the Club, in the hope that some of the members might be able to recognise them. The objects would be exhibited under a microscope at the close of the meeting.

Mr. J. E. Ingpen then communicated to the meeting "Some Notes on the Camera Lucida." Commencing by illustrating the general principles of the instrument, as applied to landscape-drawing, and describing the forms invented by Wollaston, Amici and others for that purpose, he proceeded to explain the use of the camera in conjunction with the microscope, and described various forms, both of prismatic and reflecting cameras, the principal being those of Wollaston, Amici, Soemmering, Chevalier, Doyère, Nobert, Beale and Nachet, the latter having special reference to the use of the microscope in vertical and inclined positions. The use of the reticulated micrometer was also referred to, and some concluding remarks made upon the value of camera lucida drawings for speed and accuracy, and as forming a check upon fanciful delineations of microscopical objects.* The description was illustrated by numerous diagrams, and specimens of most of the forms were also exhibited.

Mr. T. C. White regarded the subject as one of immense importance, and thought it could hardly be overrated. He quite agreed with Mr. Ingpen as to the use of the camera lucida as a check on the fancy in drawing microscopic objects, but many difficulties arose in practice, because these contrivances all required the instrument to be inclined, and what was so often wanted was something which would enable an object to be drawn whilst the body of the microscope was in a vertical position. He had tried the neutral tint reflector, and found it very well in its way, but he had also adopted a still more simple method, consisting simply of a little piece of thin covering glass, set at an angle of 45° above the eyepiece; this he found to answer very well, and he had for many years made sketches with it. But when wanting to make drawings of marine life, of course if the stage were inclined, all the things would run off at once. It was of great importance to be able to draw a striking object at any moment without disturbing it at all, and what he had seen of the new forms led him to believe that some of them would answer the purpose; he had therefore

* For particulars respecting the Reticulated Micrometer (suggested by Francis Bauer, F.R.S.) see Appendix to Goring and Pritchard's "Micrographia" p. 221. For various forms of Camera Lucida see "Quekett on the Microscope" Ed. 1853, p. 167-8, 253-4; "Carpenter on the Microscope," 5th Ed., 1875, p. 127 *et seq*; "Quart. Journ. Mic Sc, Vol. viii. (1860), p. 156.

asked Mr. Swift to make him one on Nachet's principle, and hoped for success in using it. He was very glad that the subject had been brought before them, and hoped that a good many of the members would have something to say upon it.

Dr. M. C. Cooke thought he might challenge the members that he made more microscopical drawings with the camera lucida than any one present. Scarcely a day passed without his making at least 20 of them, and he might say that he made from 100 to 1,000 every week. He believed he was the first to bring into notice the Nachet prism; he bought one many years ago with an old microscope, and found it answer exceedingly well. He was in the habit of using a tripod microscope, which had the advantage of standing always at the same angle, and he kept the prism always upon the eyepiece, so that he could use it at any moment. When he first commenced to use it, he measured very carefully the number of diameters that the drawing was magnified, so that he could always tell exactly the diameter or size of any object by means of a paper scale made for the purpose, all objects being drawn at the same angle and the same distance, and with the same eyepiece and objective. He had found this method of measurement far superior to all others, because of the facility with which it was done. He frequently made 40 or 50 drawings in an evening in this way, which would be quite impossible if he had to mount and adjust a camera lucida every time.

Mr. Hailes said he was sorry he was not aware that the subject under discussion was going to be brought forward, or he would have brought up a form of camera lucida to the meeting, which was not amongst those figured. It was made by Amici, and bore his name and mark. It consisted of a brass box with one end closed by a perfectly parallel piece of plate glass, having a prism in front of it. It had all the advantage of "the Beale," without the reversal of the image, which was of great importance in drawing such things as Foraminifera, in which one might draw the shell coiled the wrong way. He would bring up this apparatus to the next meeting.

Mr. Curties said it was a known fact that some of the most correct drawings that had been made were drawn without a camera lucida, and that in most of the schools students were taught to draw without.

Dr. Matthews suggested that, as the subject had proved so interesting, its farther discussion should be continued at their next meeting.

The President thought this a good idea, and hoped that at the next meeting those members who had any specimens of the instruments would bring them for inspection.

Votes of thanks to Mr. Fullagar and Mr. Ingpen for their communications were then unanimously passed.

Announcements of the Annual Dinner, and other engagements for the ensuing month were then made, and the meeting terminated with a conversazione, at which the following objects were exhibited:—

Silky Earthmite	by Mr. F. W. Andrew.
Leaf of *Urtica dioica*	,, Mr. T. H. Buffham.
Plates of Star Fish	,, Mr. A. L. Corbett.

Trypeta arnicæ	„ Mr. Enock.
Unknown ova	„ Mr. Fullagar.
Frond of *Adiantum macrophyllum*	„ Mr. W. H. Gilburt.
Section of Finger of Infant	„ Mr. J. J. Hunter.
Cyclosis in *Tradescantia*	„ Mr. Martinelli.
Diatoms from Pearl Shell cleanings	„ Mr. Moginie.
Grantia compressa	„ Mr. Priest.
Section of Wigan Coal	„ Mr. W. S. Smith.

Attendance—Members, 63; Visitors, 4.

July 13th, 1877.—Conversational Meeting.

The following objects were exhibited:—

Pedicellaria and Feet of *Echinus*...	Mr. T. Curties.
Pig Louse	Mr. C. Emery.
Formica rufa—The Wood Ant	Mr. F. Enock.
Campodea (?) alive	Mr. H. E. Freeman.
Leaf of *Pelargonium*	Mr. W. H. Gilburt.
Mole Flea—*Pulex talpæ*	Mr. J. W. Goodinge.
Section of Toe of a Fœtus	Mr. J. J. Hunter.
Flint—showing organic structure	Mr. M. Hawkins Johnson.
Volvox globator	Mr. Martinelli.
Mites from bark of a tree in Epping Forest	Mr. Oxley.
Geodia Barretti	Mr. B. W. Priest.
Lace Bark—*Lagetta lintearia*	Mr. W. J. Roper.

Attendance—Members, 51; Visitors, 8.

ANNUAL MEETING.—July 27th, 1877.

Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The Annual Report of the Committee was read by the Secretary.

The Treasurer's Statement of Accounts was also read to the meeting.

The President moved, "That the reports now read be received and adopted, and that they be printed and circulated in the usual way."

The motion having been seconded by Mr. T. C. White, was put to the meeting, and carried unanimously.

The President read the Annual Address, which was listened to with great attention, and loudly applauded at its conclusion.

Dr. Matthews said that a most pleasing duty devolved upon him. They had just heard a most admirable address, which he thought to be one of the best that had ever been delivered upon any similar occasion, and he felt sure that they would cordially unite in thanking the President for it. Three things had particularly struck him in connection with it, the first was that it was a bibliographical history of the progress of microscopy from the earliest to the present time; the second was an expression of wonder at the great things done by their predecessors with the small means at their command ; and the third was the importance of making themselves acquainted with the labours of those who had gone before them. As to the history and the observations respecting the social character of the Club, he could fully endorse every word that had been uttered. He had great pleasure in proposing a hearty vote of thanks to the President for his address, and moving that it be printed and circulated with the Reports.

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

The President, in acknowledging the vote of thanks, said that when he was first elected he was so overcome by the reception given to him that he quite forgot to thank Dr. Matthews for the kind way in which he had inducted him. He desired, however, to thank him on the present occasion, not only for that, but also for the way in which he had made a point of attending all the meetings, so as to give him the benefit of his advice whenever he needed it, and for the support and co-operation he had himself received not only from Dr. Matthews, but also from all the Officers and Committee. He also wished again to thank all the members of the Club for the hearty and cordial reception which he had always received whenever he came amongst them.

Mr. George Williams then proposed a vote of thanks to the President, Committee, and Officers of the Club, for their services during the past year.

Mr. McIntire having seconded the motion, it was put to the meeting, and carried unanimously.

The President moved, "That the thanks of the Club be voted to the Council of University College, for their continued permission to hold the meetings in that building." The value to the Club of this act of liberality was too apparent to need any observation from him; not only did it provide them with a place of meeting so admirable as the room they then occupied, but the position was one which, from its central locality and its associations, undoubtedly added greatly to their status.

The vote being put to the meeting, was carried with acclamation.

Mr. T. C. White proposed a vote of thanks to those gentlemen whose services were called upon at that time of the year—their Auditors and Scrutineers.

Carried *nem. dis.*

The Secretary said that Dr. Dickson was present that evening, and would, at the close of the meeting, exhibit his method of resolving diatom markings by a "Bull's-eye Illuminator," which was then briefly described by means of sketches on the black-board.

Dr. Matthews reminded the members that this was not an invention but a new application, since Sir David Brewster, many years ago, had used the same kind of lens in the same way, and showed that its advantages were to double the intensity of the reflected ray.

The Secretary pointed out that a further advantage arose from the fact that the object was quite undisturbed by any of the other rays coming from the source of light. It was also to be recommended as utilising the ordinary bull's-eye condenser for another mode of illumination.

Dr. Matthews thought that these observations showed the necessity of carrying out the advice given in the President's Address—namely, that of making themselves acquainted with the work done by those who had gone before. No doubt if the gentleman who had introduced as new this method of illumination had known what had been done by Sir D. Brewster, he would not have considered the method to be a new one, although he, Dr. Matthews, had no doubt of its originality so far as Dr. Dickson was concerned.

The Secretary said they were also favoured by the presence that evening of Dr. Habirshaw, of New York, who had brought with him a complete Index of the Diatomaceæ, which had been prepared by his brother, Mr. James Habirshaw. It was brought for examination by any of the members who were specially interested in that branch of microscopy, and in the hope of receiving corrections or additions. They had received the promise of a copy for the library as soon as the work was completed.

The Secretary called attention to an extremely complete form of microscope, which had been brought to the meeting for the inspection of the members by Mr. Washington Teesdale. There were two forms of it, fitting into mahogany cases in the most compact manner, and well deserving their attention. The instruments were manufactured by Messrs. Field, of Birmingham. Mr. Moginie had also brought for exhibition a very ingenious metal mounting for a portable microscope, for special use with the camera lucida. The body of the instrument was fixed horizontally upon a series of bars connected together so as to produce a parallel motion, by which means the microscope could be elevated at any height from the paper, from $3\frac{1}{2}$ to $10\frac{1}{2}$ inches, always remaining perfectly parallel to it, and thus enabling drawings to be made on any required scale. The instrument had been made for Mr. Tuffen West.

The Scrutineers having handed in the result of the ballot, the following gentlemen were declared to be duly elected :—

As President—Mr. Henry Lee, F.L.S., &c. ; as Vice-Presidents—Mr Frank Crisp, B.A., LL.B., &c., Dr. Matthews, F.R.M.S., Mr. E. T. Newton, F.G.S., Mr. T. C. White, M.R.C.S., &c.; To fill vacancies on the Committee —Mr. W. H. Gilburt, Mr. F. A. Parsons, Mr. B. W. Priest, Mr. T. Spencer F.C.S., &c; as Hon. Treasurer—Mr. F. W. Gay, F.R.M.S.; as Hon. Secretary—Mr. John E. Ingpen, F.R.M.S.; as Hon. Secretary for Foreign Correspondence—Dr. M. C. Cooke, M.A., A.L.S., &c.

The name of Mr. Charles Stewart (who had been nominated at the previous meeting as a member of the Committee) was withdrawn from the list at his own request, he having, with some delicacy, considered that his election as a member of the Club was of too recent a date to justify his acceptance of the position.

The business of the Ordinary Meeting was then proceeded with.

The following donations to the Club were announced :—

"The Monthly Microscopical Journal"	from the Publisher.
"The Popular Science Review"	" "
"Science Gossip"	" "
"The Quarterly Journal of Microscopical Science"	by Purchase.
Six numbers of "The Annals of Natural History"	" "
"The American Naturalist"	in exchange.
"The American Journal of Microscopy" ...	" "
"Report of the Croydon Natural History Club"	from the Club.
"Proceedings of the Geologists' Association" ...	" the Association.
"Proceedings of the Belgian Microscopical Society"	" the Society.
"Proceedings of the Brighton and Sussex Natural History Society"	" "
"Paper on the Microscopical Examination of Certain Minerals" (French) by l'Abbé Renard	" the Author.
"Economic Entomology"...	" Mr. Sigsworth.
"The Medical Examiner" (weekly)	" the Editor.
"Pamphlet descriptive of New Forms of Microscopes"	" Mr. Teesdale.
Three numbers of Papers on Diatomaceæ (Italian) by Count F. Castracane ...	" the Author.
1 Slide "Gape Worm"	" Dr. Dickson.
3 " Blyborough Tick	" Mr. C. F. George.
12 " Diatomaceæ	" Dr. Gray.
6 " "	" Mr. Curties.

The thanks of the meeting were unanimously voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. B. Blenkinsop, Mr. C. F. Chandler, Mr. J. H. Gardner, Mr. A. D. Michael, Mr. A. E. Scott, Mr. A. C. Tanqueray.

The President having decided that the further discussion of the subject of the use and varieties of the camera lucida—adjourned from the last meeting—should be postponed to the next, the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Aulacodiscus	by Mr. G. D. Brown.
Stained leaf of Frog-bit (*Hydrocharis morsus ranæ*)	" Mr. Buffham.
Amphipleura pellucida	" Dr. Dickson.
Noctiluca	" Mr. Dunning.
Salpeus scenicus	" Mr. Enock.
Section of Rachis of *Polystichum*	" Mr. Gilburt.
Human Lung (injected)...	" Mr. J. J. Hunter.
Shepherd's Purse	" Mr. Martinelli.
Scabiata micrantha	" Mr. Moginie.

Attendance—Members, 77; Visitors, 7.

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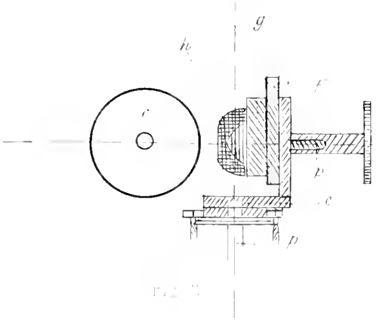

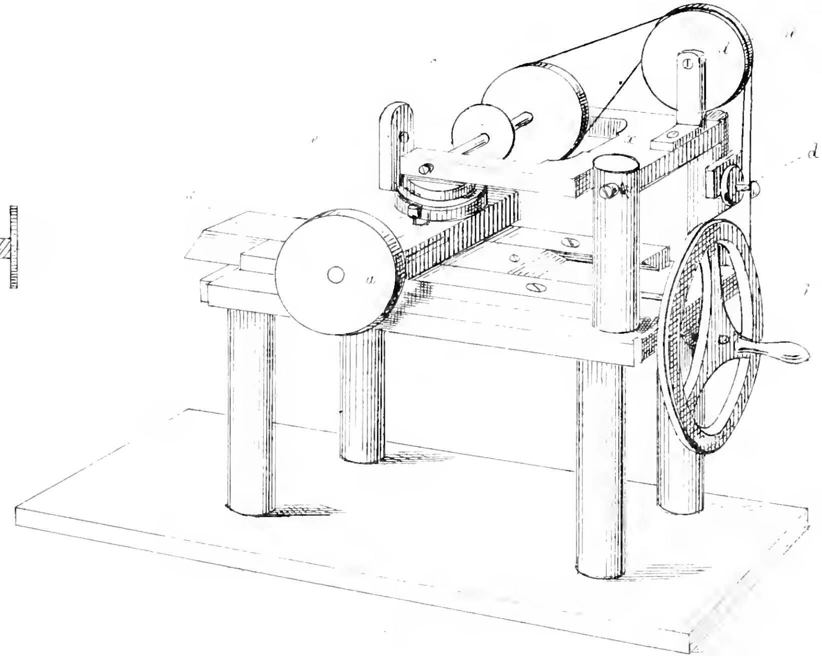

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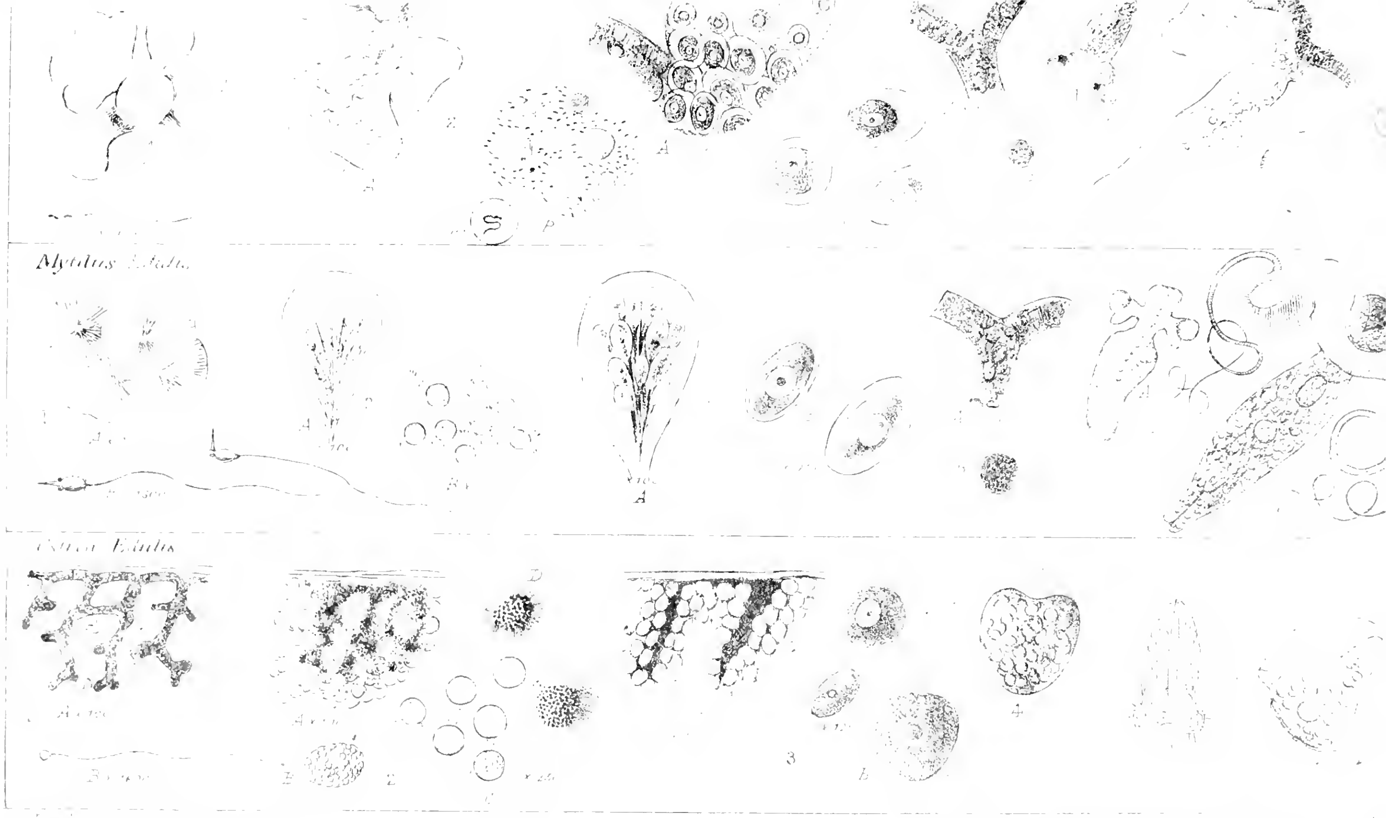

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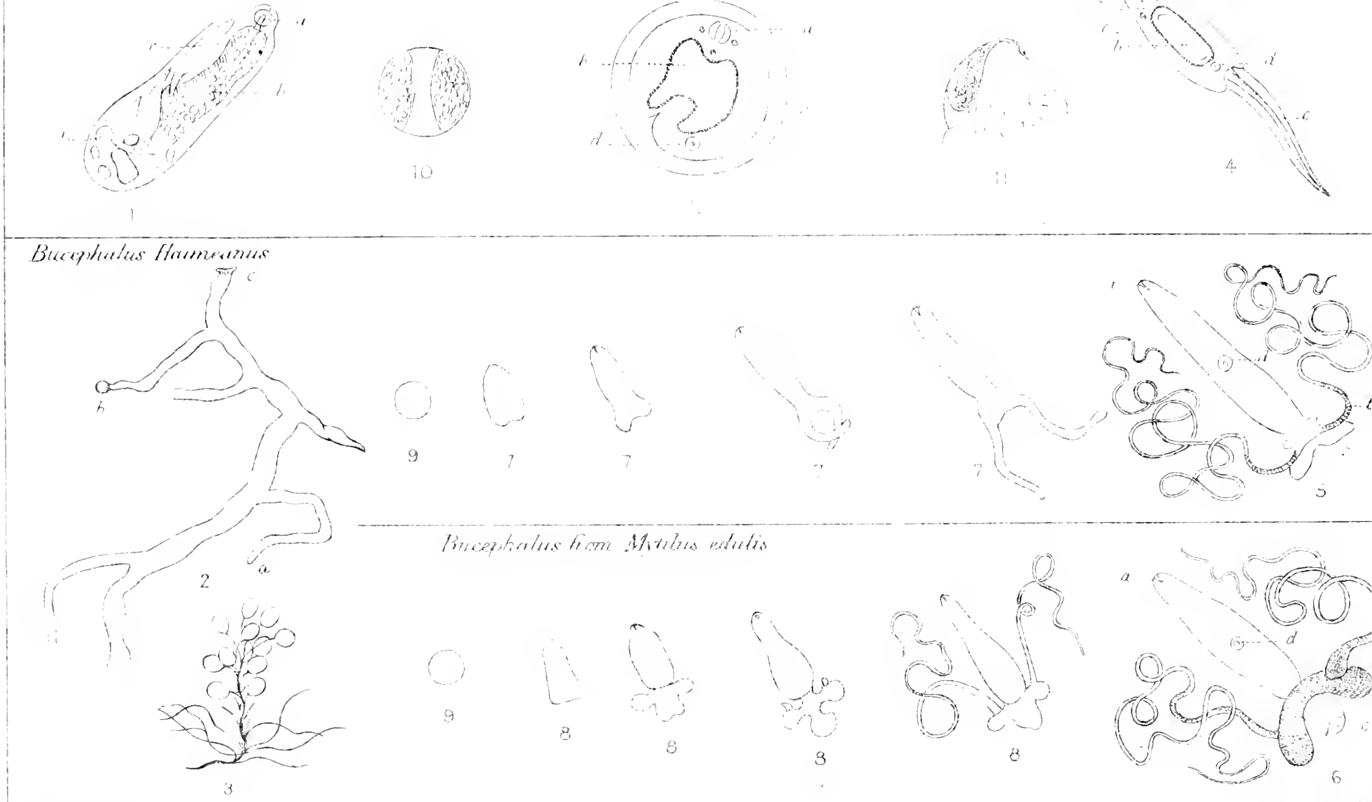
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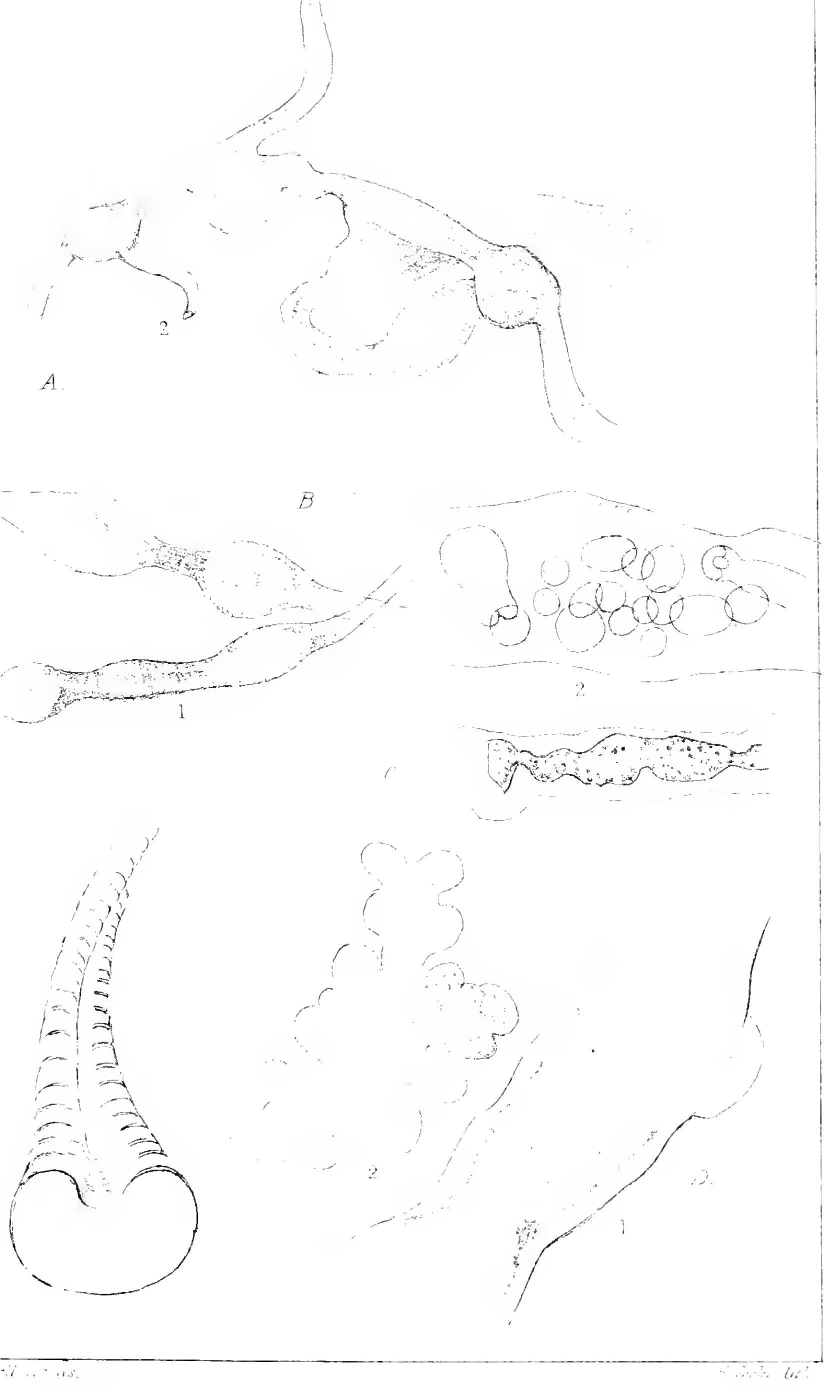
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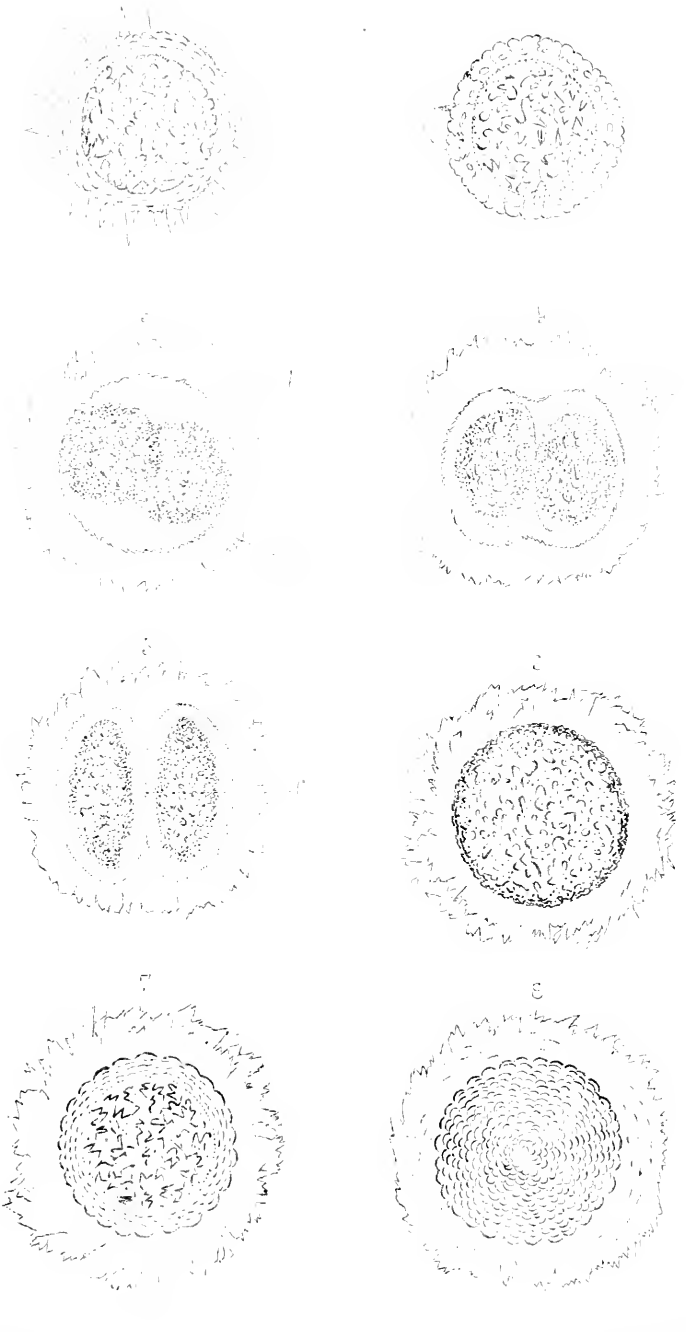


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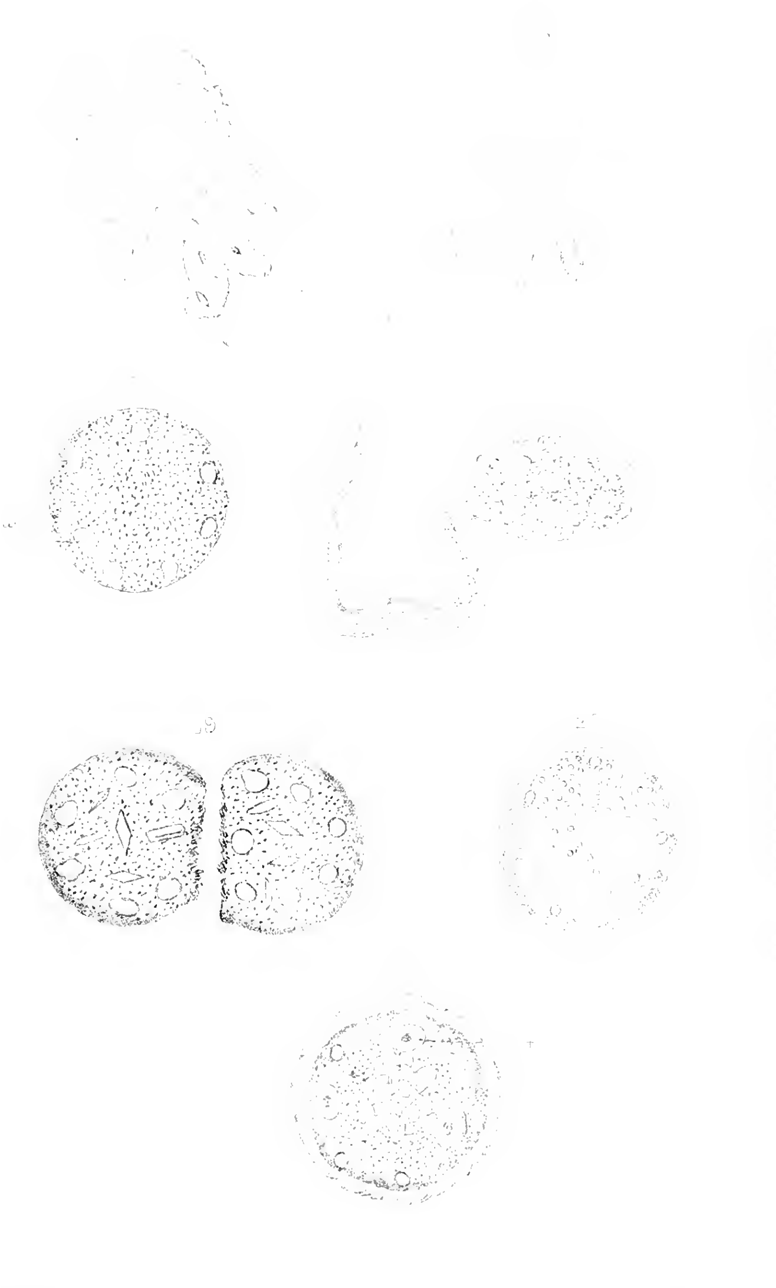

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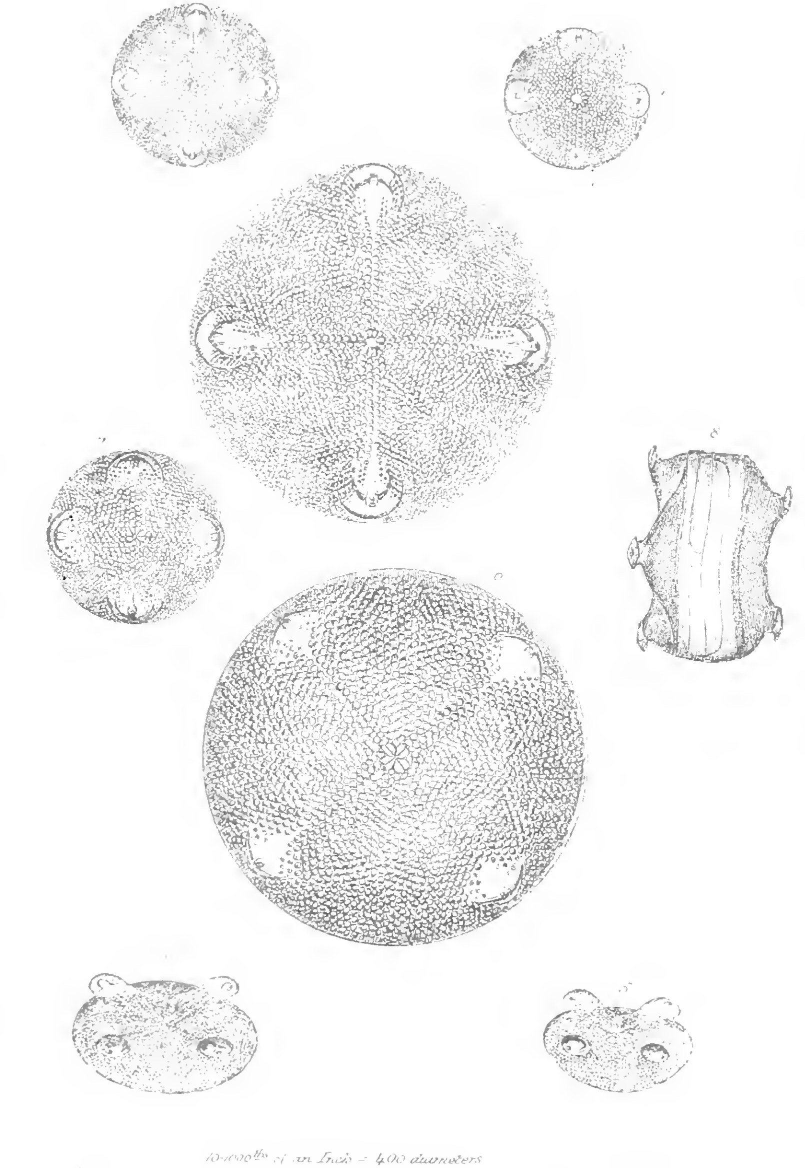

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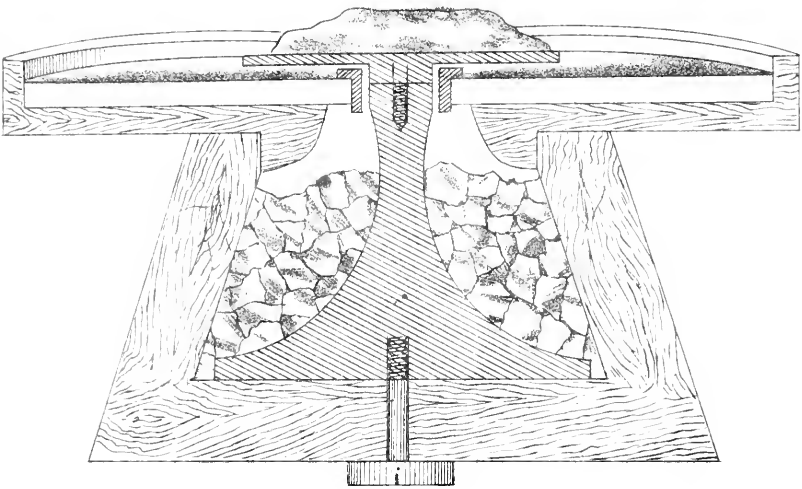

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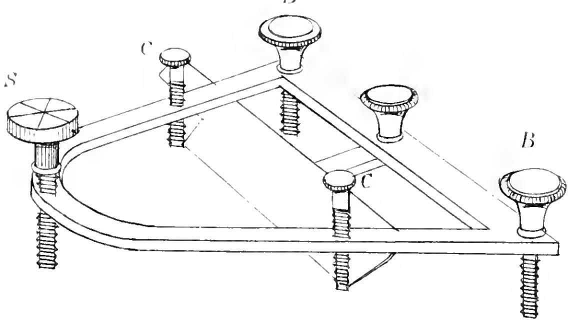

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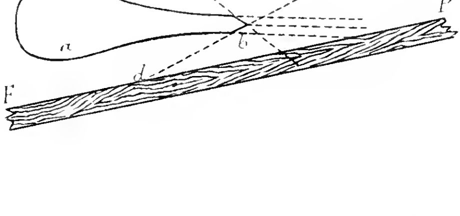

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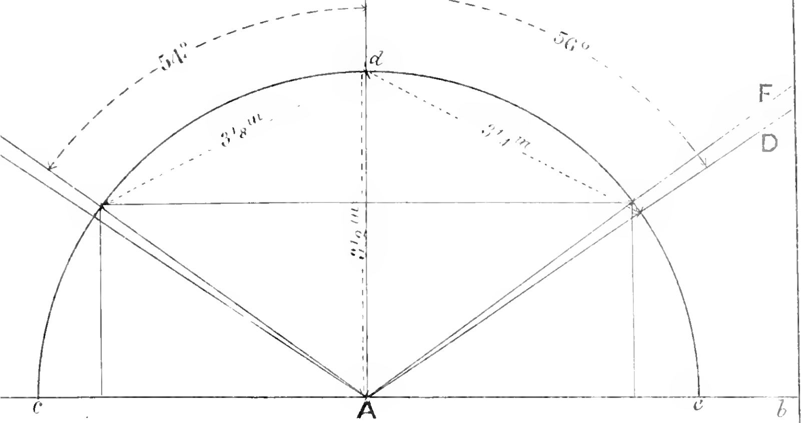

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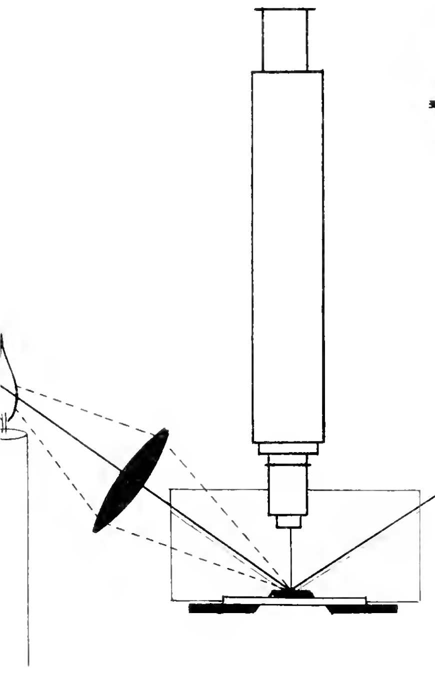

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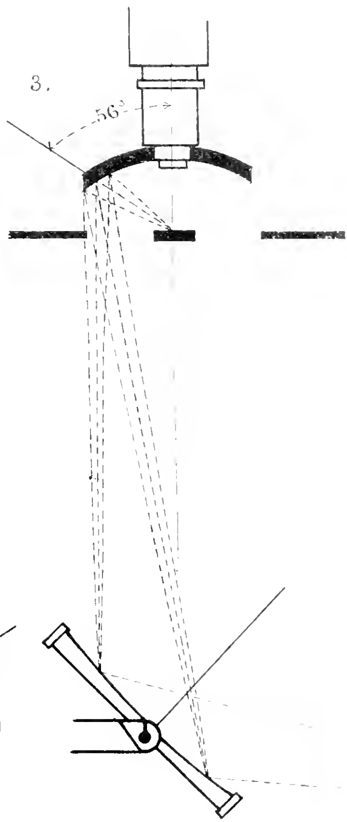

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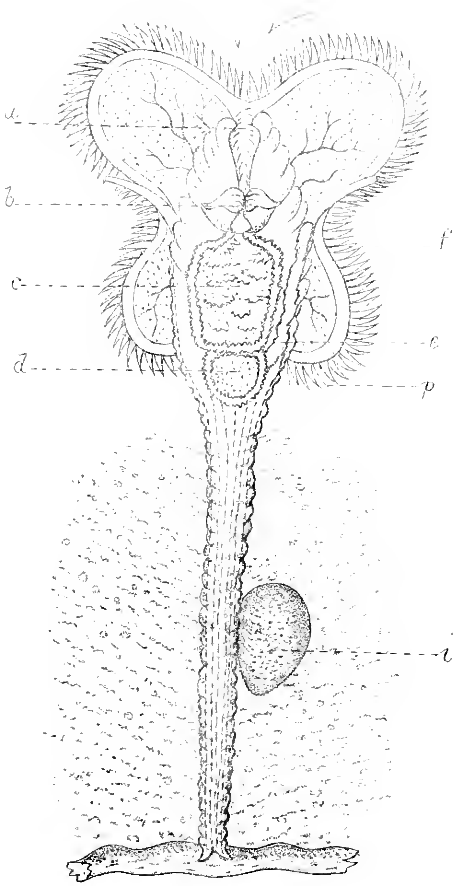

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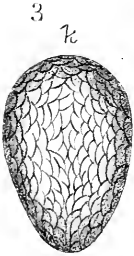

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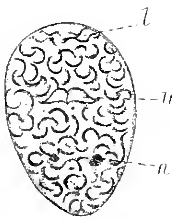

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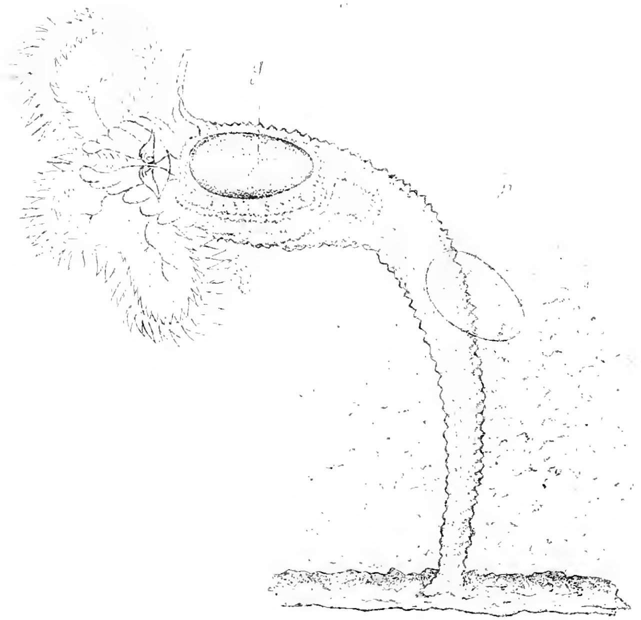

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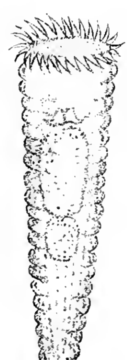

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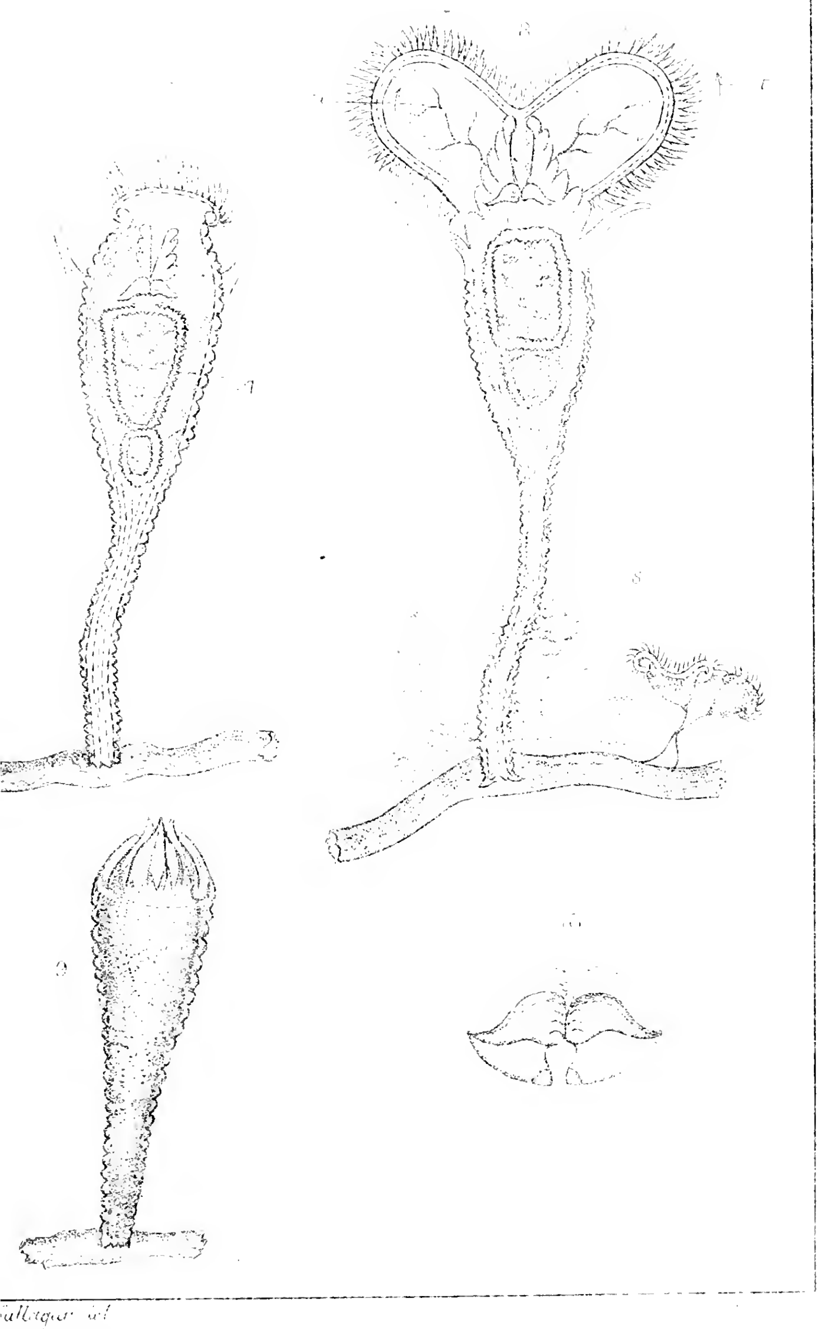

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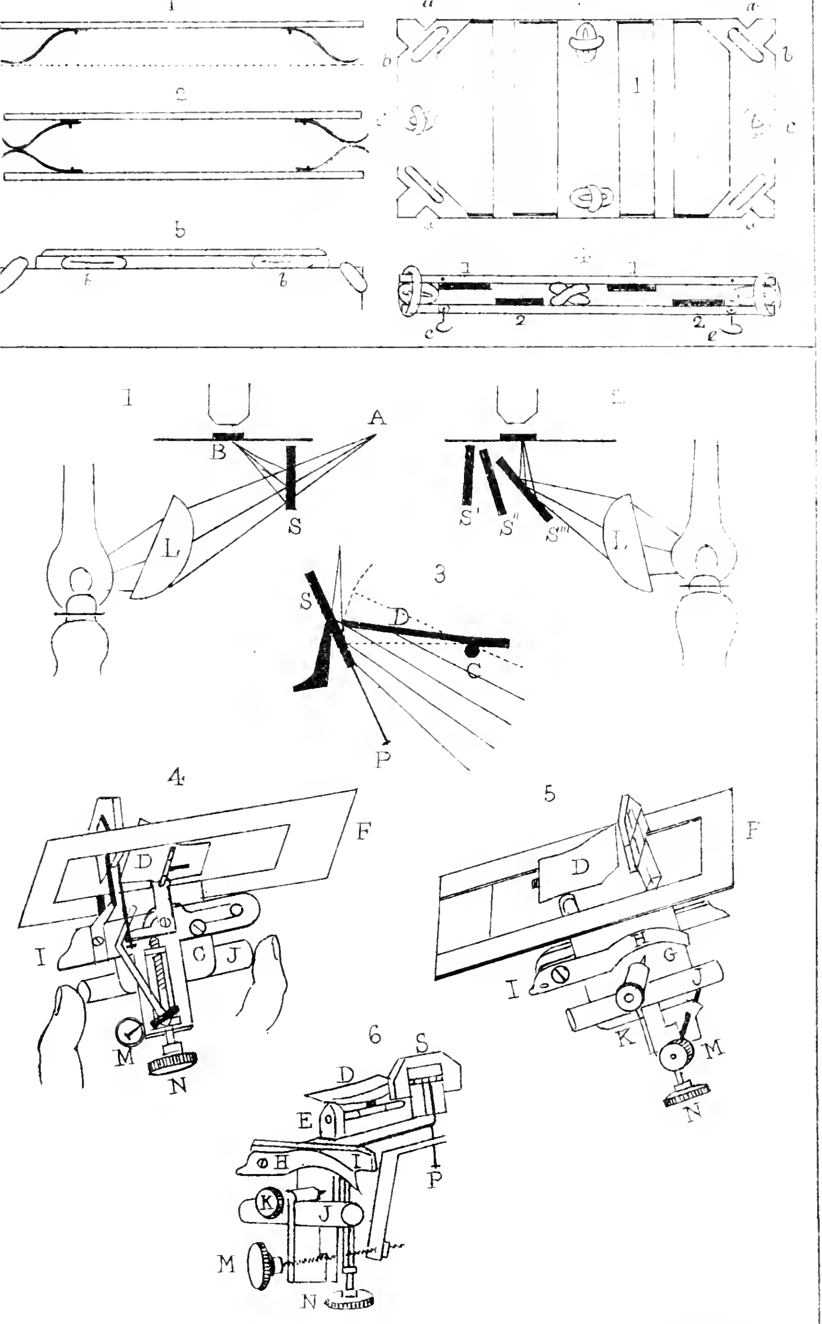

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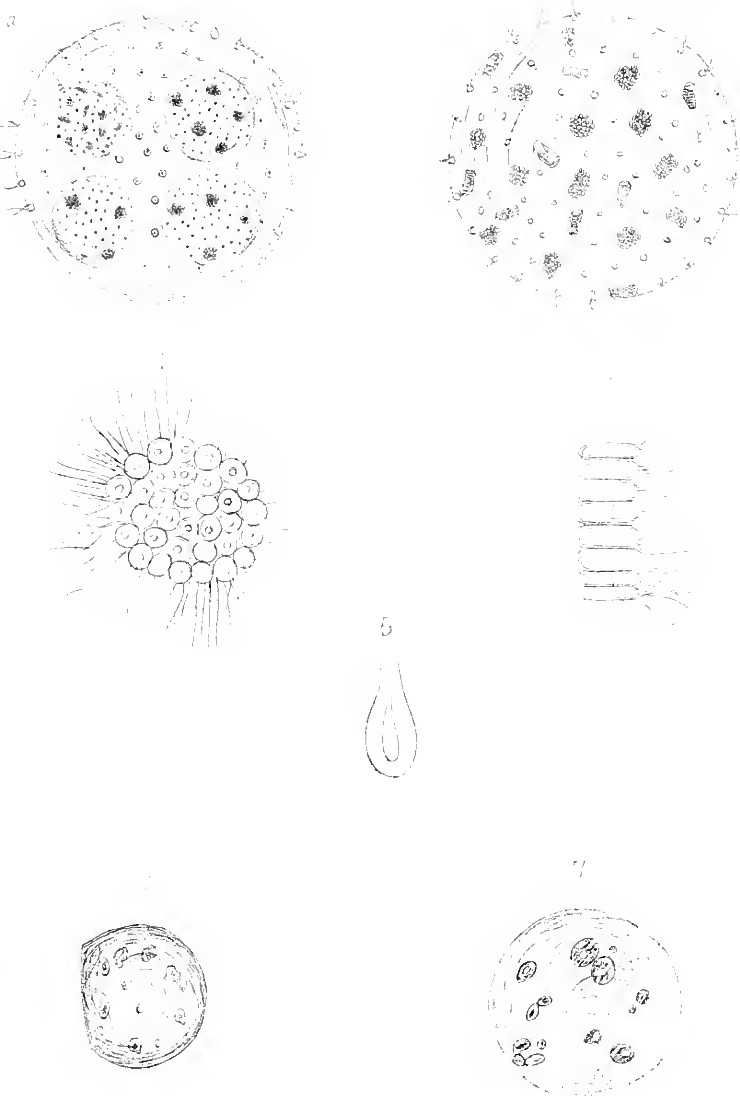
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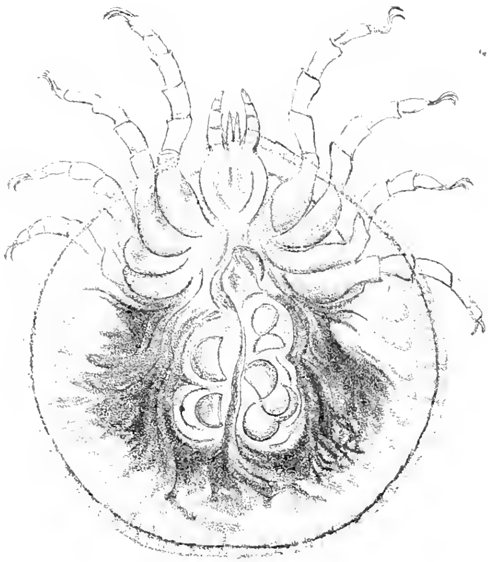

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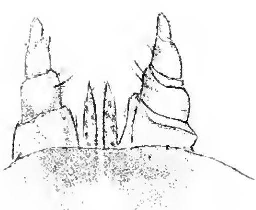

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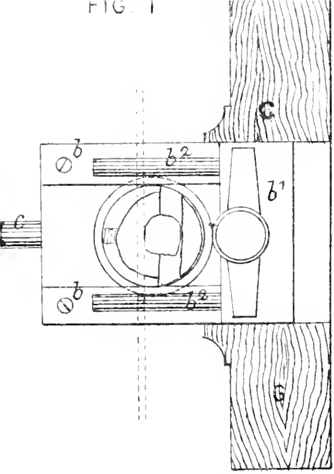

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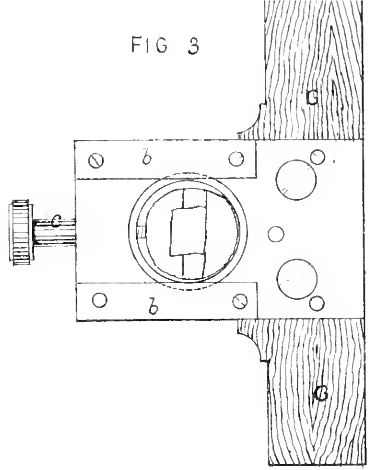

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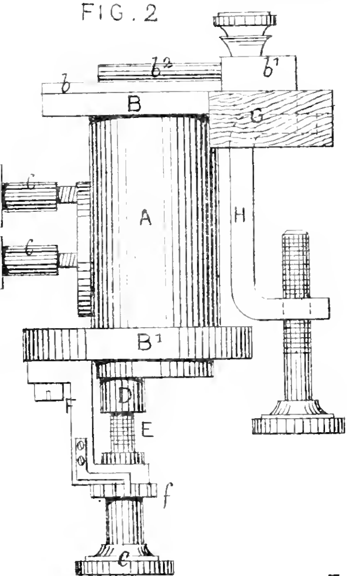

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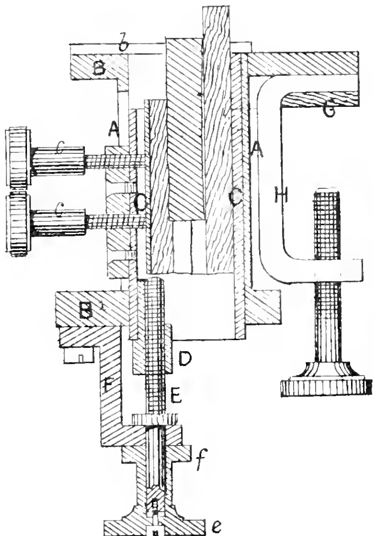

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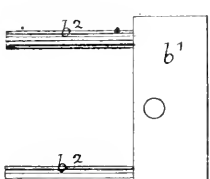

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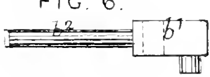

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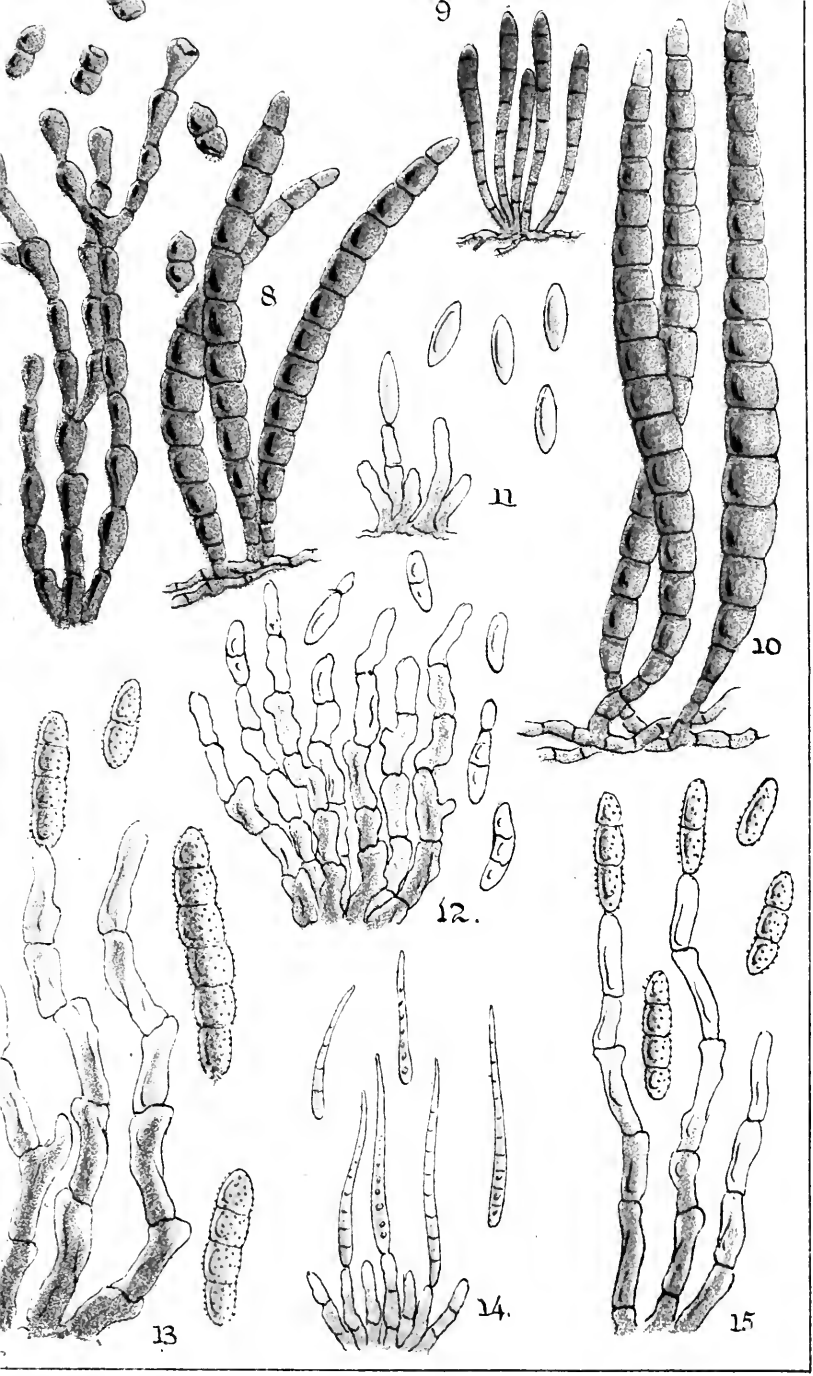

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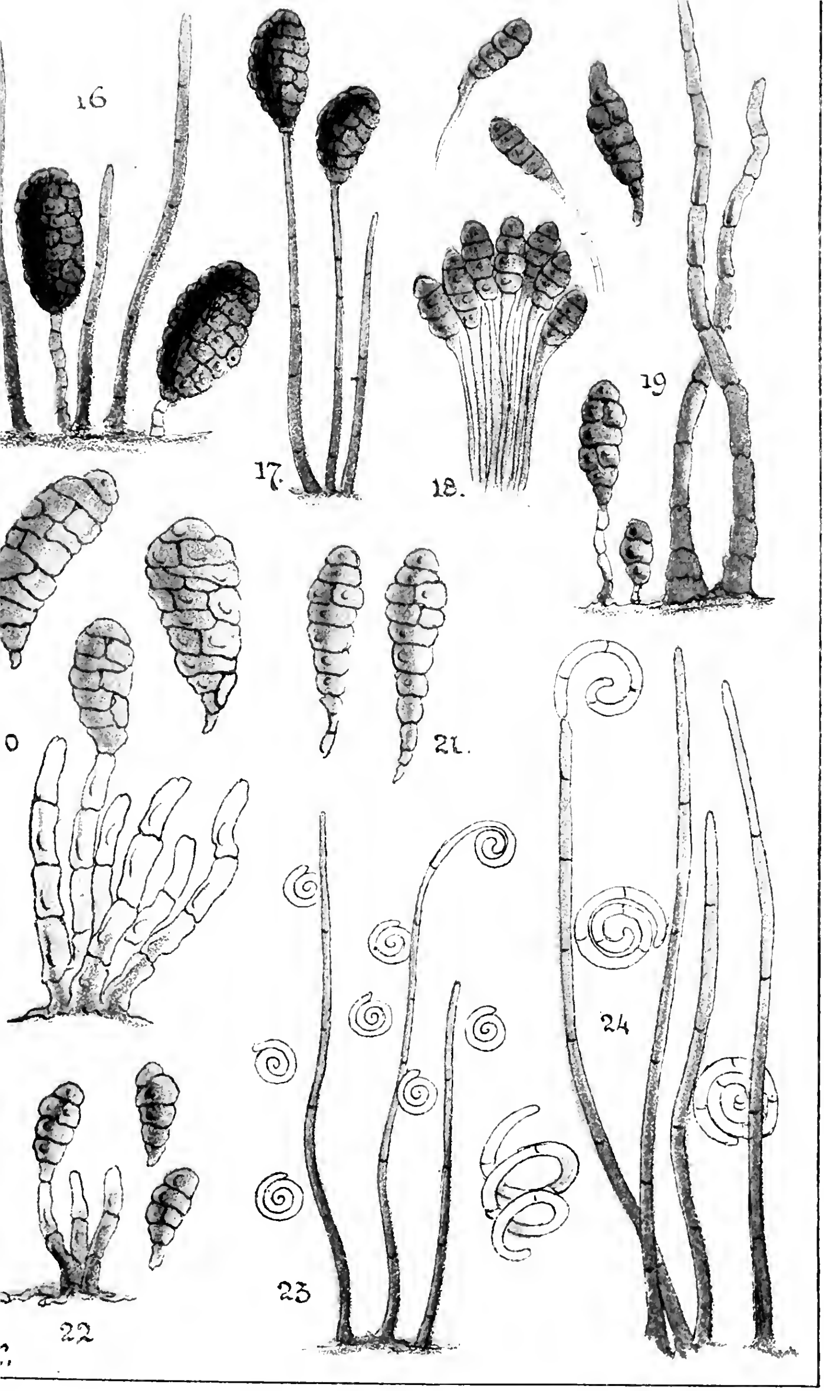

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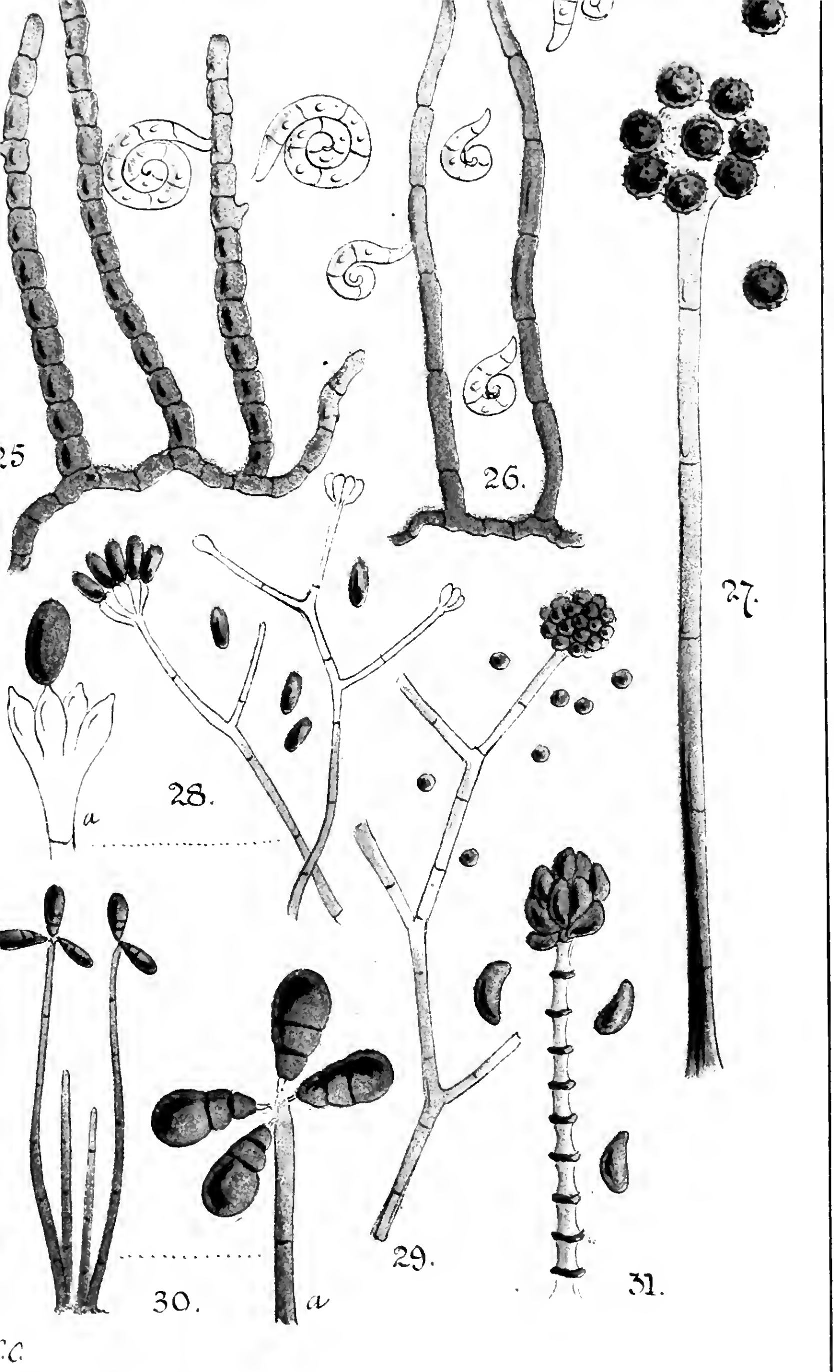

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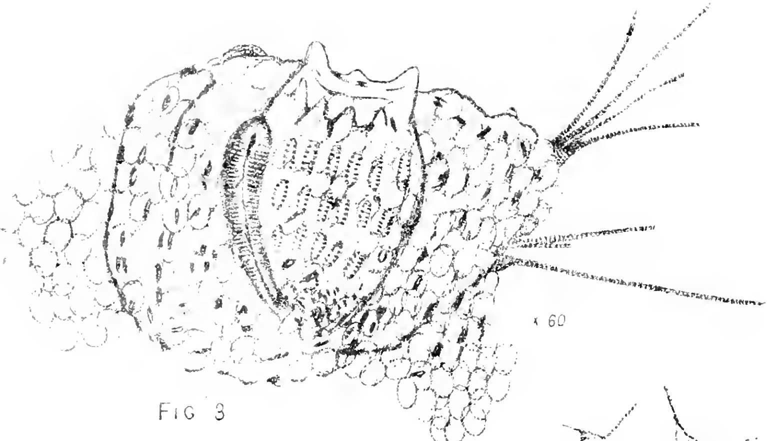

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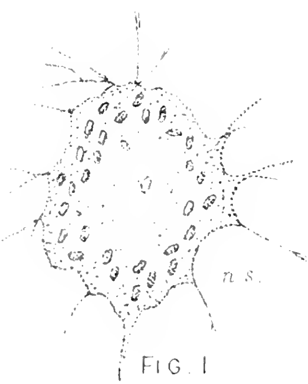

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ELEVENTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

Meeting at University College, London, on the Second and Fourth Fridays of every Month.

LONDON.

July 1876.

(*Extract from original Prospectus, July* 1865.)

"The want of such a Club as the present has long been felt, wherein
"Microscopists and students with kindred tastes might meet at stated periods
"to hold cheerful converse with each other, exhibit and exchange specimens,
"read papers on topics of interest, discuss doubtful points, compare notes of
"progress, and gossip over those special subjects in which they are more or
"less interested: where, in fact, each member would be solicited to bring his
"own individual experience, be it ever so small, and cast it into the treasury
"for the general good. Such are some of the objects which the present Club
"seeks to attain. In addition thereto it hopes to organize occasional Field
"Excursions, at proper seasons, for the collection of living specimens; to
"acquire a Library of such books of reference as will be most useful to
"enquiring students; and, trusting to the proverbial liberality of Micro-
"scopists, to add thereto a comprehensive Cabinet of Objects. By these, and
"similar means, the Quekett Microscopical Club seeks to merit the support
"of all earnest men who may be devoted to such pursuits; and, by fostering
"and encouraging a love for Microscopical studies, to deserve the approval
"of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July 1876.)

President.

HENRY LEE, ESQ., F.L.S., F.R.M.S., &c.

Vice-Presidents.

H. F. HAILES.
JOHN MATTHEWS, M.D., F.R.M.S.
J. G. WALLER.
T. CHARTERS WHITE, M.R.C.S., F.R.M.S.

Treasurer.

F. W. GAY, F.R.M.S., 113, High Holborn, W.C.

Hon. Secretary.

JOHN E. INGPEN, F.R.M.S., 7, The Hill, Putney, S.W.

Hon. Secretary for Foreign Correspondence.

M. C. COOKE, M.A., LL.D.

Hon. Reporter.

RICHARD T. LEWIS, F.R.M.S.

Committee.

W. A. BEVINGTON, F.R.M.S.
J. FOULERTON, M.D.
E. T. NEWTON, F.G.S.
J. C. SIGSWORTH, F.R.M.S.
M. HAWKINS JOHNSON, F.G.S.
FREDERICK OXLEY.
T. ROGERS, F.L.S., F.R.M.S.
JOSEPH A. SMITH.
F. W. ANDREW.
A. COTTAM, F.R.A.S.
C. G. DUNNING.
J. W. GOODINGE, F.R.G.S., &c.

Hon. Librarian.

ALPHEUS SMITH.

Hon. Curators.

H. F. HAILES. G. W. RUFFLE.

Excursion Committee.

F. W. GAY, F.R.M.S.
FREDERICK OXLEY.
W. W. REEVES, F.R.M.S.
T. ROGERS, F.L.S., F.R.M.S.
W. T. SUFFOLK, F.R.M.S.

Exchange (of Slides) Committee.

H. F. HAILES. E. MARKS.

PAST PRESIDENTS.

		Elected.
EDWIN LANKESTER, M.D., F.R.S. - -	July,	1865.
ERNEST HART - - - - - - -	,,	1866.
ARTHUR E. DURHAM, F.L.S., &c. - -	,,	1867.
,, ,, ,, - - -	,,	1868.
PETER LE NEVE FOSTER, M.A. - -	,,	1869.
LIONEL S. BEALE, M.B., F.R.S., &c. -	,,	1870.
,, ,, ,, - - -	,,	1871.
ROBERT BRAITHWAITE, M.D., F.L.S., &c.	,,	1872.
,, ,, ,, - - -	,,	1873.
JOHN MATTHEWS, M.D., F.R.M.S. - -	,,	1874.
,, ,, ,, - - -	,,	1875.

REPORT OF THE COMMITTEE.

THE close of the Eleventh Session of the Club affords your Committee the opportunity of reporting that there has been no diminution in its prosperity during that period.

The renewal for another year of the permission, so long accorded to the Club, to hold its meetings here is a matter for congratulation, and deserves the best thanks of the Club to the Council of University College for their continued kindness and liberality.

During the past year the Club has lost four Members by death:—Mr. James Annett, Mr. J. W. Burton, Mr. W. Hislop, and Mr. Benjamin Miller. Among these, Mr. W. Hislop will be remembered by many of us as one of the earliest Members of the Club, and as formerly taking an active part in its management, particularly with regard to the Journal, of which he was the first editor. There have been 38 resignations, 52 new Members have been elected, and our present numerical strength is 540.

The following papers and communications have been contributed during the Session:—

On *Sphoerularia Bombi* .... *By Mr. W. Cole.*
" *Actinophrys sol* .... " *Mr. Fullagar.*
" Mounting in Gum Arabic........................ " *Mr. E. Gardner.*
" Some Recent Views of the Classification of the Lower Animals (Lecture) .... " *Mr. Lowne.*

ceedings. The Conversational evenings have also fully kept up their character, both as sociable gatherings, and as affording frequent opportunities of intercommunication upon microscopical subjects. The facilities thus afforded for the acquisition of rudimentary microscopical knowledge are highly appreciated by the younger students, whose questions are always most willingly responded to by the more experienced. The objects exhibited have been numerous and interesting.

The three numbers of the Journal issued during the past year contain the papers read at, and a careful report of the proceedings of each meeting. The Journal is now published by Mr. Bogue, the successor to the late Mr. Hardwicke. Though its circulation outside the Club is small, the communications contained in it not unfrequently receive favourable notice in other scientific publications.

Your Committee are glad to announce that they have been able to comply with the wishes of Mr. Frank Crisp, who, in making his liberal donation last year, desired that it should be applied in such a way as to give a stimulus to exertion amongst the Members, and at the same time to avoid direct competition. Three of the communications made during the last year have especially recommended themselves, both by their intrinsic value, and by the care and pains bestowed upon them. Your Committee, therefore, in the exercise of the powers vested in them, have expended a portion of the fund in the purchase of suitable testimonials to Mr. W. Cole, for his paper on *Sphoerularia Bombi;* to Mr. A. Hammond, for his paper on the Metamorphoses of the Crane Fly and the Blow Fly; and to Mr. R. P. Williams, for his Improved Freezing Microtome.

The Treasurer's Report will be found to show a larger balance than usual, owing to the postponement of the Soirée.

The general working expenses have, however, been somewhat above the average, and they continue necessarily to increase with the increased work caused by the extension of the influence and usefulness of the Club. The arrears of subscriptions are also large, amounting to £111; and it is much to be wished that Members would more readily comply with the terms of their admission, and by prompt payment save the additional labours of unpaid officers, the amount of the subscription being too small to allow of the employment of a paid Collector. Facilities are now given for the payment of subscriptions through Bankers, which plan, if more generally adopted, would save much trouble.

The Excursions last year were marred by unfavourable weather; but those during the present year have been very successful, showing no diminution in the interest that has always been taken in them. Several of the meetings have been arranged in conjunction with other kindred Societies—the South London, Watford, Croydon, &c., thus opening out new localities and increasing the value of the results obtained. The Excursionists' Annual Dinner, which was held as usual at Leatherhead, was also highly successful.

Your Committee cordially thank the Officers of the Club, and the Members of the various Sub-Committees, for their services in performing the large amount of routine work which is now required. The constant attention to the Library, of which a new catalogue has been issued—to the Reporting, so ably performed by one of our most valued Members—to the Cabinet, the re-arrangement of which is now in active progress—and, not least, the arduous duties connected with matters of finance, involve a large and continually increasing amount of labour; and the Club is much indebted to those Members who, by their constant exertions, ensure the smooth working of the machinery of the Club.

The past of the Club has shown a steady and uninterrupted progress in the work for which it was established; its present position is one of undoubted success. That this may continue in the future must be the wish of all of us, and in order to promote the welfare of the Club we must take care to maintain the genial and friendly character which has always distinguished it; we must assist as far as possible in the great work of scientific education; we must endeavour to extend its already widely-spread influence with kindred Societies; and we must encourage, so far as lies in our power, the prosecution of microscopical research.

QUEKETT MICROSCOPICAL CLUB, JUNE 30TH, 1876.

TREASURER'S STATEMENT OF ACCOUNT.

Cr. June 30th, 1876.	£	s.	d.	Dr. June 30th, 1876.	£	s.	d.
To Printing and Stationery	38	2	3	By Balance in hand July 1st, 1875	73	9	9
,, Postage	23	10	6	,, Subscriptions	208	0	0
,, Attendance	10	2	6	,, Donation per Mr. Horncastle	1	0	0
,, Property Purchased	10	13	11	,, Cash from Sale of Catalogues	0	9	0
,, Petty Expenses	32	18	2	,, Balance of account for sale of Journals (from Mr. R. Hardwicke's Estate)	14	7	3
,, Advertisements	2	4	6	,, Sale of Journals by Messrs. Hardwicke and Bogue, from Jan. 1st, 1876	3	9	0
,, Journal (Nos. 29, 30 and 31)	66	14	10				
,, Balance in hand (including Mr. Crisp's donation of £20)	116	8	4				
	£300	15	0		£300	15	0

Amount standing in New 3 per Cent. Annuities, £30.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify that the said Account is correct.

July 5th, 1876.

WM. HAINWORTH, JUN., } *Auditors.*
H. H. DOBSON, }

HONORARY MEMBERS.

Date of Election.	
Oct. 25, 1867	Guiseppe de Notaris, *Professor of Botany, &c., &c.*, Rome.
Jan. 24, 1868	Arthur Mead Edwards, M.D. (*Ex-President of the American Microscopical Society: President of the Newark Scientific Association*), 120, Belleville Avenue, Newark, New Jersey, U.S.A.
Mar. 19, 1869	Rev. E. C. Bolles (*Ex-President of the Portland Society of Natural History*), Salem, Mass., U.S.A.
July 26, 1872	S. O. Lindberg, M.D., Professor of Botany, University of Helsingfors, Finland.
July 26, 1872	Prof. Hamilton L. Smith, President of Hobart College, Geneva, New York, U.S.A.
July 26, 1872	J. J. Woodward, Assist. Surgeon, U.S.A., War Department, Surgeon General's Office, Washington.
July 24, 1874	Sharpey, W., M.D., F.R.S., 50, Torrington-square, W.C.
July 23, 1875	Beale, Lionel S., M.B., F.R.S., F.R.M.S., &c., 61, Grosvenor-street, W.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869	Ackland, William, L.S.A., F.R.M.S., 416, Strand, W.C.
June 23, 1876	Addis, W., 28 Benyon-road, Southgate-road, N.
Nov. 27, 1868	Adkins, William, 270 Oxford-street, W.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
Sept. 25, 1874	Allen, Alfred, F.R.M.S., Felstead, Essex.
Oct. 28, 1870	Allen, Rev. Francis H., Ditchingham, Bungay, Norfolk.
Sept. 27, 1867	Allen, John T.
June 23, 1876	Allison, Charles, 8 Knowles-crescent, Hither-green, Lewisham, S.E.
July 26, 1872	Alstone, John, 140 Rye-lane, Peckham, S.E.
Dec. 17, 1869	Ames, George Ackland, F.R.M.S., Union Club, Trafalgar-square, W.C.
May 28, 1875	Amner, George M.
Sept. 25, 1868	Andrew, Arthur R., 37 Oxford-street, W.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Fulham-road, S.W.
July 7, 1865	Archer, J. A., 172 Strand, W.C.
Nov. 27, 1874	Armbruster, C., F.C.S., 9 Augustus-road, Hammersmith, W.
June 25, 1875	Arnold, Theodore P.
May 28, 1875	Arrowsmith, Wastell, 22 Camden-cottages, N.W.
Feb. 23, 1872	Atkins, A., M.R.C.S., 232 Mile End-road, E.
Feb. 23, 1872	Atkins, A., jun., L.R.C.P., 232 Mile End-road, E.
Dec. 22, 1865	Atkinson, John, 33 Brook-street, W.
Feb. 26, 1869	Atkinson, Wm., F.L.S., 47 Gordon-square, W.C.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.
July 23, 1875	Ayling, J. J., 37 Edward-street, Newington-butts, S.E.

Date of Election.

Nov. 25, 1870	Baber, Edward Cresswell, L.R.C.P., M.R.C.S., F.R.M.S., 34 Thurlow-square, S.W.
June 26, 1874	Badcock, John, F.R.M.S., 2 Banbury-road, South Hackney, E.
May 22, 1868	Bailey, Captain L. C., R.N., F.R.G.S., F.R.A.S., Topographical Department, New-street, Spring-gardens, S.W.
Dec. 27, 1867	Bailey, John W., 75 Broke-road, Dalston, E.
April 24, 1868	Baker, Chas., F.R.M.S., 244 High Holborn, W.C.
Feb. 28, 1873	Baker, George H., M.R.C.S., 14 Mare-street, Hackney, E.
Feb. 25, 1876	Ballard, Dr. W. R., jun., 26 Manchester-square, W.
July 28, 1876	Barnard, Hy., 15 Melton-street, Euston-sq., N.W.
Dec. 27, 1872	Barnard, Herbert, 33 Portland-place, W.
April 22, 1870	Barnes, Chas. Barritt, 4 Egremont-villas, White Horse-lane, South Norwood, S.E.
Nov. 23, 1866	Barnes, Captain E., Bridlington-quay, Yorkshire.
Aug. 28, 1874	Barnett, E. W., The Larches, Penge-lane, Sydenham, S.E.
Sept. 27, 1872	Bartlett, Edward, jun., L.D.S., M.R.C.S.E., 38 Connaught-square, W.
June 23, 1871	Bartlett, Wm. P., 2A Eastbourne-terrace, W.
May 22, 1874	Bate, George Paddock, M.D., F.R.M.S., 412 Bethnal Green-road, E.
Nov. 26, 1875	Bayfield, Chas. Moulden, 2 Leamington-road-villas, Westbourne-park, W.
Mar. 27, 1874	Beach, Richard J., 59 Ashburton-grove, Lower Holloway, N.
May 28, 1869	Bean, Charles E., Brooklyn-house, Goldhawk-rd., Shepherd's-bush, W.
Nov. 26, 1875	Beaulah, John, Bracken-hill, Brigg.
Oct. 26, 1866	Beck, Joseph, F.R.A.S., F.R.M.S., 31 Cornhill, E.C.
May 26, 1871	Bedwell, Fras. Alfred, M.A., Cantab., F.R.M.S., Bridlington, Hull.
May 24, 1872	Bennett, W. H., St. George's-hospital, S.W.
Mar. 24, 1871	Bentley, Algernon Royds, 36 Portland-place, W.
Dec. 27, 1867	Bentley, C. S., Hazelville-villa, Sunnyside-road, Hornsey-rise, N.

Date of Election.	
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Oct. 23, 1868	Bevington, W. A., F.R.M.S., 113 Grange-road, S.E.
June 24, 1870	Birch, A. E., 47 Halliford-street, Islington, N.
July 28, 1871	Bishop, Wm., 4 Whitley-villas, Caledonian-rd., N.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 15 Belitha-villas, Barnsbury, N.
May 26, 1876	Blundell, Joseph, 97 Mount-street, Grosvenor-square, W.
Oct. 24, 1873	Bolton, Major Frank, 21 Victoria-mansions, S.W.
Jan. 22, 1875	Bolton, Thos. H., Hyde-house, near Stourbridge.
Sept. 27, 1872	Borthwick, Lord, 35 Hertford-street, Mayfair, W.
April 22, 1870	Bossy, Alfred Horsley, Walton Lodge, 118 Stoke Newington-road, N.
Jan. 28, 1876	Bowcher, W., 6 Brownswood-villas, Stroud Green-road, N.
June 23, 1876	Bowles, James, 18 Grove-road, Highgate-road, N.
May 22, 1874	Box, Edward Gaspar.
Oct. 23, 1868	Brabham, T.
June 26, 1874	Brady, Henry, 96, Palace-gardens-terrace, W.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S , The Ferns, 303 Clapham-road, S.W.
Mar. 28, 1873	Bridgman, Frank G., 18 Queen Anne-street, Cavendish-square, W.
Dec. 27, 1872	Bridgman, William Kencely, L.D.S., 69 St. Giles's-street, Norwich.
May 26, 1876	Brigstock, John Wm., 9 Willes-road, N.W.
May 27, 1870	Brown, George Dransfield, M.R.C.S., Henley-villa, Uxbridge-road, Ealing, W.
May 22, 1868	Brown, W. J., 4 Marlbro-terrace, Maple-road, Penge, S.E.
May 26, 1871	Browne, George, 45 Victoria-road, N.W.
May 28, 1875	Browne, J. W. Frascati, Mason's-hill, Bromley, Kent.
Feb. 27, 1872	Browne, Rev. Thomas Henry, F.R.M.S., F.G.S., M.E.S., High Wycombe, Bucks.

Date of Election.	
Sept. 27, 1872	Bugby, Wm., 3 Wilton-villas, Uxbridge-road, W.
May 22, 1874	Burgess, John James, 1 Copthall-chambers, E.C.
Sept. 28, 1866	Burgess, J. W., 1 Sylvester-villas, Markhouse-rd., Walthamstow, E.
June 25, 1869	Burgess, W. F., Guy's-hospital, S.E.
May 22, 1874	Burnham, F. C., 78 Farringdon-street, E.C.
Sept. 27, 1872	Bush, Wm., care of Mr. J. A. Smith, Branville-lodge, Croydon-road, Penge.
June 14, 1865	Bywater, Witham M., F.R.M.S., 5 Hanover-sq., W.
May 24, 1867	Callaghan, James, 278 Commercial-road, Peckham, S.E.
May 22, 1874	Callaghan, William Edmund.
Dec. 17, 1875	Caplatzi, A., 1 North-crescent, Bedford-square, W.C.
May 22, 1874	Carruthers, Herbert, 5 Darnley-road, Notting-hill, W.
May 26, 1871	Catchpole, Robert, 101 Lancaster-road, Notting-hill, W.
Feb. 28, 1873	Chapman, A. W., Beaufoy-lodge, 32 St. John's-wood-road, N.W.
Dec. 27, 1867	Chapman, W. C., 39 Granville-square, W.C.
Oct. 22, 1875	Cheshire, F., Avenue-house, Acton, W.
Nov. 27, 1874	Chippindale, Geo., 3 Rough Down-villas, Boxmoor.
Mar. 24, 1876	Clarkson, A., 49 Southampton-street, Pentonville-road, N.
May 22, 1874	Clayton, James, 67 Barnsbury-road, N.
May 22, 1868	Cocks, W. G., 36 Gayhurst-road, Dalston, E.
Nov. 27, 1874	Cole, B. G., 1 The Common, Stoke Newington, N.
May 28, 1869	Cole, Walter B., F.R.M.S., St. John's-terrace, Weymouth.
April 24, 1874	Cole, Wm., M.E.S., 1 The Common, Stoke Newington, N.
May 23, 1873	Coles, Alfred K., F.R.M.S., Stamford-hill, N.
Jan. 25, 1867	Coles, Ferdinand, A.P.S., 248 King's-road, Chelsea, S.W.
April 23, 1869	Collings, Thomas P., Surrey-chambers, 172 Strand, W.C.

Date of Election.	
July 7, 1865	Collins, C., F.R.M.S., 157 Great Portland-street, W.
Mar. 24, 1876	Colsell, Geo. Dannett, 5 Austin-friars, E.C.
Feb. 23, 1872	Colvin, Alexander, Beaconside, Penrith, Cumberland.
Sept. 27, 1872	Connolly, Charles T., L.S.A., 3 Church-hill-villas, Wood-green, N.
June 14, 1865	Cooke, M. C., M.A., LL.D. (*Hon. Sec for Foreign Correspondence*), 2 Grosvenor-villas, Junction-road, Upper Holloway, N.
May 28, 1875	Cooper, Chas., Jesmond-cottage, Walham-green, S.W.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S., Edin., Leytonstone, E.
Mar. 23, 1869	Coppock, C., F.M.S., F.R.M.S., 31 Cornhill, E.C.
June 27, 1873	Corbett, Alfred L., 103 Fentiman-road, Clapham-road, S.W.
May 28, 1869	Cottam, Arthur, F.R.A.S., Office of Woods, Whitehall-place, S.W.
Jan. 28, 1876	Cotton, Thos., M.D , 214 Seven-sisters'-road, N.
July 26, 1872	Cowan, Thos. Wm., F.R.M.S., Hawthorn-house, Horsham, Sussex.
Aug. 28, 1868	Crisp, Frank, LL.B., B.A. Lond., F.R.M.S., 5 Lansdowne-road, Notting-hill, W.
Dec. 23, 1870	Crisp, John S., F.R.M.S., 62 Camberwell-road, S.E.
Feb. 27, 1868	Crook, Thomas, F.R.M.S., care of Mr. T. Curties, 244 High Holborn, W.C.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 66 Barbican, E.C.
Nov. 26, 1875	Cunningham, Francis Bertram, 65 Chepstow-place, Bayswater, W.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
Jan. 22, 1875	Dadswell, Edward, 42 Barrington-road, Stockwell, S.W.
Jan. 27, 1872	Daintrey, George, Terminus Chambers, Eastbourne.
June 25, 1868	Darnley, D. Rowland, Ealing Dean, W.
Oct. 24, 1873	Dashwood, Horace, 192, St. Paul's-road, Canonbury, N.

Date of Election.

July 23, 1871	D'Aubney, Thos., Shepherdess-walk, Hoxton, N.
May 23, 1873	Davey, Robert F., War-office, Pall-mall, S.W.
Oct. 24, 1873	Davies, John Russell, 91 London-road, Clapton, E.
Oct. 22, 1869	Davis, Henry, 19 Warwick-street, Leamington.
May 28, 1875	Dean, Arthur, 2 Mary-terrace, Cecil-road, Leytonstone.
May 28, 1875	Defriez, Joseph George, M.R.C.S., L.S.A., 173 Bethnal-green-road, E.
June 26, 1868	Dickens, Charles, Latimer-house, Hadley, Middlesex.
Jan. 28, 1876	Dilnott, Geo. Hayling, Havant, Hants.
Jan. 23, 1874	Doble, Edmund Mohun, 12 Mount Ararat-villas, Richmond, Surrey.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Holmesdale, Grange-park, Ealing.
July 26, 1872	Doggett, Ernest.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton-rectory, Moreton-hampstead, Exeter.
Jan. 28, 1870	Dowson, Edward, M.D., M.R.C.S., F.R.M.S., 117 Park-street, Grosvenor-square, W.
July 28, 1871	Drew, G. C., Milton-house, Cassland-road, South Hackney, E.
Dec. 23, 1870	Duck, William A., 4 High-street, Vauxhall-cross, S.E.
Aug. 26, 1872	Dudgeon, R. E., M.D., 53 Montagu-square, W.
Oct. 25, 1872	Dunning, Chas. G., 53 Crowndale-road, Camden-town, N.W.
Sept. 22, 1865	Durham, Arthur E., F.R.C.S., F.L.S., F.R.M.S., &c., 82 Brook-street, Grosvenor-square, W.
Nov. 23, 1866	Durham, F., M.B., F.R.C.S., 14 St. Thomas'-street, S.E.
Sept. 25, 1868	Eady, James Ray, F.R.M.S., F.G.S., Carleton-grange, Skipton, Yorkshire.
June 28, 1867	Edmonds, R., 178 Burrage-road, Plumstead, S.E.
May 26, 1876	Emery, Charles, 2 Sheen-villas, Rectory-road, Hornsey, N.
May 26, 1871	Enock, Fredk., 30 Russell-road, Seven Sisters-road, N.

Date of Election.

Dec. 18, 1868	Eyre, Samuel, Belmore-lodge, Priory-grove, South Lambeth, S.W.
June 26, 1874	Fardon, Edward Ashby, 80 Cambridge-street, Pimlico, S.W.
Dec. 17, 1875	Farries, Thomas, F.C.S., 7 New Basinghall-street, E.C.
July 25, 1873	Fase, Rev. Henry J., 57 Winchester-street, Pimlico, S.W.
June 25, 1875	Faulkner, Hy., jun., Fernwood, Roehampton-park, S.W.
Jan. 28, 1876	Faulkner, John, Mornington-crescent, N.W.
Mar. 27, 1868	Field, James, High-street, Highgate, N.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
Jan. 23, 1874	Flux, E. H., 1 West-hill, Highgate, N.
Jan. 27, 1871	Forshaw, Thomas, jun., The Bower, Bowden, Altrincham, Cheshire.
Aug. 4, 1865	Foster, Peter Le Neve, M.A. Cantab., Society of Arts, Adelphi, W.C.
Mar. 24, 1871	Foulerton, J., M.D., Scientific Club, 7 Savile-row, W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 54 Conduit-street, W.
Nov. 26, 1875	Freckelton, Rev. T. W., 28A Lonsdale-square, Islington, N.
June 23, 1871	Freeman, Henry E., 48 Woodstock-road, Finsbury-park, N.
May 26, 1871	Freshwater, Thos. E., 2 Charlotte-street, Caledonian-road, N.
Feb. 26, 1869	Fricker, C. J., 4 Westow-hill-terrace, Upper Norwood, S.E.
May 22, 1868	Fryer, G. Henry, 14 The Terrace, Kilburn, N.W.
Oct. 26, 1868	Furlonge, W. H., Coed Mawr-house, Holywell, Flintshire.
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
Mar. 25, 1870	Garden, Robert Spring, 42 Carlton-hill, St. John's-wood, N.W.
May 25, 1866	Gardiner, G., F.M.S., 244 High Holborn, W.C.
Feb. 26, 1875	Gardner, Edmund, 454 Strand, W.C.

Date of Election.	
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S. (*Hon. Treasurer*), 113 High Holborn, W.C.
Jan. 28, 1870	Gellatly, Peter, Loughton, Essex.
July 26, 1867	George, Edward, F.R.M.S., 12 Derby-villas, Forest-hill, S.E.
July 22, 1870	Gibson, Joseph F., F.R.M.S., 3 Furnival's-inn, E.C.
June 14, 1865	Gibson, W., 273 Regent-street, W.
June 27, 1873	Glasspoole, Hampden G., 34 Bernard-st., Russell-square, W.C.
Feb. 25, 1876	Godwin, John, 144 Oakley-street, Chelsea, S.W.
Nov. 22, 1867	Golding, W. H., 19 Regina-road, Tollington-park, N.
Dec. 23, 1870	Goldsmith, John Charles, 5 America-square, E.C.
Nov. 22, 1872	Goodchild, J. E., 114 Englefield-rd., Islington, N.
Aug. 23, 1872	Goode, A., Whitehall-lane, Woodford, Essex.
April 26, 1872	Goodinge, James Wallinger, F.R.G.S., F.R.M.S., 18 Aldersgate-street, E.C.
Mar. 27, 1866	Gray, S. Octavus, Bank of England, E.C.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Nov. 27, 1874	Grayling, J. Francis, 41 Guildford-street, Russell-square, W.C.
May 22, 1874	Green, G., 6 Helmet-row, St. Luke's, E.C.
Jan. 28, 1870	Green, Nathaniel E., F.R.A.S., 3 Circus-road, St. John's-wood, N.W.
Oct. 23, 1868	Greenish, T., F.R.M.S., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 3, Edith-grove, Fulham, S.W.
May 23, 1873	Gregory, William, 406 Strand, W.C.
May 22, 1874	Grey, Ernest, 290 Essex-road, Annett's-crescent, Islington, N.
June 26, 1874	Gritton, John Hall, 18 Northampton-park, Canonbury, N.
June 26, 1874	Gritton, Joseph, 18 Northampton-park, Canonbury, N.
July 24, 1868	Groves, J. W., F.R.M.S., 55 Russell-square, W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.

Date of Election.	
Jan. 27, 1871	Guimaraens, Augustus de Souza, F.R.M.S., 120 Ossulton-street, Euston-square, N.W.
Feb. 28, 1873	Haddon, Alfred C., 3 Bouverie-street, E.C.
Jan. 23, 1874	Hadland, J. H., 11 King William-street, E.C.
June 14, 1865	HAILES HENRY F. (*Vice President*), 7 Haringay-road, Hornsey, N.
Aug. 26, 1870	Hailstone, Robert H., 35 Walworth-road, S.E.
Feb. 23, 1867	Hainworth, W., jun., Clare-villa, Cricketfield-road, Lower Clapton, E.
July 28, 1876	Halford, Edwd., 18 Leinster-square, Bayswater, W.
July 23, 1875	Hallett, Marmaduke, James, Hurst Lodge, East Moulsey, Surrey.
Dec. 28, 1866	Hallet, R. J., 9 Lawford-road, Kentish-town, N.W.
Nov. 26, 1875	Halley, Alex., Hay, 7 Elgin-road, Kensington-park, W.
May 28, 1875	Hamley, Fras. J., 231 High Holborn, W.C.
Feb. 22, 1869	Hammond, A., 4 Neptune-terrace, Marine-town, Sheerness.
Jan. 23, 1874	Hardy, James Daniel, 11 Clarence-villas, Clarence-road, Clapton, E.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
June 23, 1871	Harris, Edward, F.R.M.S., Rydal-villa, Langton-grove, Upper Sydenham, S.E.
April 23, 1875	Harrison, James, 19 Methley-street, Kennington, S.E.
July 26, 1872	Harrod, John, 3 Great Tower-street, E.C.
Nov. 26, 1869	Hart, Edward, Highbury New-park, N.
Nov. 24, 1871	Hawker, Charles, M.D., 2 Albion-terrace, White-Horse-lane, Stepney, E.
June 24, 1870	Hawkins, Samuel J., 27 Lichfield-grove, Finchley, N.
June 28, 1867	Hawksley, Thos. P., 97 Adelaide-road, N.W.
Oct. 23, 1874	Haydon, W. F.
May 27, 1870	Haywood, Henry, Dartmouth-terrace, Rotherhithe, S.E.
Aug. 23, 1872	Hembry, F. W., F.R.M.S., 7 St. John's-villas, Overton-road, Brixton, S.W.
Aug. 26, 1870	Hennell, Col. S., F.R.M.S., Ventnor-villa, Ventnor, Isle of Wight.

Date of Election.	
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
June 26, 1874	Hewitt, W. W., F.R.M.S., 5 Torriano-gardens, Camden-road, N.W.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
Dec. 17, 1869	Hill, D. W., 78 Highbury New-park, N.
Sept. 24, 1869	Hilton, J. D., M.D., Upper Deal, Deal, Kent.
Sept. 28, 1866	Hind, F. H. P., Bartholomew-house, Bartholomew-lane, E.C.
May 22, 1874	Hind, George, 244 High Holborn, W.C.
July 26, 1872	Hinton, Ernest, 12 Vorley-road, Junction-road, Upper Holloway, N.
Aug. 26, 1870	Hirst, John, jun., F.R.M.S., Dobcross, near Manchester.
Oct. 26, 1866	Holdernesse, W. B., 12 Park-street, Windsor.
Feb. 26, 1875	Holford, Chr., Club-chambers, Regent-street, S.W.
April 26, 1867	Hooton, C., 90 Junction-rd., Upper Holloway, N.
May 22, 1868	Hopkinson, John, jun., F.L.S., F.R.M.S., F.G.S., Holly-bank, Watford.
April 28, 1876	Horn, Wm. E., A.I.C.E., 10 Vincent-square, Westminster, S.W.
Oct. 26, 1866	Horncastle, H., Whitemoor, near Ollerton, Notts.
June 25, 1869	Houghton, W., Walthamstow, E.
May 22, 1874	Hovendon, C. W., 95 City-road, E.C.
April 26, 1867	Hovenden, F., F.R.M.S., Glenlea, Thurlow-park-road, Dulwich, S.E.
June 23, 1876	How, Wm. Samuel, 145 Great Portland-street, W.
Jan. 22, 1875	Howard, F. W., The Grove, Teddington.
Feb. 25, 1870	Hudleston, W. H., J.P., F.G.S., 23 Cheyne-walk, S.W.
Jan. 26, 1872	Hudson, Robert, F.R.S., F.R.M.S., &c., Clapham-common, S.W.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
Oct. 22, 1875	Hunter, John, 5 Eton-rise, Ealing, W.
Nov. 24, 1871	Hurdell, Charles, 9 North Audley-street, W.
July 25, 1873	Hurst, John Thomas, The War-office, Whitehall, S.W.
Nov. 25, 1870	Hutton, Rev. Wyndham M., Lezayre-vicarage, Ramsey, Isle of Man.

Date of Election.	
May 24, 1867	Ingpen, John E., F.R.M.S. (*Hon. Secretary*), 7 The Hill, Putney, S.W.
Aug. 22, 1873	Israel, S., 1 The Crescent, America-square, E.C.
Dec. 17, 1869	Jackson, B. D., F.R.M.S., 30 Stockwell-road, S.W.
Dec. 17, 1875	Jackson, C. L., 11 Hesketh-street, Southport, Lancashire.
July 24, 1868	Jackson, F. R., Culver-cottage, Slindon, Arundel, Sussex.
June 14, 1865	Jaques, Edward, B.A., F.R.M.S., 5 Hargrave-park-road, Upper Holloway, N.
Feb. 28, 1873	Jenkins, J. W., 1 St. John's-hill, Wandsworth, S.W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 66 Avenue-road, Regent's-park, N.W.
Jan. 25, 1867	Johnson, John A., 15 Wellington-road, Stoke Newington, N.
Feb. 24, 1871	Johnson, M. Hawkins, F.G.S., 379 Euston-road, N.W.
June 23, 1876	Johnson, Tom Richard, 364 Camden-road, N.
Mar. 24, 1871	Johnstone, James, jun., 14 Lordship-park, Green-lanes, N.
Oct. 25, 1872	Jones, E. W., F.R.A.S., F.R.M.S., 53 Cowley-road, North Brixton, S.W.
Feb. 28, 1873	Jones, Geo. J., 1 Friar-lane, Leicester.
June 25, 1875	Jones, J. Birdsall, care of W. R. Jones, Esq., Athenæum, Liverpool.
Nov. 25, 1870	Jones, Lieut.-Col. Lewis, Ambarrow-house, Sandhurst, Wokingham.
May 23, 1873	Jones, Captain Loftus F., United Service Club, Pall Mall, S.W.
June 23, 1876	Jones, Thos. Edwd., 2 Park-terrace, Park-street, Stoke Newington, N.
May 22, 1874	Jones, W. W., 14 Lancaster-street, Lancaster-gate, Hyde-park, W.
May 23, 1873	Karop, Geo. C., Middlesex-hospital, W.
Oct. 26, 1866	Kemp, Robert, F.R.M.S., 60 Windsor-road, Upper Holloway, N.

Date of Election.

Oct. 26, 1866	Kent, W. S., F.R.M.S., F.Z.S., Royal Aquarium, Westminster, S.W.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall Mall, S.W.
Mar. 19, 1869	Kilsby, Thomas W., 4 Brompton-villas, Edmonton.
June 23, 1876	Kindon, Chas. J., 30 Overton-road, Brixton, S.W.
July 7, 1865	King, G. H., Sea-horse-house, 165 and 190 Great Portland-street, W.
July 22, 1870	King, Henry, 65 Myddleton-square, E.C.
Dec. 23, 1870	King, Robert, F.R.M.S., Fern-house, Upper Clapton, E.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, E.
Nov. 27, 1874	Kirkman, Rev. Joshua, Thurlow-road, South Hampstead, N.W.
Feb. 28, 1873	Kitsell, Francis J., 7 John's-terrace, Latymer-road, W.
June 24, 1870	Knaggs, Henry G., M.D., 49 Kentish-town-road, N.W.
Oct. 24, 1873	Knight, John Mackenzie, 2 Lansdowne-terrace, Bow-road, E.
Mar. 28, 1873	Lacy, Brooke, V., London-bridge, S.E.
Nov. 25, 1870	Ladd, Wm., F.R.A.S., F.R.M.S., 12 Beak-street, Regent-street, W.
July 27, 1866	Lambert, T. J., 151 Highbury New-park, N.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.
Aug. 24, 1866	Lampray, John, F.R.G.S., 16 Camden-square, N.W.
Mar. 22, 1867	Lancaster, Thos., Bownham-house, Stroud, Gloucestershire.
Dec. 28, 1866	Langrish, H., 250 Pentonville-road, N.
May 28, 1875	Larkin, John, 24 Charterhouse-square, E.C.
April 26, 1872	Law, Rev. William, Marston Trussell, Market Harborough.
May 28, 1875	Laws, Joseph C., 41 St. John's-park, Upper Holloway, N.
June 25, 1869	Layton, Charles E., 8 Upper Hornsey-rise, N.
Aug. 28, 1868	Leaf, C. J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.

Date of Election.	
Mar. 19, 1869	LEE, HENRY, F.L.S., F.R.M.S., &c. (*President*), The Waldrons, Croydons.
Mar. 27, 1874	Leefe, Frederick Ewbank, 289 Goswell-road, E.C.
June 23, 1876	Leeson, Herbert Seymour, 4 Old Buildings, Lincoln's-inn, W.C.
Oct. 25, 1867	Leifchild, J. R., M.A., 21 St. Lawrence-road, Notting-hill, W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
July 25, 1873	Le Pelley, C., 17 Underwood-street, Shepherdess-walk, Hoxton, N.
May 28, 1869	Letts, Edmund A., M.D., 16 St. Patrick-square, Edinburgh.
July 26, 1872	Levien, Charles N., 3 Great Tower-street, E.C.
Mar. 22, 1867	Lewinsky, John, 13 Frith-street, Soho, W.
April 27, 1866	Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1 Lowndes-terrace, Knightsbridge, S.W.
Nov. 24, 1871	Lewis, T. Preston, 8 The Crescent, Norwich.
June 26, 1868	Lindley, W., jun., Kidbrook-terrace, Blackheath, S.E.
Nov. 24, 1865	Loam, Michael, Hampton, Middlesex.
May 26, 1871	Locke, John, 16 Georgiana-street, Camden-town, N.W.
April 23, 1869	Long, Henry, 90 High-street, Croydon.
Aug. 28, 1874	Love, James, Talbot-lodge, Bickerton-road, Upper Holloway, N.
Nov. 24, 1866	Lovibond, J. W., F.R.M.S., St. Anne-street, Salisbury.
Sept. 22, 1865	Lovick, T., Board of Works, Spring-garden, S.W.
May 28, 1869	Lowe, Henry W., Heathfield, Sydenham-hill, S.E.
Dec. 18, 1868	Lowne, Benjamin Thompson, M.R.C.S., F.R.M.S., 49 Colville-gardens, W.
April 27, 1866	Loy, W. T., F.R.M.S., 9 Garrick-chambers, Garrick-street, W.C.

Jan. 24, 1873	McBride, Francis J.
Jan. 24, 1868	Macdonald, J., M.D., 68 Up. Kennington-lane, S.E.
Nov. 23, 1866	McIntire, S.J., F.R.M.S., 22 Bessborough-gardens, S.W.

Date of Election.	
Jan. 26, 1872	Mackechnie, J. Hamilton, M.D., 60 Wimpole-street, Cavendish-square, W.
July 26, 1874	Magor, Thomas, M.D., Myddelton-road, Hornsey, N.
May 22, 1874	Manly, Dr., Thatched House Club, St. James'-st., S.W.
Sept. 27, 1872	Manning, His Eminence the Cardinal Archbishop, Archbishop's House, Westminster, S.W.
June 14, 1865	Marks, E., Beaumont-villa, Beaumont-rd., Hornsey-rise, N.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 50 Cornhill, E.C.
June 27, 1873	Mason, Thomas, 416 Strand, W.C.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent.
Oct. 26, 1866	MATTHEWS, JOHN, M.D., F.R.M.S. (*Vice-President*), 30 Colebrooke-row, Islington, N.
Sept. 24, 1869	Matthews, William, 374 Camden-road, N.
May 26, 1871	May, John William, F.R.M.S., Arundel-house, Percy-cross, Fulham, S.W.
Feb. 27, 1874	May, Lewis J., 371 Holloway-road, N.
Dec. 17, 1875	May, Thomas, 54 Coburg-road, Old Kent-road, S.E.
Feb. 25, 1876	May, W. R., 39 Mortimer-road, Kingsland, E.
Feb. 28, 1873	Mayhew, A. F., 6 Bessborough-gardens, S.W.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
May 22, 1874	Meates, Edgar A., 83 Cambridge-street, Pimlico, S.W.
Feb. 25, 1876	Meredyth, Rev. T. E., M.A., Burleydam-vicarage, Whitchurch, Salop.
May 22, 1874	Messenger, G. A., 21 Glengall-grove, Old Kent-rd., S.E.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S. 7 Buckland-crescent, Belsize-park, N.W.
June 26, 1868	Milledge, Alfred, 4 Upper Winchester-road, Stanstead-road, Forest-hill, S.E.
July 7, 1865	Millett, F. W., 21 Duncan-terrace, Islington, N.
Feb. 28, 1873	Mills, Charles, 5 Union-road, Tuffnell-park, N.

Date of Election.

May 25, 1866 Moginie, W., F.R.M.S., 14 Riding-house-street, W.
Mar. 27, 1868 Moore, Daniel, M.D., Hastings-lodge, Victoria-road, Upper Norwood, S.E.
Jan. 23, 1874 Moreland, Richard, jun., M.I.C.E., F.R.M.S., 3 Old-street, St. Luke's, E.C.
Oct. 27, 1866 Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
April 24, 1868 Mummery, J. Rigden, F.L.S., F.R.M.S., &c., 10 Cavendish-place, W.
April 24, 1868 Mummery, J. Howard, 10 Cavendish-place, W.
Dec. 18, 1868 Mundie, George, M.R.C.S., 93 Richmond-road, Dalston, E.
Jan. 25, 1867 Murray, R. C., 69, Jermyn-st., St. James's, S.W.

Mar. 23, 1866 Nation, W. J., 30 King-square, Goswell-road, E.C.
Mar. 24, 1876 Nelson, Edward M., 9 Marlborough-hill, N.W.
Mar. 24, 1871 Nelson, James, 3 Oakden-street, Kennington-road, S.E.
Jan. 26, 1872 Newton, Edwin Tulley, F.G.S., Geological Museum, Jermyn-street, S.W.
Jan. 23, 1874 Newton, Henry Edward, Woolsthorpe, The Avenue, Gipsey Hill, Norwood, S.E.
July 7, 1865 Nicholson, D., 51 St. Paul's-churchyard, E.C.
May 22, 1874 Nixon, Philip Charles, 23 Crutched-friars, E.C.

Feb. 25, 1876 Ongley, H. H., 21 The Grove, Boltons, Brompton, S.W.
Dec. 27, 1867 Oxley, F., 8 Crosby-square, Bishopsgate, E.C.

May 22, 1874 Palmer, Thomas, F.R.M.S., Elmstead, near Chislehurst, Kent.
July 27, 1873 Parker, William, Whitehall Club, S.W.
Oct. 27, 1871 Parsons, Fred. Anthony, 90 Leadenhall-street, E.C.
June 25, 1869 Pass, H., 11 Spring-terrace, Wandsworth-road, S.W.
May 26, 1871 Paxton, Rev. W. Archibald, M.A., Otterden Rectory, Faversham, Kent.

Date of Election.

April 23, 1875 Peal, Charles Nathaniel, Westbourne-lodge, Castlebar-hill, Ealing, W.
May 22, 1874 Pearce, George Alonzo Creech, B.A., M.B., B.C.N., Priory-chambers, Crutched-friars, E.C.
May 24, 1867 Pearce, George, 1 Queen's-terrace, Camden-road-villas, N.W.
Feb. 23, 1872 Pearce, W. E. Grindley, L.R.C.P., 24 Bessborough-gardens, S.W.
June 23, 1876 Pearcy, Richard Gilbert, 31 Packington-street, Islington, N.
May 24, 1867 Pearson, John, 212, Edgware-road, W.
Oct. 27, 1865 Pickard, J. F., 1 Bloomsbury-street, W.C.
Dec. 23, 1870 Pigott, G. W. Royston, M.A., M.D., F.R.S., &c., Hartley-court, near Reading.
Jan. 22, 1869 Pillischer, M., F.R.M.S., 88 New Bond-street, W.
Nov. 24, 1871 Pitts, Frederick, Harvard-house, St. John's-hill, Clapham, S.W.
June 25, 1869 Pocock, Lewis, jun., 70 Gower-street, W.C.
Nov. 23, 1866 Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
June 22, 1866 Powe, I., 71 George-street, Richmond, Surrey.
May 25, 1866 Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
May 26, 1876 Powell, Jas. F., 12 Dalrymple-terrace, Glenarm-road, Clapton-park, E.
Jan. 24, 1873 Powell, Jas. J., 43 Burton-road, Brixton, S.W.
July 7, 1865 Powell, Thomas, 18 Doughty-street, Mecklenberg-square, W.C.
July 24, 1874 Powell, Thomas Henry, 7 Poultry, E.C.
Jan. 22, 1875 Power, Henry, 8 Manor-terrace, New Church-road, Camberwell, S.E.
Oct. 25, 1872 Price, W. H., 1 The Terrace, Kennington-park, S.E.
Feb. 26, 1869 Prichard, Thomas, M.D., Abbington Abbey, Northampton.
June 27, 1873 Priest, B. W., 22 Parliament-street, S.W.
Nov. 27, 1868 Pritchett, Benjamin, 131 Fenchurch-street, E.C.
July 26, 1867 Pritchett, Francis, 131 Fenchurch-street, E.C.

April 23, 1868 Quekett, Alfred J. S., 13 Delamere-crescent, Westbourne-square, W.

Date of Election.	
April 23, 1868	Quekett, Arthur Edwin, 13 Delamere-crescent, Westbourne-square, W.
April 23, 1868	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Highfield, Dartmouth-park, Forest-hill, S.E.
Sept. 24, 1869	Radcliffe, J. D., 93 Albion-road, Dalston, E.
Nov. 23, 1866	Radermacher, J. J., The Pantechnicon, Motcombe-street, Belgrave-square, S.W.
June 25, 1875	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866	Ramsbotham, J. M., M.D., 15 Amwell-street, Pentonville, E.C.
Oct. 26, 1866	Ramsden, Hildebrand, M.A. Cant., F.L.S., F.R.M.S., Forest-rise, Walthamstow, E.
Aug. 28, 1868	Rance, T. G., Widmore-lane, Bromley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
Oct. 28, 1869	Rean, Walter, Woodstock-road, Poplar, E.
June 23, 1876	Redmayne, John T., M.R.C.S., &c., Bolton, Lancashire.
June 27, 1873	Reeve, Fredk., 37 Fentiman-road, Clapham-road, S.W.
July 7, 1865	Reeves, W. W., F.R.M.S., 37 Blackheath-hill, Greenwich, S.E.
May 22, 1874	Reid, Wm. Wardlaw, 16 Warwick-place, Peckham Rye, S.E.
May 26, 1871	Richards, Edward, F.R.M.S., 289 Camberwell New-road, S.E.
Jan. 24, 1868	Richardson, C. J., 44 Duncan-terrace, Islington, N.
Mar. 25, 1870	Richardson, Thomas Hyde, 1 Belgrave-villas, Holmesdale-road, Selhurst, S.E.
Feb. 23, 1866	Rixon, F., F.R.M.S., Loats-road, Clapham-park, S.W.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 82 Finchley-road, St. John's-wood, N.W.
April 26, 1872	Roberts, S. Hackett, F.R.M.S., 355 Walworth-road, S.E.
May 22, 1868	Rogers, John, F.R.M.S., Forest-road-west, Nottingham.

Date of Election.	
Oct. 26, 1866	Rogers, Jos. R., 12 Bellefield-terrace, Bellefield-road, Stockwell, S.W.
Oct. 26, 1866	Rogers, Thomas, F.L.S., F.R.M.S., Selmiston House, Thurlow-park-road, West Dulwich.
Mar. 22, 1872	Rolfe, Charles Spencer, 6 Westminster Chambers, S.W.
May 22, 1868	Roper, F.C.S., F.L.S., F.G.S., F.R.M.S., Palgrave-house, Eastboure, Sussex.
June 23, 1876	Roper, Hy. John, 5 Lausanne-road, Peckham, S.E.
July 24, 1868	Rowe, James, Jun., M.R.C.V.S., 65 High-street, Marylebone, W.
Oct. 26, 1866	Rowlett, John, 19 Marrow-street, Walworth, S.E.
July 14, 1865	Ruffle, G. W. (*Hon. Curator*), 131 Blackfriars-road, S.E.
July 24, 1874	Rushton, William, 26 Park-street, Islington, N.
Oct. 27, 1865	Russell, James, 10 High-street, Shoreditch, E.
Feb. 27, 1874	Russell, James, 61 Leipsic-road, Camberwell, S.E.
Oct. 26, 1866	Russell, Joseph, Blenheim House, Middle Mall, Hammersmith, S.W.
May 22, 1868	Russell, Thomas D., 21 Park-road, West Dulwich, S.E.
Feb. 22, 1867	Rutter, H. Lee, 1 St. Barnabas-villas, Lansdowne-circus, South Lambeth, S.W.
May 23, 1873	Salkeld, Lt.-Colonel Joseph C., F.R.M.S., 29 St. James's-street, S.W.
Dec. 17, 1869	Salmon, John, 24 Seymour-st., Euston-sq., N.W.
May 28, 1875	Saul, Geo. William, 2 Fountain-court, Aldermanbury, E.C.
May 22, 1868	Scatliff, John Parr, M.D., 132 Sloane-street, S.W.
May 24, 1872	Schloesser, Ernest, 9 College-hill, Cannon-street, E.C.
Feb. 26, 1875	Scofield, W. J., M.R.C.S., F.L.S., 13 South Hill Park-gardens, Hampstead, N.W.
May 24, 1872	Sequeira, H. L., M.R.C.S., 1 Jewry-street, Aldgate, E.C.
July 27, 1868	Sewell, Richard
Oct. 22, 1869	Shaw, Wm. Forster, Moss Hall Grove, Finchley, N.
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.

Date of Election.	
May 24, 1872	Sheehy, W. H. Podmore, 4 Claremont-square, N.
May 26, 1876	Shepheard, Thomas, F.R.M.S., 12 Bridge-street, Row, Chester.
May 26, 1871	Sigsworth, J. C., F.R.M.S., 18 Loraine-road, Holloway, N.
June 27, 1873	Simmonds, Joseph E., 13, Ann's-terrace, near Walham-green, S.W.
Aug. 23, 1867	Simmons, James J., L.D.S., 18 Burton-crescent, W.C.
May 26, 1876	Simpson, Edwd., 15 St. Mark's-crescent, Regent's-park-road, N.W.
Mar. 27, 1868	Simson, Thos., The Laurels, Courtyard, Eltham.
May 28, 1869	Sketchley, H. G., 72 Wilson-street, Derby.
Dec. 28, 1866	Slade, J., 100 Barnsbury-road, N.
Mar. 24, 1872	Smart, Harry, 11 Paragon-terrace, Hackney, E.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus (*Hon. Librarian*), 42 Choumert-road, Rye-lane, Peckham, S.E.
Feb. 25, 1876	Smith, Edward, F.S.S., 37 Old Jewry, E.C.
Mar. 25, 1870	Smith, Francis Lys, 3 Grecian-cottages, Crown-hill, Norwood, S.E.
June 27, 1873	Smith, G. J., 2 Foster-lane, Cheapside, E.C.
Oct. 26, 1866	Smith, H. Ambrose, 2 King William-st., City, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 407 Liverpool-road, N.
Dec. 23, 1870	Smith, Joseph A., Granville-lodge, Croydon-road, Penge, S.E.
May 22, 1874	Smith, Roland D., M.R.C.S.E., F.R.M.S., York-house, Chatteris, Cambridgeshire.
June 24, 1870	Smith, William, 15 Ifield-road, West Brompton, S.W.
Feb. 28, 1873	Smith, W. Lepard, Southfield-house, Watford.
Aug. 23, 1872	Smith, W. Stuart, 30 Loraine-road, Holloway, N.
April 24, 1868	Snellgrove, W., 22 Surrey-square, S.E.
Sept. 22, 1865	Southwell, C., 44 Princes-street, Soho, W.
May 26, 1876	Southwell, Chas. Wm., 1 Stoke Newington-green, N.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, E.
May 22, 1874	Spencer, James, South-street, Greenwich, S.E.
June 26, 1868	Spencer, John, Brook's Bank, 81 Lombard-street, City, E.C.

Date of Election.	
Nov. 22, 1872	Spencer, Thomas, F.C.S., F.R.M.S., 32 Euston-square, N.W.
Mar. 24, 1866	Starling, Benjamin, 9 Gray's-Inn-square, W.C.
Feb. 23, 1872	Stevens, C. R., 7 Ashby-road, Canonbury, N.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
May 23, 1873	Steward, James H. C., 406 Strand, W.C.
Mar. 19, 1869	Stokes, Frederick, 17 Milton-road, Herne-hill, S.E.
April 28, 1876	Stopher, Wm., 24 Coleman-street, E.C.
Oct. 27, 1871	Stuart, David John, 53 Ferntower-road, Highbury-New-park, N.
July 7, 1865	Suffolk, W. T., F.R.M.S., 48 Treherne-road, Vassal-road, Brixton, S.E.
June 27, 1873	Suter, Edward D., Kent-lodge, Douglas-road-north, Canonbury, N.
June 24, 1870	Swain, Ernest, 89, Ladbroke-road, W.
Nov. 22, 1867	Swainston, J. T., 3 St. Mark's-square, Regent's-park, N.W.
Nov. 24, 1866	Swansborough, E., 20 John-st., Bedford-row, W.C.
Dec. 18, 1868	Swift, James, 43 University-street, W.C.
Dec. 17, 1875	Swift, Mansell, 43 University-street, W.C.
Nov. 25, 1870	Tafe, John Forwood, Fernlea, King Edward-road, Victoria-park, E.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Jan. 23, 1874	Taylor, John Ellor, The Museum, Ipswich.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
Aug. 23, 1872	Terry, Thomas, 5 Austin-friars, E.C.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road. S.W.
May 28, 1875	Thomson, John Reid, 18 Highbury-place, N.
Feb. 24, 1871	Thornthwaite, W. H., 416 Strand, W.C.
Dec. 17, 1875	Tidmarsh, Wm., B.A. Lond., Putney School, Putney, S.W.
Jan. 22, 1875	Tinney, William A., 4 Alfred-place, Bedford-sq., W.C.
Nov. 27, 1867	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
June 23, 1871	Topping, Amos, 28 Charlotte-street, Caledonian-road, N.

Date of Election.

July 26, 1872	Townsend, John Sumsion, F.R.M.S., 59 London-road, Croydon.
April 26, 1872	Tozer, Edward, Ivy-lodge, Woodford, Essex.
July 24, 1868	Tulk, John A., M.D.
July 26, 1867	Turnbull, Joseph, Laurel-house, North-hill, Highgate, N.
June 25, 1869	Turner, R. D., Chafford, Tunbridge.
June 25, 1875	Turner, Sydney, Argyll-house, Wellington-square, Oxford.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Jan. 22, 1875	Vivian, The Hon. J. C., The Lawn, Twickenham.
May 22, 1874	Wadmore, Ernest.
Feb. 23, 1866	Walker, A., M.D.
April 24, 1874	Walker, Enoch, 4 Banbury-terrace, South Hackney, E.
May 28, 1869	Walker, Henry, F.G.S., 8 Walterton-road, St. Peter's-park, Paddington, W.
Feb. 27, 1874	Walker, John C., 14 Hilldrop-road, Camden-road, N.
July 25, 1873	Walker, John Stringer, Warwick-road, Upper Clapton, E.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.
Dec. 18, 1868	Waller, A., 11 Aberdeen-park, Highbury, N.
May 22, 1868	WALLER, J. G. (*Vice-President*), 68 Bolsover-street, Portland-road, W.
July 24, 1874	Wallis, James, 22 Cranmer-road, Brixton-road, S.E.
Aug. 26, 1870	Warburton, Samuel, Merton-villa, New-road, Lower Tooting, S.W.
Dec. 22, 1871	Ward, Daniel, 26 Coleman-street, Woolwich, S.E.
Nov. 22, 1867	Ward, F. H., M.R.C.S., F.R.M.S., Springfield-house, near Tooting, S.W.
Dec. 18, 1868	Warner, Alfred, care of Mr. W. F. Stanley, 13 Railway-approach, London-bridge, S.E.
Feb. 26, 1869	Warner, William.
May 25, 1866	Warrington, H. R., 7 Royal Exchange, Cornhill, E.C.

Date of Election.	
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
Oct. 25, 1872	Watkins, J., L.C.P., 40 Store-street, Bedford-square, W.C.
Dec. 28, 1866	Way, T. E., 65 Wigmore-street, W.
July 24, 1874	Webb, C. E., Wildwood-lodge, North-end, Hampstead, N.W.
May 24, 1867	Weeks, A. W. G., 18 Gunter-grove, West Brompton, S.W.
Feb. 25, 1876	Wheeler, George, 7 St. John's-terrace, E.C.
Dec. 28, 1866	Wheldon, W., 58 Great Queen-street, W.C.
Dec. 27, 1872	White, Charles, E., L.D.S., 32 Belgrave-road, S.W.
April 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing, W.
Feb. 26, 1868	White, Francis W., 2 Alexander-terrace, Culmore-road, Balham, S.W.
May 22, 1868	WHITE, T. CHARTERS, M.R.C.S., L.D.S., F.R.M.S., (*Vice-President*), 32 Belgrave-road, S.W.
July 25, 1873	White, Walter, Litcham, Norfolk.
May 23, 1873	Whitmore, John, M.D., 15 Wimpole-street, W.
June 25, 1875	Whitney, Edward Underwood, 13 Gt. College-st., Westminster, S.W.
July 24, 1868	Wight, James F., F.R.M.S., Grazeley, Gipsy-hill, Upper Norwood, S.E.
Mar. 24, 1871	Williams, George, 6 St. John's-park, Upper Holloway, N.
April 23, 1875	Williams, Henry, Victoria Nurseries, Upper Holloway, N.
June 23, 1876	Williams, Jas. W., 1 Hope-villas, Powell-road, Clapton, E.
Oct. 24, 1873	Williams, John R., F.R.M.S., 59 Albion-road, Stoke Newington, N.
Oct. 28, 1870	Williams, Martin G., 2 Highbury-crescent, N.
July 28, 1871	Williams, Robert Packenham, 18 Brunswick-road, Upper Holloway, N.
Jan. 25, 1867	Willsworth, H., 3 St. John's-villas, Upper Holloway, N.
Mar. 24, 1876	Wilson, Chas. Joseph, 14 Highbury-crescent, N.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.

Date of Election.	
Feb. 27, 1874	Wilson, William, 420 Holloway-road, N.
Aug. 27, 1869	Woods, W. Fell, 1 Park-hill, Forest-hill, S.E.
June 28, 1876	Woollett, John, 58 Cloudesley-road, N.
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
June 27, 1873	Wrey, George E. B., Addington-house, Addington-road, Reading.
Jan. 23, 1874	Wright, Cecil H., 27 Wardour-street, W.
Nov. 23, 1866	Wright, Edward, 89 Shepherdess-walk, E.C.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.

NOTICE.

Members are requested to give the Hon. Secretary early notice of any change of Residence, so as to prevent miscarriage of Journals and Reports.

RULES.

I.—That "The Quekett Microscopical Club" hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by a Committee, consisting of the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and twelve other members,—six to form a quorum. That the President, Vice-Presidents, Treasurer, Secretaries, and the four senior members of the Committee (by election) retire annually, but be eligible for re-election. That the Committee may appoint a stipendiary Assistant Secretary, who shall be subject to its direction.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of President, Vice-Presidents, Treasurer, Honorary Secretaries, and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That the President, Vice-Presidents, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Vice-Presidents, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended ballotted for at the following Meeting. Three black balls to exclude.

VI.—That the society include not more than twenty Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting, of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary meeting, who shall enter his name with that of the Member by whom he is introduced in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

Form of Proposal for Membership.

Quekett Microscopical Club.

Mr.

of

being desirous of becoming a Member of this Club, we beg to recommend him for election.

(on my personal knowledge).

This Certificate was read 187

The Ballot will take place 187

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Exchange Committee.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one Member.

III. That the Slides be classified by the Committee into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the ordinary meetings of the Club.

V. Members may leave the selection to the Exchange Committee, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII.—All expenses incurred in the transmission of Slides or in correspondence respecting them, to be borne by the Member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. John E. Ingpen
7, The Hill,
Putney, S.W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.

If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked box and forwarded by Railway.

TWELFTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

MEETING AT UNIVERSITY COLLEGE, LONDON, ON THE SECOND AND FOURTH FRIDAYS OF EVERY MONTH.

LONDON.

July 1877.

(*Extract from original Prospectus, July* 1865.)

"The want of such a Club as the present has long been felt, wherein
" Microscopists and students with kindred tastes might meet at stated periods
" to hold cheerful converse with each other, exhibit and exchange specimens,
" read papers on topics of interest, discuss doubtful points, compare notes of
" progress, and gossip over those special subjects in which they are more or
" less interested: where, in fact, each member would be solicited to bring his
" own individual experience, be it ever so small, and cast it into the treasury
" for the general good. Such are some of the objects which the present Club
" seeks to attain. In addition thereto it hopes to organize occasional Field
" Excursions, at proper seasons, for the collection of living specimens; to
" acquire a Library of such books of reference as will be most useful to
" enquiring students; and, trusting to the proverbial liberality of Micro-
" scopists, to add thereto a comprehensive Cabinet of Objects. By these, and
" similar means, the Quekett Microscopical Club seeks to merit the support
" of all earnest men who may be devoted to such pursuits; and, by fostering
" and encouraging a love for Microscopical studies, to deserve the approval
" of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July 1877.)

President.

Henry Lee, Esq., F.L.S., F.G.S., F.R.M.S., &c.

Vice-Presidents.

F. Crisp, LL.B., B.A. Lond., F.R.M.S.
John Matthews, M.D., F.R.M.S.
E. T. Newton, F.G.S.
T. Charters White, M.R.C.S., F.R.M.S.

Hon. Treasurer.

F. W. Gay, F.R.M.S., 113, High Holborn, W.C.

Hon. Secretary.

John E. Ingpen, F.R.M.S., 7, The Hill, Putney, S.W.

Hon. Secretary for Foreign Correspondence.

M. C. Cooke, M.A., LL.D., A.L.S.

Hon. Reporter.

Richard T. Lewis, F.R.M.S.

Committee.

M. Hawkins Johnson, F.G.S.
Frederick Oxley.
T. Rogers, F.L.S., F.R.M.S.
Joseph A. Smith.
F. W. Andrew.
A. Cottam, F.R.A.S.
C. G. Dunning.
J. W. Goodinge, F.R.G.S., &c.
W. H. Gilburt.
F. A. Parsons.
B. W. Priest.
T. Spencer, F.C.S., F.R.M.S.

Hon. Librarian.

Alpheus Smith.

Hon. Curator.

H. F. Hailes.

Excursion Committee.

F. W. Gay, F.R.M.S.
Frederick Oxley.
W. W. Reeves, F.R.M.S.
T. Rogers, F.L.S., F.R.M.S.
W. T. Suffolk, F.R.M.S.

PAST PRESIDENTS.

	Elected.
EDWIN LANKESTER, M.D., F.R.S. - -	July, 1865.
ERNEST HART - - - - - - -	,, 1866.
ARTHUR E. DURHAM, F.L.S., &c. - -	,, 1867.
,, ,, ,, - - -	,, 1868.
PETER LE NEVE FOSTER, M.A. - -	,, 1869.
LIONEL S. BEALE, M.B., F.R.S., &c. -	,, 1870.
,, ,, ,, - - -	,, 1871.
ROBERT BRAITHWAITE, M.D., F.L.S., &c.	,, 1872.
,, ,, ,, - - -	,, 1873.
JOHN MATTHEWS, M.D., F.R.M.S. - -	,, 1874.
,, ,, ,, - - -	,, 1875.
HENRY LEE, F.L.S., F.G.S., F.R.M.S., &c.	,, 1876.

REPORT OF THE COMMITTEE.

Your Committee, in presenting their Twelfth Annual Report, have to record that the past year, although unmarked by any very striking occurrence, has been by no means deficient in work of interest and utility.

Your Committee have the pleasure of announcing that the Council of University College have again renewed, for the ensuing year, their long-continued permission for the meetings of the Club to be held at this place; and that the cordial feeling that has always existed between the College and the Club remains unabated.

The Club has lost by death during the past year the oldest Honorary Member, Professor Guiseppe de Notaris, who was elected in 1867, and of whom a short obituary notice appears in the Journal: also six ordinary Members—Mr. J. Bowles, Mr. J. Callaghan, Mr. S. Eyre, Mr. W. B. Holdernesse, Mr. F. Rixon, and Mr. W. Wheldon. Twenty-one Members have resigned, twenty-four have been struck off the list of Members for non-payment of Subscription for five years and upwards, forty-five new Members have been elected, and the Club's numerical strength is now, 534, out of a total of 1,050 gentlemen who have joined since its commencement.

The following papers and communications have been contributed during the past year:—

On an Improved Anti-vibration Turntray ...... *By Mr. W. K. Bridgman.*
,, A New Universal Reflecting Condenser ... ,, *Mr. W. K. Bridgman.*
,, *Empusa muscæ* .... ,, *Mr. T. C. White.*
,, The Relation between *Volvox globator* and *Sphærosira volvox* .... ,, *Mr. W. H. Gilburt.*
,, A New Species of *Argas* .... ,, *Mr. C. F. George.*
,, The Histology of Skin........................... ,, *Mr. Charles Stewart.*
,, Microscopy in the United States .... ,, *Mr. Henry Crouch.*
,, An Improved Section-cutter .... ,, *Mr. H. F. Hailes.*
,, Some Recent Applications of the Microscope to Physics............................. ,, *Mr. T. B. Lowne.*
,, Black Moulds .... ,, *Dr. M. C. Cooke.*
,, The Absence of Stomata from certain Ferns ,, *Mr. W. H. Gilburt.*
,, Some Personal Observations on *Botrylloides* ,, *Mr. T. C. White.*
,, Some Improvements in the Ordinary Condenser .... ,, *Mr. W. K. Bridgman.*
,, The Staining of Vegetable Tissues .... ,, *Mr. W. H. Gilburt.*
,, The Camera Lucida .... ,, *Mr. J. E. Ingpen.*

In addition to the above, several short and interesting communications have been made at the Meetings, and are recorded in the Proceedings.

The following additions to the Library have been made by donation, exchange and purchase :—

PRESENTED BY

Dawson (J. W.), The Dawn of Life .... *Mr. B. W. Priest.*
Taylor (J. E.), The Aquarium..................... *The Publisher.*
Rutherford (J. W.), Outlines of Practical Histology .... *Mr. T. C. White.*
Cash (J.), "Where there's a will there's a way" ,, ,,
An Album of Micro-Photographs of Diatomaceæ .... *Mr. J. Redmayne.*
Smithsonian Institution Report for 1875 ...... *United States Govt.*
Grevillea (from commencement).................. *Mr. A. Cottam.*
Popular Science Review .... *The Publisher.*
Monthly Microscopical Journal .... ,, ,,
Science Gossip .... ,, ,,
Quarterly Journal of Microscopical Science ... *Purchased.*

Darwin (C.), Insectivorous Plants	*Purchased.*
Annals of Natural History. Third Series. 20 Vols. 1858–67	,,
Do. do. Fourth Series. 12 Vols. 1868–73	,,
Walckenaer and Gervais' Histoire Naturelle des Insectes. Apteres. 5 Vols.	,,
Buckton (G.B.), Monograph of the British Aphides. Ray Society	*By Subscription.*
McIntosh (W.C.), Monograph of the British Annelids. Part I. Ray Society	,,
American Naturalist	*In Exchange.*
American Journal of Microscopy..................	,, ,,
Proceedings of various Scientific Societies.	
Sundry Pamphlets.	

Fifteen Photographs have been contributed to the Album, which now contains 35 portraits of Members of the Club.

The following Donations have been made to the Object Cabinet :—

Mr. W. A. Bevington	4	Slides.
Mr. W. K. Bridgman	19	,,
Mr. A. C. Cole	37	,,
Dundee Naturalists' Society	3	,,
Mr. F. Enock	12	,,
Mr. H. E. Freeman...	2	,,
Mr. H. F. Hailes	77	,,
Mr. S. Israel	6	,,
Mr. J. C. Sigsworth	6	,,
Mr. J. Tatem	1	,,
Mr. A. Topping	1	,,
Mr. T. C. White	1	,,
Total	169	

The Slides in the Cabinet have been thoroughly examined by a Sub-Committee appointed for that purpose, and a new

Catalogue is in course of preparation, which will include the numerous and valuable contributions recently made. This work, which is of some considerable extent and difficulty, will, when completed, greatly increase the value of the collection, by rendering it more easy of reference than it is at present.

The Ordinary and Conversational Meetings have been unusually well attended during the past year, and the objects exhibited have been more numerous, and of greater scientific interest than formerly. The assistance and information so freely given by the more experienced Members on methods of mounting and manipulation, &c., have greatly tended to improve the quality of such work produced by Members of the Club, among which may be found some of the highest class specimens of amateur microscopical preparations. The value of such instruction to young microscopists cannot well be over-rated.

The Treasurer's Report speaks for itself, showing, as it does, a satisfactory balance, and a prudent and economical expenditure of the funds of the Club. It is to be regretted, however, that a large amount is still outstanding from unpaid Subscriptions.

The Journal continues to be published at suitable intervals, and contains the Papers read and faithful reports of the oral communications made at the meetings and the discussions thereon. Its circulation outside the Club has increased, and it is favourably noticed in many British and Foreign Publications.

The Excursions have been well attended, and productive of many interesting specimens in various branches of Natural History. The attention of the Members is particularly called to this portion of the work of the Club, and information respecting new localities is much desired. Even at those so frequently visited, the utility to beginners of lessons in the art of collecting Microscopical Objects is manifest. The Excursions also continue to be the means of keeping up a friendly feeling between our own and kindred Societies.

No award has been made out of the Fund presented by Mr. Crisp, for papers written, or other work done for the Club during the past year.

The Soirée of last April was one of the most successful hitherto held by the Club. The increased space allotted to exhibitors in the South Library allowed of a larger display of microscopes than was previously practicable. The lecture and other attractions were of a very satisfactory character, and the selection of music performed by a small and efficient band was highly appreciated by the numerous visitors.

The thanks of your Committee are due and gladly offered on this occasion to the various officers of the Club, by whom the large amount of routine labour required for its proper working is performed. In the departments of the Library and the Cabinet the work continues to increase, owing to their greater extent and their more extended use by Members than formerly; while our Honorary Reporter, by kindly consenting to continue his arduous duties for another year, adds to the obligation which the Club is under to him for his valuable and long-continued record of its proceedings.

Your Committee consider that the Club may well be congratulated upon its present satisfactory condition, occupying, as it does, a definite and well-earned scientific position—free from internal dissensions and rivalry of party—pursuing steadily its useful work of instruction in Microscopy, none the less valuable perhaps for not being strictly formal—and maintaining the genial and social character which has always distinguished it. Its strongest position is that of a working Society, able and willing to impart sound instruction in the use of an instrument which is now employed in almost every branch of Art and Science, and also in the rudiments of histology, a most important branch of the study of Natural History; and keeping this steadily in view we may confidently anticipate the best results, both as regards the future contributions of the Club to original scientific research, and the extension of its already widely-spread influence and usefulness.

QUEKETT MICROSCOPICAL CLUB.—TREASURER'S STATEMENT OF ACCOUNT.

Dr.				Cr.			
June 30th, 1877.	£	s.	d.	June 30th, 1877.	£	s.	d.
To Balance in hand July 1st, 1876	116	8	4	By Printing and Stationery	34	9	0
,, Subscriptions received	229	10	0	,, Postage	12	6	0
,, Sale of Journals	11	7	7	,, Attendance	10	2	6
,, Compounding Fee to Invest	10	0	0	,, Property Purchased	52	15	11
,, Mr. Crisp's Second Donation	20	0	0	,, Petty Expenses	20	12	7
				,, Advertisements	1	6	3
				,, Soirée	88	15	9
				,, Journal	55	3	1
				,, Amount transferred to Mr. Crisp's Donation Fund Account	40	0	0
				,, Balance in hand	71	14	10
	£387	5	11		£387	5	11

MR. CRISP'S DONATION FUND ACCOUNT.

To Amount transferred from General Account	40	0	0	By Awards in accordance with Rules	14	9	2
				,, Balance in hand	25	10	10
	£40	0	0		£40	0	0

Amount standing in New 3 per Cent. Annuities, £30.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify that the said Account is correct.

WM. HAINWORTH, Jun., } *Auditors.*
H. H. DOBSON,

July 24th, 1877.

HONORARY MEMBERS.

Date of Election.	
Jan. 24, 1868	Arthur Mead Edwards, M.D. (*Ex-President of the American Microscopical Society: President of the Newark Scientific Association*), 120, Belleville Avenue, Newark, New Jersey, U.S.A.
Mar. 19, 1869	Rev. E. C. Bolles (*Ex-President of the Portland Society of Natural History*), Salem, Mass., U.S.A.
July 26, 1872	S. O. Lindberg, M.D., Professor of Botany, University of Helsingfors, Finland.
July 26, 1872	Prof. Hamilton L. Smith, President of Hobart College, Geneva, New York, U.S.A.
July 26, 1872	J. J. Woodward, Assist. Surgeon, U.S.A., War Department, Surgeon General's Office, Washington.
July 24, 1874	W. Sharpey, M.D., F.R.S., 50, Torrington-square, W.C.
July 23, 1875	Lionel S. Beale, M.B., F.R.S., F.R.M.S., &c., 61, Grosvenor-street, W.
Sept. 22, 1876	Frederick Kitton, Hon. F.R.M.S., &c., 10, Haymarket, Norwich.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869	Ackland, William, L.S.A., F.R.M.S., 416 Strand, W.C.
June 23, 1876	Addis, W., 28, Benyon-road, Southgate-road, N.
Nov. 27, 1868	Adkins, William, 270 Oxford-street, W.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
Oct. 28, 1870	Allen, Rev. Francis H., Ditchingham, Bungay, Norfolk.
Sept. 27, 1867	Allen, John T.
June 23, 1876	Allison, Charles, 71 Graham-road, Dalston, E.
July 26, 1872	Alstone, John, 140 Rye-lane, Peckham, S.E.
Dec. 17, 1869	Ames, George Ackland, F.R.M.S., Union Club, Trafalgar-square, W.C.
Sept. 25, 1868	Andrew, Arthur R., 3 Neville-terrace, Onslow-gardens, S.W.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Onslow-gardens, S.W.
July 7, 1865	Archer, J. A., 172 Strand, W.C.
Nov. 27, 1874	Armbruster, C., F.C.S., 9 Augustus-road, Hammersmith, W.
June 25, 1875	Arnold, Theodore P.
May 28, 1875	Arrowsmith, Wastell, 22 Camden-cottages, N.W.
Nov. 24, 1876	Atkins, Walter George, Mem. Soc. Eng., 62 Fleet-street, E.C.
Dec. 22, 1865	Atkinson, John, 33 Brook-street, W.
Feb. 26, 1869	Atkinson, Wm., F.L.S., 47 Gordon-square, W.C.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.
July 23, 1875	Ayling, J. J., 37 Edward-street, Newington-butts, S.E.

Date of Election.	
Nov. 25, 1870	Baber, Edward Cresswell, L.R.C.P., M.R.C.S., 34 Thurloe-square, S.W.
June 26, 1874	Badcock, John, F.R.M.S., 2 Banbury-road, South Hackney, E.
May 22, 1868	Bailey, Captain L. C., R.N., F.R.G.S., F.R.A.S., Topographical Department, New-street, Spring-gardens, S.W.
Dec. 27, 1867	Bailey, John W., 75 Broke-road, Dalston, E.
April 24, 1868	Baker, Chas., F.R.M.S., 244, High Holborn, W.C.
Feb. 28, 1873	Baker, George H., M.R.C.S., 14 Mare-street, Hackney, E.
May 25, 1877	Baker, G. Levett, 15 Winslow-road, Denmark-hill.
Feb. 25, 1876	Ballard, Dr. W. R., jun., 26 Manchester-square, W.
July 28, 1876	Barnard, Hy., 22 Red Lion-street, Clerkenwell, E.C.
Dec. 27, 1872	Barnard, Herbert, 33 Portland-place, W.
April 22, 1870	Barnes, Chas. Barritt, 4 Egrement-villas, White Horse-lane, South Norwood, S.E.
Nov. 23, 1866	Barnes, Captain E., Bridlington-quay, Yorkshire.
Aug. 28, 1874	Barnett, E. W., The Larches, Penge Lane, Sydenham, S.E.
Sept. 27, 1872	Bartlett, Edward, jun., L.D.S., M.R.C.S.E., 40 Elgin-road, St. Peter's-park, W.
June 23, 1871	Bartlett, Wm. P., 41 Gloucester-place, Hyde-park, W.
May 22, 1874	Bate, George Paddock, M.D., F.R.M.S., 412 Bethnal Green-road, E.
Nov. 26, 1875	Bayfield, Chas. Moulden, 2 Leamington-road-villas, Westbourne-park, W.
Mar. 27, 1874	Beach, Richard J., 59 Ashburton-grove, Lower Holloway, N.
May 28, 1869	Bean, Charles E., Brooklyn-house, Goldhawk-road, Shepherd's-bush, W.
Nov. 26, 1875	Beaulah, John, Bracken-hill, Brigg.
Oct. 26, 1866	Beck, Joseph, F.R.A.S., F.R.M.S., 31 Cornhill, E.C.
May 26, 1871	Bedwell, Fras. Alfred., M.A. Cantab., F.R.M.S., Bridlington, Hull.
May 24, 1872	Bennett, W. H., St. George's-hospital, S.W.
Mar. 24, 1871	Bentley, Algernon Royds, 36 Portland-place, W.

Date of Election.	
Dec. 27, 1867	Bentley, C. S., F.R.M.S., Hazelville-villa, Sunny-side-road, Hornsey-rise, N.
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Oct. 23, 1868	Bevington, W. A., F.R.M.S., 113 Grange-road, S.E.
June 24, 1870	Birch, A. E., 47, Halliford-street, Islington, N.
July 28, 1871	Bishop, Wm., 4 Whitley-villas, Caledonian-rd., N.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 15 Belitha-villas, Barnsbury, N.
July 27, 1877	Blenkinsop, Benj., Sec. Hand-in-Hand Insurance Office, New Bridge-street, Blackfriars, E.C.
May 26, 1876	Blundell, Joseph, St. George's Club, 2 Savile-row, W.
Oct. 24, 1873	Bolton, Major Frank, 21 Victoria-mansions, S.W.
Jan. 22, 1875	Bolton, Thos., Hyde-house, near Stourbridge.
Sept. 27, 1872	Borthwick, Lord, 35 Hertford-street, Mayfair, W.
April 22, 1870	Bossy, Alfred Horsley, Walton Lodge, 118 Stoke Newington-road, N.
Jan. 28, 1876	Bowcher, W., 6 Brownswood-villas, Stroud Green-road, N.
May 22, 1874	Box, Edward Gaspar.
June 26, 1874	Brady, Henry, 96 Palace-gardens-terrace, W.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S., The Ferns, 303 Clapham-road, S.W.
May 25, 1877	Bramhall, Rev. John, R.D., Terrington St. John's, near Lynn, Norfolk.
Mar. 28, 1873	Bridgman, Frank G., 18 Queen Anne-street, Cavendish-square, W.
Dec. 27, 1872	Bridgman, William Kencely, L.D.S., 69 St. Giles's-street, Norwich.
May 26, 1876	Brigstock, John Wm., 4 Comberton-road, Upper Clapton, E.
May 27, 1870	Brown, George Dransfield, M.R.C.S., Henley-villa, Uxbridge-road, Ealing, W.
May 22, 1868	Brown, W. J., 4 Marlbro'-terrace, Maple-road, Penge, S.E.
May 26, 1871	Browne, George, 45 Victoria-road, N.W.

Date of Election.	
May 28, 1875	Browne, J. W., Frascati, Mason's-hill, Bromley, Kent.
Feb. 27, 1872	Browne, Rev. Thomas Henry, F.R.M.S., F.G.S., M.E.S., High Wycombe, Bucks.
Jan. 26, 1877	Buffham, T. Hughes, Clarence-villas, Clarendon-road, Walthamstow.
Sept. 27, 1872	Bugby, Wm., 3 Wilton-villas, Uxbridge-road, W.
May 22, 1874	Burgess, John James, 1 Copthall-chambers, E.C.
Sept. 27, 1872	Bush, Wm., Hanworth-house, Hanworth.
June 14, 1865	Bywater, Witham M., F.R.M.S., 5 Hanover-sq., W.
Sept. 22, 1876	Canton, Fredk., L.R.C.P., M.R.C.S., &c., 17 Great Marlborough-street, Regent-street, W.
Dec. 17, 1875	Caplatzi, A., 1 North-crescent, Bedford-square, W.C.
May 25, 1877	Carr, George, 4 Bread-street, Cheapside, E.C.
May 22, 1874	Carruthers, Herbert, 5 Darnley-road, Notting-hill, W.
May 26, 1871	Catchpole, Robert, 3 Beaconsfield-terrace, Godolphin-road, Shepherd's-bush, W.
July 27, 1877	Chandler, Chas. F., 65 Lupus-street, S.W.
Oct. 22, 1875	Cheshire, F., Avenue-house, Acton, W.
Nov. 27, 1874	Chippindale, Geo., 3 Rough Down-villas, Boxmoor.
Mar. 24, 1876	Clarkson, A., 49 Southampton-street, Pentonville-road, N.
May 22, 1874	Clayton, James, 67 Barnsbury-road, N.
May 22, 1868	Cocks, W. G., 36 Gayhurst-road, Dalston, E.
Sept. 22, 1876	Cole, Arthur C., St. Domingo-house, Oxford-gardens, Notting-hill, W.
Nov. 27, 1874	Cole, B. G., Ivy-cottage, Hermon-hill, Wanstead, Essex.
May 28, 1869	Cole, Walter B., F.R.M.S., St. John's-terrace, Weymouth.
April 24, 1874	Cole, Wm., M.E.S., Ivy-cottage, Hermon-hill, Wanstead, Essex.
May 23, 1873	Coles, Alfred K., F.R.M.S., Stamford-hill, N.
Jan. 25, 1867	Coles, Ferdinand, A.P.S., 341 Amherst-road, Stoke Newington, N.

Date of Election.	
April 23, 1869	Collings, Thomas P., Surrey-chambers, 172 Strand, W.C.
July 7, 1865	Collins, C., F.R.M.S., 157 Great Portland-street, W.
Mar. 24, 1876	Colsell, Geo. Dannett, 5 Austin-friars, E.C.
Feb. 23, 1872	Colvin, Alexander, Beaconside, Penrith, Cumberland.
Sept. 27, 1872	Connolly, Charles T., L.S.A., 3 Church-hill-villas, Wood-green, N.
June 14, 1865	Cooke, M. C., M.A., LL.D., A.L.S. (*Hon. Sec. for Foreign Correspondence*), 2 Grosvenor-villas, Junction-road, Upper Holloway, N.
May 28, 1875	Cooper, Chas., Jesmond-cottage, Walham-green, S.W.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, E.
June 27, 1873	Corbett, Alfred L., 103 Fentiman-road, Clapham-road, S.W.
May 28, 1869	Cottam, Arthur, F.R.A.S., Office of Woods, Whitehall-place, S.W.
Jan. 28, 1876	Cotton, Thos., M.D., 214 Seven-sisters'-road, N.
July 26, 1872	Cowan, Thos. Wm., F.R.M.S., Hawthorn-house, Horsham, Sussex.
May 25, 1877	Coxhead, Albert C., 47 Russell-square, W.C.
Aug. 28, 1868	CRISP, FRANK, LL.B., B.A. Lond., F.R.M.S. (*Vice-President*), 5 Lansdowne-road, Notting-hill, W.
Dec. 23, 1870	Crisp, John S., F.R.M.S., 62 Camberwell-road, S.E.
Feb. 23, 1877	Crofton, Edward, M.A. Oxon., F.R.M.S., 45 West Cromwell-road, South Kensington, S.W.
Feb. 27, 1868	Crook, Thomas, F.R.M.S., care of Mr. T. Curties, 244 High Holborn, W.C.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 66 Barbican, E.C.
June 22, 1877	Cunliffe, P. G., The Elms, Handforth, Cheshire.
Nov. 26, 1875	Cunningham, Francis Bertram, 8 Durham-terrace, Westbourne-park, W.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
Jan. 22, 1875	Dadswell, Edward, 42 Barrington-road, Stockwell, S.W.
Jan. 27, 1872	Daintrey, George, Terminus Chambers, Eastbourne.

Date of Election.	
June 25, 1868	Darnley, D. Rowland, Ealing Dean, W.
Oct. 24, 1873	Dashwood, Horace, 192 St. Paul's-road, Canonbury, N.
July 23, 1871	D'Aubney, Thos., Shepherdess-walk, Hoxton, N.
May 23, 1873	Davey, Robert F., War Office, Pall-mall, S.W.
Oct. 22, 1869	Davis, Henry, 19 Warwick-street, Leamington.
May 28, 1875	Dean, Arthur, 11 Caxton-street, Addington-road, Bow, E.
Feb. 23, 1877	Death, James, Jun., Cheshunt, Herts.
May 28, 1875	Defriez, Joseph George, M.R.C.S., L.S.A., 173 Bethnal-green-road, E.
Feb. 23, 1877	Delferier, Wm. Adrian, 40 Sloane-square, Chelsea, S.W.
Nov. 24, 1876	Despointes, Francis, 16 St. George's-square, Regent's-park-road, N.W.
June 26, 1868	Dickens, Charles, Latimer-house, Hadley, Middlesex.
Jan. 28, 1876	Dilnott, Geo., Hayling, Havant, Hants.
Jan. 23, 1874	Doble, Edmund Mohun, 12 Mount Ararat-villas, Richmond, Surrey.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Holmesdale, Grange-Park, Ealing.
July 26, 1872	Doggett, Fredk. Ernest, Reid's Brewery, Liquor-pond-street, E.C.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton-rectory, Moreton-hampstead, Exeter.
Jan. 28, 1870	Dowson, Edward, M.D., M.R.C.S., F.R.M.S., 117 Park-street, Grosvenor-square, W.
April 27, 1877	Draper, George, 25 Mount-pleasant, Lewisham, S.E.
July 28, 1871	Drew, G. C., Milton-house, Cassland-road, South Hackney, E.
Dec. 23, 1870	Duck, William A., 4 High-st., Vauxhall-cross, S.E.
Aug. 26, 1872	Dudgeon, R. E., M.D., 53 Montagu-square, W.
Oct. 25, 1872	Dunning, Chas. G., 22 Oseney-crescent, Camden-road, N.W.
Sept. 22, 1865	Durham, Arthur E., F.R.C.S., F.L.S., F.R.M.S., &c., 82 Brook-street, Grosvenor-square, W.
Sept. 25, 1868	Eady, James Ray, F.R.M.S., F.G.S., Carleton-grange, Skipton, Yorkshire.

Date of Election.	
June 28, 1867	Edmonds, R., 178 Burrage-road, Plumstead, S.E.
May 26, 1876	Emery, Charles, 2 Sheen-villas, Rectory-road, Hornsey, N.
May 26, 1871	Enock, Fredk., 30 Russell-road, Seven Sisters-road, N.
June 26, 1874	Fardon, Edward Ashby, 80 Cambridge-street, Pimlico, S.W.
Dec. 17, 1875	Farries, Thomas, F.C.S., 7 New Basinghall-street, E.C.
July 25, 1873	Fase, Rev. Henry J., 57 Winchester-street, Pimlico, S.W.
June 25, 1875	Faulkner, Hy., jun., Fernwood, Roehampton-park, S.W.
Jan. 28, 1876	Faulkner, John, Mornington-crescent, N.W.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
Jan. 23, 1874	Flux, E. H., 1 West-hill, Highgate, N.
Aug. 4, 1865	Foster, Peter Le Neve, M.A. Cantab., Society of Arts, Adelphi, W.C.
Mar. 24, 1871	Foulerton, J., M.D., Scientific Club, 7 Savile-row, W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 26 South Molton-street, Oxford-street, W.
Nov. 26, 1875	Freckelton, Rev. T. W., F.R.M.S., 28A Lonsdale-square, Islington, N.
June 23, 1871	Freeman, Henry E., 48 Woodstock-road, Finsbury-park, N.
Feb. 26, 1869	Fricker, C. J., 4 Westow-hill-terrace, Upper Norwood, S.E.
May 22, 1868	Fryer, Geo. H., 82 Belsize-road, N.W.
Oct. 26, 1868	Furlonge, W. H., Coed Mawr-house, Holywell, Flintshire.
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
Mar. 25, 1870	Garden, Robert Spring, 42 Carlton-hill, St. John's-wood, N.W.
May 25, 1866	Gardiner, G., F.M.S., 244 High Holborn, W.C.
Feb. 26, 1875	Gardner, Edmund, 454 Strand, W.C.

Date of Election.	
July 27, 1877	Gardner, J. H., A.K.C., Royal Polytechnic Institution, Regent-street, W.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S. (*Hon. Treasurer*), 113 High Holborn, W.C.
Jan. 28, 1870	Gellatly, Peter, Loughton, Essex.
July 26, 1867	George, Edward, F.R.M.S., 12 Derby-villas, Forest-hill, S.E.
July 22, 1870	Gibson, Joseph F., F.R.M.S., 9 Saltoun-road, Brixton, S.W.
June 14, 1865	Gibson, W., 273 Regent-street, W.
April 27, 1877	Gilbertson, Henry, Hertford.
Oct. 27, 1876	Gilburt, W. H., 42 Malmesbury-road, Bow, E.
June 27, 1873	Glasspoole, Hampden G., 34 Bernard-st., Russell-square, W.C.
Feb. 25, 1876	Godwin, John, 144 Oakley-street, Chelsea, S.W.
Nov. 22, 1867	Golding, W. H., 19 Regina-road, Tollington-park, N.
Nov. 22, 1872	Goodchild, J. E., Prospect-hill-lodge, Walthamstow, E.
Aug. 23, 1872	Goode, A., Whitehall-lane, Woodford, Essex.
April 26, 1872	Goodinge, James Wallinger, F.R.G.S., F.R.M.S., 18 Aldersgate-street, E.C.
Mar. 27, 1866	Gray, S. Octavus, Bank of England, E.C.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Nov. 27, 1874	Grayling, J. Francis.
May 22, 1874	Green, G., 6 Helmet-row, St. Luke's, E.C.
Jan. 28, 1870	Green, Nathaniel E., F.R.A.S., 3 Circus-road, St. John's-wood, N.W.
Oct. 23, 1868	Greenish, T., F.R.M.S., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 38 Welbeck-street, W.
May 23, 1873	Gregory, William, 406 Strand, W.C.
May 22, 1874	Grey, Ernest, 290 Essex-road, Annett's-crescent, Islington, N.
June 26, 1874	Gritton, John Hall.
June 26, 1874	Gritton, Joseph.
July 24, 1868	Groves, J. W., F.R.M.S., 55 Russell-square, W.C.

Date of Election.	
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.
Jan. 27, 1871	Guimaraens, Augustus de Souza, F.R.M.S., 120 Ossulton-street, Euston-square, N.W.
Jan. 23, 1874	Hadland, J. H., 11 King William-street, E.C.
June 14, 1865	Hailes, Henry F. (*Hon. Curator*), 7 Haringay-road, Hornsey, N.
Aug. 26, 1870	Hailstone, Robert H., 35 Walworth-road, S.E.
Feb. 23, 1867	Hainworth, W., jun., Clare-villa, Cricketfield-road, Lower Clapton, E.
July 28, 1876	Halford, Edwd., 18 Leinster-square, Bayswater, W.
May 25, 1877	Hall, George W. L. Marshall, 1 Cresswell-park, Blackheath, S.E.
July 23, 1875	Hallett, Marmaduke J., The National Provincial Bank of England, Norwich.
Dec. 28, 1866	Hallett, R. J.
Nov. 26, 1875	Halley, Alex. Hay, 7 Elgin-road, Kensington-park, W.
Feb. 22, 1869	Hammond, A., 4 Neptune-terrace, Marine-town, Sheerness.
Jan. 23, 1874	Hardy, James Daniel, 73 Clarence-road, Clapton, E.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
June 23, 1871	Harris, Edward, F.R.M.S., Rydal-villa, Langton-grove, Upper Sydenham, S.E.
April 23, 1875	Harrison, James, 22 Treherne-road, North Brixton, S.W.
July 26, 1872	Harrod, John, Mark-lane-square, E.C.
Nov. 26, 1869	Hart, Edward, Highbury New-park, N.
Jan. 26, 1877	Harvey, G., 45 High-street, Kensington, W.
Nov. 24, 1871	Hawker, Charles, M.D., 2 Albion-terrace, White-horse-lane, Stepney, E.
June 24, 1870	Hawkins, Samuel J., 27 Lichfield-grove, Finchley, N.
June 28, 1867	Hawksley, Thos. P., 97 Adelaide-road, N.W.
Oct. 23, 1874	Haydon, W. F.
Aug. 23, 1872	Hembry, F. W., F.R.M.S., 7 St. John's-villas, Overton-road, Brixton, S.W.

Date of Election.	
Aug. 26, 1870	Hennell, Col. S., F.R.M.S., Ventnor-villa, Ventnor, Isle of Wight.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
June 26, 1874	Hewitt, W. W., F.R.M.S., 5 Torriano-gardens, Camden-road, N.W.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
June 22, 1877	Hill, Rd. W., 9 Paragon-place, Surbiton Hill.
Sept. 24, 1869	Hilton, T. D., M.D., Upper Deal, Deal, Kent.
Sept. 28, 1866	Hind, F. H. P., Bartholomew-house, Bartholomew-lane, E.C.
May 22, 1874	Hind, George, 244 High Holborn, W.C.
July 26, 1872	Hinton, Ernest, 12 Vorley-road, Junction-road, Upper Holloway, N.
Aug. 26, 1870	Hirst, John, jun., F.R.M.S., Dobcross, near Manchester.
Feb. 26, 1875	Holford, Chr., Bounty-office, Dean's-yard, Westminster, S.W.
April 26, 1867	Hooton, C., Sunningdale-house, Bickerton-road, Upper Holloway, N.
May 22, 1868	Hopkinson, John, jun., F.L.S., F.R.M.S., F.G.S., Holly-bank, Watford.
April 28, 1876	Horn, Wm. E., A.I.C.E., 10 Vincent-square, Westminster, S.W.
Oct. 26, 1866	Horncastle, H., Whitemoor-house, near Ollerton, Notts.
June 25, 1869	Houghton, W., Hoe-street, Walthamstow, E.
May 22, 1874	Hovenden, C. W., F.R.M.S., 95 City-road, E.C.
April 26, 1867	Hovenden, F., F.R.M.S., Glenlea, Thurlow-park-road, Dulwich, S.E.
June 23, 1876	How, Wm. Samuel, 145 Great Portland-street, W.
Oct. 27, 1876	Howard, D., 60 Belsize-park, N.W.
Jan. 22, 1875	Howard, F. W., The Grove, Teddington.
Feb. 25, 1870	Hudleston, W. H., J.P., F.G.S., 23 Cheyne-walk, S.W.
Jan. 26, 1872	Hudson, Robert, F.R.S., F.R.M.S., &c., Clapham-common, S.W.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
Oct. 22, 1875	Hunter, John, 5 Eton-rise, Ealing, W.
Dec. 22, 1876	Hunter, J. J., 5 Eton-rise, Ealing, W.

Date of Election.	
July 25, 1873	Hurst, John Thomas, Royal Engineer Office, Portsmouth.
Nov. 25, 1870	Hutton, Rev. Wyndham M., Lezayre-vicarage, Ramsey, Isle of Man.
May 24, 1867	Ingpen, John E., F.R.M.S. (*Hon. Secretary*), 7 The Hill, Putney, S.W.
Aug. 22, 1873	Israel, S., 1 The Crescent, America-square, E.C.
Dec. 17, 1869	Jackson, B. D., F.R.M.S., 30 Stockwell-road, S.W.
Dec. 17, 1875	Jackson, C. L., F.Z.S., F.R.M.S., 11 Hesketh-street, Southport, Lancashire.
July 24, 1868	Jackson, F. R., Culver-cottage, Slindon, Arundel, Sussex.
June 14, 1865	Jaques, Edward, B.A., F.R.M.S., 5 Hargrave-park-road, Upper Holloway, N.
Feb. 28, 1873	Jenkins, J. W., 1 St. John's-hill, Wandsworth, S.W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 66 Avenue-road, Regent's-park, N.W.
Jan. 25, 1867	Johnson, John A., 15 Wellington-road, Stoke Newington, N.
Feb. 24, 1871	Johnson, M. Hawkins, F.R.M.S., F.G.S., 379 Euston-road, N.W.
June 23, 1876	Johnson, Tom Richard, 364 Camden-road, N.
Feb. 23, 1877	Johnston, J. M. C., Tudor-house, Grove-lane, Camberwell, S.E.
Mar. 24, 1871	Johnstone, James, jun.
Oct. 25, 1872	Jones, E. W., F.R.A.S., F.R.M.S., 53 Cowley-road, North Brixton, S.W.
Feb. 28, 1873	Jones, Geo. J., Churton-house, Melverton-terrace, Leamington.
June 25, 1875	Jones, J. Birdsall, F.R.M.S., care of W. R. Jones, Esq., Athenæum, Liverpool.
Nov. 25, 1870	Jones, Lieut.-Col. Lewis, Ambarrow-house, Sandhurst, Wokingham.
May 23, 1873	Jones, Captain Loftus F., United Service Club, Pall Mall, S.W.
June 23, 1876	Jones, Thomas Edwd., 46 Park-street, Stoke Newington, N.

Date of Election.	
May 22, 1874	Jones, W. W., 14 Lancaster-street, Lancaster-gate, Hyde-park, W.
May 23, 1873	Karop, Geo. C., Middlesex-hospital, W.
Mar. 23, 1877	Keene, John H., The Cottage, Bishopsgate, near Staines.
Oct. 26, 1866	Kemp, Robert, F.R.M.S., 60 Windsor-road, Upper Holloway, N.
Oct. 26, 1866	Kent, W. S., F.R.M.S., F.Z.S.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall-mall, S.W.
Mar. 19, 1869	Kilsby, Thomas W., 4 Brompton-villas, Edmonton.
June 23, 1876	Kindon, Chas. J., 30 Overton-road, Brixton, S.W.
July 7, 1865	King, G. H., Sea-horse-house, 165 and 190 Great Portland-street, W.
July 22, 1870	King, Henry, 65 Myddleton-square, E.C.
Dec. 23, 1870	King, Robert, F.R.M.S., Fern-house, Upper Clapton, E.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, E.
Nov. 27, 1874	Kirkman, Rev. Joshua, Thurlow-road, South Hampstead, N.W.
Feb. 28, 1873	Kitsell, Francis J., 7 John's-terrace, Latymer-road, W.
Mar. 23, 1877	Kluht, Hy. John, 16 Bishop's-road, W.
May 25, 1877	Knaggs, Hy. Valentine, 189 Camden-road, N.W.
Oct. 24, 1873	Knight, John Mackenzie, 2 Lansdowne-terrace, Bow-road, E.
Nov. 25, 1870	Ladd, Wm., F.R.A.S., F.R.M.S., 12 Beak-street, Regent-street, W.
July 27, 1866	Lambert, T. J., Trentham-house, 151 Highbury New-park, N.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.
Aug. 24, 1866	Lampray, John, F.R.G.S., 16 Camden-square, N.W.
Mar. 22, 1867	Lancaster, Thos., Bownham-house, Stroud, Gloucestershire.
May 25, 1877	Lane-Fox, Hon. Sackville F. H., 22 Camden-cottages, Camden-road, N.W.

Date of Election.	
Dec. 28, 1866	Langrish, H., 250 Pentonville-road, N.
May 28, 1875	Larkin, John, 24 Charterhouse-square, E.C.
May 28, 1875	Laws, Joseph C., 41 St. John's-park, Upper Holloway, N.
June 25, 1869	Layton, Charles E., 12 Upper Hornsey-rise, N.
Aug. 28, 1868	Leaf, C. J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.
Mar. 19, 1869	LEE, HENRY, F.L.S., F.R.M.S., &c. (*President*), The Waldrons, Croydon.
May 27, 1874	Leefe, Frederick Ewbank, 289 Goswell-road, E.C.
June 23, 1876	Leeson, Herbert Seymour, 4 Old Buildings, Lincoln's-inn, W.C.
Oct. 25, 1867	Leifchild, J. R., M.A., 21 St. Lawrence-road, Notting-hill, W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
July 25, 1873	Le Pelley, C., 17 Underwood-street, Shepherdess-walk, Hoxton, N.
May 28, 1869	Letts, Edmund A., M.D., 16 St. Patrick-square, Edinburgh.
July 26, 1872	Levien, Charles N., 3 Great Tower-street, E.C.
April 27, 1866	Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1 Lowndes-Terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., Jun., Kidbrook-terrace, Blackheath, S.E.
May 26, 1871	Locke, John, 16 Georgiana-street, Camden-town, N.W.
April 23, 1869	Long, Henry, 90 High-street, Croydon.
Aug. 28, 1874	Love, James, Talbot-lodge, Bickerton-road, Upper Holloway, N.
Nov. 24, 1866	Lovibond, J. W., F.R.M.S., St. Anne-street, Salisbury.
Sept. 22, 1865	Lovick, T., Board of Works, Spring-garden, S.W.
Dec. 18, 1868	Lowne, B. Thompson, F.R.C.S., F.L.S., F.Z.S., 7 Devonshire-street, Portland-place, W.
April 27, 1866	Loy, W. T., F.R.M.S., 11 Garrick-chambers, Garrick-street, W.C.
Jan. 24, 1873	McBride, Francis J.

Date of Election.	
Nov. 23, 1866	McIntire, S.J., F.R.M.S., 22 Bessborough-gardens, S.W.
Jan. 26, 1872	Mackechnie, J. Hamilton, M.D., 60 Wimpole-street, Cavendish-square, W.
July 26, 1874	Magor, Thomas, M.D., Myddelton-road, Hornsey, N.
May 22, 1874	Manly, Dr., Thatched House Club, St. James'-st., S.W.
Sept. 27, 1872	Manning, His Eminence the Cardinal Archbishop, Archbishop's House, Westminster, S.W.
June 14, 1865	Marks, E., Beaumont-villa, Beaumont-rd., Hornsey-rise, N.
Sept. 22, 1876	Martin, W. H., 11 Markham-square, Chelsea, S.W.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 50 Cornhill, E.C.
June 27, 1873	Mason, Thomas, 416 Strand, W.C.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent.
Oct. 26, 1866	MATTHEWS, JOHN, M.D., F.R.M.S., (*Vice-President*), 30 Colebrooke-row, Islington, N.
Jan. 26, 1877	Matthews, Wavell, 12 Wigmore-street, W.
Sept. 24, 1869	Matthews, William, 374 Camden-road, N.
May 26, 1871	May, John William, F.R.M.S., Arundel-house, Percy-cross, Fulham, S.W.
Feb. 27, 1874	May, Lewis J., 371 Holloway-road, N.
Dec. 17, 1875	May, Thomas, 54 Coburg-road, Old Kent Road, S.E.
Feb. 25, 1876	May, W. R., 39 Mortimer-road, Kingsland, E.
Feb. 28, 1873	Mayhew, A. F., 167 Long-lane, Bermondsey, S.E.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
May 22, 1874	Meates, Edgar A., 83 Cambridge-street, Pimlico, S.W.
Feb. 25, 1876	Meredyth, Rev. T. E., M.A., Burleydam-vicarage, Whitchurch, Salop.
May 22, 1874	Messenger, G. A., 21 Glengall-grove, Old Kent-rd., S.E.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S., 7 Buckland-crescent, Belsize-park, N.W.

Date of Election.	
July 27, 1877	Michael, Albert D., 3 & 4 Great Winchester-street, E.C.
July 7, 1865	Millett, F. W., 21 Duncan-terrace, Islington, N.
Feb. 28, 1873	Mills, Charles, 4 Stanbridge-road, Putney, S.W.
May 25, 1866	Moginie, W., F.R.M.S., 14 Riding-house-street, W.
Mar. 27, 1868	Moore, Daniel, M.D., Hastings-lodge, Victoria-road, Upper Norwood, S.E.
Jan. 23, 1874	Moreland, Richard, jun., M.I.C.E., F.R.M.S., 3 Old-street, St. Luke's, E.C.
Mar. 23, 1877	Morrell, Fred. Kent, 306 Kennington-park-road, S.E.
Oct. 27, 1866	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
Dec. 22, 1876	Morris, J. Griffith, M.R.C.S., 135 St. Owen-street, Hereford.
Oct. 27, 1876	Morris, W. G., L.D.S., 12 White-friars, Chester.
April 24, 1868	Mummery, J. Howard, 10 Cavendish-place, W.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-st., St. James's, S.W.
Mar. 23, 1866	Nation, W. J., 30 King-square, Goswell-road, E.C.
Mar. 24, 1876	Nelson, Edward M., 9 Marlborough-hill, N.W.
Mar. 24, 1871	Nelson, James, 3 Oakden-street, Kennington-road, S.E.
Jan. 26, 1872	Newton, Edwin Tulley, F.G.S. (*Vice-President*), Geological Museum, Jermyn-street, S.W.
Jan. 23, 1874	Newton, Henry Edward, Woolsthorpe, The Avenue, Gipsey Hill, Norwood, S.E.
July 7, 1865	Nicholson, D., 51 St. Paul's-churchyard, E.C.
May 22, 1874	Nixon, Philip Charles, 23 Crutched-friars, E.C.
Dec. 22, 1876	Ogilvy, Campbell P., Sizewell-house, Leiston, Suffolk.
Feb. 25, 1876	Ongley, H. H.
June 22, 1877	Oswin, Fred., F.S.A., 10 Gower-street, W.C.
Dec. 27, 1867	Oxley, F., 8 Crosby-square, Bishopsgate, E.C.
May 22, 1874	Palmer, Thomas, B.S., F.R.M.S., Holme Lee, Lower Camden, Chislehurst, Kent.
July 27, 1873	Parker, William, Whitehall Club, S.W.

Date of Election.	
Oct. 27, 1871	Parsons, Fred. Anthony, 90 Leadenhall-street, E.C.
April 23, 1875	Peal, Charles Nathaniel, Westbourne-lodge, Castlebar-hill, Ealing, W.
May 22, 1874	Pearce, George Alonzo Creech, B.A., M.B., B.C.N., Priory-chambers, Crutched-friars, E.C.
May 24, 1867	Pearce, George, Villa Helvetia, Tufnell-park, N.
Feb. 23, 1872	Pearce, W. E. Grindley, L.R.C.P., 24 Bessborough-gardens, S.W.
April 27, 1877	Pearcy, Alfred Copley, 31 Packington-street, Islington, N.
June 23, 1876	Pearcy, Richard Gilbert, 31 Packington-street, Islington, N.
May 24, 1867	Pearson, John, 212 Edgware-road, W.
Dec. 22, 1876	Perry, George, 82 Finborough-road, South Kensington, S.W.
Oct. 27, 1865	Pickard, J. F., 1 Bloomsbury-street, W.C.
Jan. 22, 1869	Pillischer, M., F.R.M.S., 88 New Bond-street, W.
Nov. 24, 1871	Pitts, Frederick, Harvard-house, St. John's-hill, Clapham, S.W.
Nov. 23, 1866	Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
June 22, 1866	Powe, I., 71 George-street, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
May 26, 1876	Powell, Jas. F., 12 Dalrymple-terrace, Glenarm-road, Clapton park, E.
Jan. 24, 1873	Powell, Jas. J., 43 Burton-road, Brixton, S.W.
July 7, 1865	Powell, Thomas. 18 Doughty-street, Mecklenberg-square, W.C.
July 24, 1874	Powell, Thomas Henry, 7 Poultry, E.C.
Jan. 22, 1875	Power, H. D'Arcy, F.L.S., 33 St. Paul'-road, Kennington, S.E.
Oct. 25, 1872	Price, W. H., 1 The Terrace, Kennington-park, S.E.
Feb. 26, 1869	Prichard, Thomas, M.D., Abbington Abbey, Northampton.
June 27, 1873	Priest, B. W., 22 Parliament-street, S.W.
July 26, 1867	Pritchett, Francis, 131, Fenchurch-street, E.C.

Date of Election.

April 23, 1868	Quekett, Alfred J. S., 13 Delamere-crescent, Westbourne-square, W.
April 23, 1868	Quekett, Arthur Edwin, 13 Delamere-crescent, Westbourne-square, W.
April 23, 1868	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Highfield, Dartmouth-park, Forest-hill, S.E.
Sept. 24, 1869	Radcliffe, J. D.
Nov. 23, 1866	Radermacher, J. J., The Pantechnicon, Motcombe-street, Belgrave-square, S.W.
June 25, 1875	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866	Ramsbotham, J. M., M.D., 15 Amwell-street, Pentonville, E.C.
Oct. 26, 1866	Ramsden, Hildebrand, M.A. Cant., F.L.S., F.R.M.S., Forest-rise, Walthamstow, E.
Aug. 28, 1868	Rance, T. G., Elmside, Bickley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
Oct. 28, 1869	Rean, Walter, Woodstock-road, Poplar, E.
June 23, 1876	Redmayne, John T., M.R.C.S., F.R.M.S., &c., Astley-bank, Bolton, Lancashire.
June 22, 1877	Reed, John W., F.R.G.S., 27 Clarence-street, Islington, N.
June 27, 1873	Reeve, Fredk., 37 Fentiman-road, Clapham-road, S.W.
July 7, 1865	Reeves, W. W., F.R.M.S., 37 Blackheath-hill, S.E.
May 22, 1874	Reid, Wm. Wardlaw, 16 Warwick-place, Peckham Rye, S.E.
May 26, 1871	Richards, Edward, F.R.M.S., 289 Camberwell New-road, S.E.
Mar. 25, 1870	Richardson, Thomas Hyde, 1 Belgrave-villas, Holmesdale-road, Selhurst, S.E.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 82 Finchley-road, St. John's-wood, N.W.
April 26, 1872	Roberts, S. Hackett, F.R.M.S., 355 Walworth-road, S.E.
May 22, 1868	Rogers, John, F.R.M.S., 4 Tennyson-street, Nottingham.

Date of Election.	
Oct. 26, 1866	Rogers, Thomas, F.L.S., F.R.M.S., Selmeston-house, Thurlow-park-road, West Dulwich.
Mar. 22, 1872	Rolfe, Charles Spencer, 6 Westminster-chambers, S.W.
May 22, 1868	Roper, F.C.S., F.L.S., F.G.S., F.R.M.S., Palgrave-house, Eastbourne, Sussex.
June 23, 1876	Roper, Hy. John, F.R.M.S., 5 Lausanne-road, Peckham, S.E.
Oct. 27, 1876	Roper, Robert, 4 Westbury-villas, Westbury-road, Upton, Stratford, E.
July 24, 1868	Rowe, James, Jun., M.R.C.V.S., 65 High-street, Marylebone, W.
Oct. 26, 1866	Rowlett, John, 92 Enville-road, Walworth, S.E.
July 14, 1865	Ruffle, G. W., 131 Blackfriars-road, S.E.
July 24, 1874	Rushton, William, 61 Tufnell-park-road, Holloway, N.
Oct. 27, 1865	Russell, James, 10 High-street, Shoreditch, E.
Feb. 27, 1874	Russell, James, 61 Leipsic-road, Camberwell, S.E.
Oct. 26, 1866	Russell, Joseph, Blenheim-house, Middle Mall, Hammersmith, S.W.
May 22, 1868	Russell, Thomas D., 21 Park-road, West Dulwich, S.E.
Feb. 22, 1867	Rutter, H. Lee, 1 St. Barnabas-villas, Lansdowne-circus, South Lambeth, S.W.
May 23, 1873	Salkeld, Lt.-Colonel Joseph C., F.R.M.S., 29 St. James's-street, S.W.
Dec. 17, 1869	Salmon, John, 24 Seymour-st., Euston-sq., N.W.
May 28, 1875	Saul, Geo. William, 120 Cheapside, E.C.
May 22, 1868	Scatliff, John Parr, M.D., 132 Sloane-street, S.W.
May 24, 1872	Schloesser, Ernest, 9 College-hill, Cannon-st., E.C.
Feb. 26, 1875	Scofield, W. J., M.R.C.S., F.L.S., 13 South Hill Park-gardens, Hampstead, N.W.
July 27, 1877	Scott, Archibald E., 70 Old Broad-street, E.C.
May 24, 1872	Sequeira, H. L., M.R.C.S., 1 Jewry-street, Aldgate, E.C.
July 27, 1868	Sewell, Richard, 17 Gloucester-terrace, Palace-gate, S.W.
Oct. 22, 1869	Shaw, Wm. Forster, Mosshall Grove, Finchley, N.

Date of Election.	
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.
May 26, 1876	Shepheard, Thomas, F.R.M.S., 12 Bridge-street, Row, Chester.
May 26, 1871	Sigsworth, J. C., F.R.M.S., 44 Parliament-street, Westminster, S.W.
June 27, 1873	Simmonds, Joseph E., 13 Ann's-terrace, near Walham-green, S.W.
Aug. 23, 1867	Simmons, James J., L.D.S., 18 Burton-crescent, Euston-road, W.C.
May 26, 1876	Simpson, Edwd., 24 Grummant-road, Peckham-road, S.E.
Mar. 27, 1868	Simson, Thos., The Laurels, Courtyard, Eltham.
May 28, 1869	Sketchley, H. G., 72 Wilson-street, Derby.
Dec. 28, 1866	Slade, J., 100 Barnsbury-road, N.
Mar. 24, 1872	Smart, Harry, 8 The Paragon, Hackney, E.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus (*Hon. Librarian*), 42 Choumert-road, Rye-lane, Peckham, S.E.
Feb. 25, 1876	Smith, Edward, F.S.S., 37 Old Jewry, E.C.
Mar. 25, 1870	Smith, Francis Lys, 3 Grecian-cottages, Crown-hill, Norwood, S.E.
June 27, 1873	Smith, G. J., 5 St. Bride's-st., Ludgate-circus, E.C.
Oct. 26, 1866	Smith, H. Ambrose, 2 King William-street, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 13 Canonbury-place, Islington, N.
Dec. 23, 1870	Smith, Joseph A., Granville-lodge, Croydon-road, Penge, S.E.
May 22, 1874	Smith, Roland D., M.R.C.S.E., F.R.M.S., York-house, Chatteris, Cambridgeshire.
June 24, 1870	Smith, William.
Feb. 28, 1873	Smith, W. Lepard, Southfield-house, Watford.
Aug. 23, 1872	Smith, W. Stuart, 30 Loraine-road, Holloway, N.
April 24, 1868	Snellgrove, W., 1A Cranfield-road, Wickham-park, S.E.
Sept. 22, 1865	Southwell, C., 44, Princes-street, Soho, W.
May 26, 1876	Southwell, Chas. Wm., 1 Stoke Newington-green, N.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, E.
May 22, 1874	Spencer, James, F.R.M.S., South-street, Greenwich, S.E.

Date of Election.	
June 26, 1876	Spencer, John, Brook's Bank, 81 Lombard-street, E.C.
Nov. 22, 1872	Spencer, Thomas, F.C.S., F.R.M.S., 32 Euston-square, N.W.
Mar. 24, 1866	Starling, Benjamin, 9 Gray's-inn-square, W.C.
Jan. 26, 1877	Steele, James W., 7 Charlemont-terrace, Cork.
Feb. 23, 1872	Stevens, C. R., 7 Ashby-road, Canonbury, N.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
May 23, 1873	Steward, James H. C., 406 Strand, W.C.
June 22, 1877	Stewart, Chas., M.R.C.S., F.L.S., F.R.M.S., &c., St. Thomas' Hospital, and 25 Albert-square, Clapham, S.W.
Sept. 22, 1876	Stiles, M. H., 24 Cleveland-road, N.
Mar. 19, 1869	Stokes, Frederick, 17 Milton-road, Herne-hill, S.E.
April 28, 1876	Stopher, Wm., 24 Coleman-street, E.C.
Oct. 27, 1871	Stuart, David John, 53 Ferntower-road, Highbury New-park, N.
July 7, 1865	Suffolk, W. T., F.R.M.S., 48 Treherne-road, Vassal-road, Brixton, S.E.
June 27, 1873	Suter, Edward D., Kent-lodge, Douglas-road-north, Canonbury, N.
June 24, 1870	Swain, Ernest, 90 Campden-hill-road, W.
Nov. 22, 1867	Swainston, J. T., 3 St. Mark's-square, Regent's-park, N.W.
Nov. 24, 1866	Swansborough, E., 20 John-st., Bedford-row, W.C.
Dec. 18, 1868	Swift, James, 43 University-street, W.C.
Dec. 17, 1875	Swift, Mansell, 43 University-street, W.C.
Nov. 25, 1870	Tafe, John Forwood, Fernlea, King Edward-road, Victoria-park, E.
July 27, 1877	Tanqueray. A. C., 3 Wells-street, Gray's inn-road, W.C.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Jan. 23, 1874	Taylor, John Ellor, The Museum, Ipswich.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
Aug. 23, 1872	Terry, Thomas, 5 Austin-friars, E.C.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road, S.W.
May 28, 1875	Thomson, John Reid, 18 Highbury-place, N.

Date of Election.	
Feb. 24, 1871	Thornthwaite, W. H., 416 Strand, W.C.
April 27, 1877	Thorpe, George, 20 Eastcheap, E.C.
Jan. 22, 1875	Tinney, William A., 4 Alfred-place, Bedford-square, W.C.
Nov. 27, 1867	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
June 23, 1871	Topping, Amos, 28 Charlotte-street, Caledonian-road, N.
July 26, 1872	Townsend, John Sumsion, F.R.M.S., Stamford-lodge, St. John's, Sevenoaks.
July 24, 1868	Tulk, John A., M.D.
July 26, 1867	Turnbull, Joseph, Laurel-house, North-hill, Highgate, N.
June 25, 1869	Turner, R. D., Chafford, Tunbridge.
June 25, 1875	Turner, Sydney, 29 Ampthill-square, Hampstead-road, N.W.
May 25, 1877	Veasey, Robt. Geo., Ashchurch-lodge, Ashchurch-road, Shepherd's-bush, W.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Jan. 22, 1875	Vivian, The Hon. J. C., Selwyn-court, Richmond, Surrey.
May 22, 1874	Wadmore, Ernest.
April 24, 1874	Walker, Enoch.
May 28, 1869	Walker, Henry, F.G.S., 8 Walterton-road, St. Peter's-park, Paddington, W.
Feb. 27, 1874	Walker, John C., 14 Hilldrop-road, Camden-road, N.
July 25, 1873	Walker, John Stringer, Warwick-road, Upper Clapton, E.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.
Dec. 18, 1868	Waller, A., 11 Aberdeen-park, Highbury, N.
May 22, 1868	Waller, J. G., 68 Bolsover-street, Portland-road, W.
July 24, 1874	Wallis, James, 22 Cranmer-road, Brixton-road, S.E.
Aug. 26, 1870	Warburton, Samuel, Merton-villa, New-road, Lower Tooting, S.W.

Date of Election.	
Dec. 22, 1871	Ward, Daniel, 26 Coleman-street, Woolwich, S.E.
Nov. 22, 1867	Ward, F. H., M.R.C.S., F.R.M.S., Springfield-house, near Tooting, S.W.
Dec. 18, 1868	Warner, Alfred, care of Mr. W. F. Stanley, 13 Railway-approach, London-bridge, S.E.
May 25, 1866	Warrington, H. R., 7 Royal Exchange, Cornhill, E.C.
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
Oct. 25, 1872	Watkins, J., L.C.P., 40 Store-street, Bedford-square, W.C.
Dec. 28, 1866	Way, T. E., 65 Wigmore-street, W.
July 24, 1874	Webb, C. E., Wildwood-lodge, North-end, Hampstead, N.W.
June 22, 1877	Weddall, G. E., North Hall, Brough, East Yorkshire.
May 24, 1867	Weeks, A. W. G., 36 Gunter-grove, West Brompton, S.W.
Feb. 25, 1876	Wheeler, George, 7 St. John's-terrace, E.C.
Dec. 27, 1872	White, Charles, E., L.D.S., 32 Belgrave-road, S.W.
April 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing, W.
Feb. 26, 1868	White, Francis W., 2 Alexander-terrace, Culmore-road, Balham, S.W.
May 22, 1868	WHITE, T. CHARTERS, M.R.C.S., L.D.S., F.R.M.S., (*Vice-President*), 32 Belgrave-road, S.W.
July 25, 1873	White, Walter, Litcham, Norfolk.
May 23, 1873	Whitmore, John, M.D., 15 Wimpole-street, W.
June 25, 1875	Whitney, Edward Underwood, 13 Gt. College-st., Westminster, S.W.
July 24, 1868	Wight, James F., F.R.M.S., Grazeley, Gipsy-hill, Upper Norwood, S.E.
Mar. 24, 1871	Williams, George, 6 St. John's-park, Upper Holloway, N.
April 23, 1875	Williams, Henry, Victoria Nurseries, Upper Holloway, N.
June 23, 1876	Williams, Jas. W., 1 Hope-villas, Powell-road, Clapton, E.
Oct. 24, 1873	Williams, John R., F.R.M.S., 59 Albion-road, Stoke Newington, N.

Date of Election.	
Oct. 28, 1870	Williams, Martin G., 2 Highbury-crescent, N.
July 28, 1871	Williams, Robert Packenham, 18 Brunswick-road, Upper Holloway, N.
Jan. 25, 1867	Willsworth, H., 3 St. John's-villas, Upper Holloway, N.
Mar. 24, 1876	Wilson, Chas. Joseph, 14 Highbury-crescent, N.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
Aug. 27, 1869	Woods, W. Fell, 1 Park-hill, Forest-hill, S.E.
Jan. 28, 1876	Woollett, John, 58 Cloudesley-road, N.
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
June 27, 1873	Wrey, George E. B., Addington-house, Addington-road, Reading.
Jan. 23, 1874	Wright, Cecil H., 27 Wardour-street, W.
Nov. 23, 1866	Wright, Edward, 89 Shepherdess-walk, E.C.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.
May 25, 1877	Yates, Francis, Rockwood, Surbiton-hill.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.

NOTICE.

Members are requested to give the Hon. Secretary early notice of any change of Residence, so as to prevent miscarriage of Journals and Reports.

RULES.

I.—That the Quekett Microscopical Club hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by a Committee, consisting of the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and twelve other members,—six to form a quorum. That the President, Vice-Presidents, Treasurer, Secretaries, and the four senior members of the Committee (by election) retire annually, but be eligible for re-election. That the Committee may appoint a stipendiary Assistant Secretary, who shall be subject to its direction.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of President, Vice-Presidents, Treasurer, Honorary Secretaries, and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That the President, Vice-Presidents, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Vice-Presidents, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended balloted for at the following Meeting. Three black balls to exclude.

VI.—That the society include not more than twenty Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary meeting, who shall enter his name with that of the Member by whom he is introduced in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

Form of Proposal for Membership.

Quekett Microscopical Club.

Mr.
of
being desirous of becoming a Member of this Club, we beg to recommend him for election.

(*on my personal knowledge*).

This Certificate was read 187
The Ballot will take place 187

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Hon. Curator.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one Member.

III. That the Slides be classified by the Curator into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the conversational meetings of the Club.

V. Members may leave the selection to the Curator, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII.—All expenses incurred in the transmission of Slides or in correspondence respecting them, to be borne by the Member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. John E. Ingpen,
7, The Hill,
Putney, S.W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.

If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked box and forwarded by Railway.

MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB,

AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

1877.—August	10	....	24
September	14	....	28
October	12	....	26
November	9	....	23
December	14	....	28
1878.—January	11	....	25
February	8	....	22
March	8	....	22
April	12	....	26
May	10	....	24
June	14	....	28
July	12	....	26

The Ordinary Meetings are held on the *fourth* Friday in each month:—business commences at 8 o'clock p.m.

The Meetings on the *second* Friday in each month are for Conversation and Exhibition of Objects; from 7 to 9.30 p.m.

The Annual General Meeting will be held on July 26th, 1878, at 8 o'clock, for Election of Officers and other business.

EXCURSIONS, 1877.

March 24th	BARNES. To meet at Waterloo Station (Richmond Line).
April 7th	SNARESBROOK. To meet at Fenchurch Street or Liverpool Street Stations.
April 21st	TORRINGTON PARK (for TOTTERIDGE), returning by Mill Hill. To meet at Moorgate Street Station.
May 5th	CHISLEHURST. To meet at Charing Cross Station.
May 19th	EAST END (for FINCHLEY COMMON). To meet at Moorgate Street Station.
June 2nd	EPSOM DOWNS (for MICKELHAM). To meet at London Bridge Station, South London Line.
June 16th	CATERHAM. To join the Croydon Club. To meet at Charing Cross Station.
June 30th	WATFORD (for RICKMANSWORTH). To join the Watford Club. To meet at Euston Station.
July 5th	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
July 14th	ELSTREE. To meet at St. Pancras Station at 1.30 P.M.
July 21st	SOUTHEND, DAY EXCURSION. To meet at Fenchurch Street Station, the first Train after 10 A.M.
July 28th	THAMES DITTON. To meet at Waterloo Station (Main Line).
Sept. 1st	BROMLEY (for KESTON COMMON). To meet at Holborn Viaduct Station.
Sept. 15th	HAMPTON COURT. To meet at Waterloo Station (Main Line).
Sept. 29th	WALTHAMSTOW (Wood Street Station). To meet at Liverpool Street G.E.R. Station.
Oct. 13th	HACKNEY MARSHES. To meet at Homerton Station (North London Line).

The time of departure from Town, unless otherwise specified, will be THE FIRST TRAIN AFTER TWO O'CLOCK.

F. W. Gay,
F. Oxley,
W. W. Reeves,
T. Rogers,
W. T. Suffolk,
} Excursion Committee.

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